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Does life begin at 40? Celebrating the 40th anniversary of the UWC Faculty of Dentistry, 2018.

SADJ May 2018, Vol 73 no 4 p183

KC Makhubele.

Congratulations on reaching your 40th anniversary! The South African Dental Association (SADA) joins you as you celebrate such an important milestone. Not only are we celebrating the courage of all the people who were the pioneers of the Institution that is responsible for graduating 47% of South Africa’s new dentists, but we are also celebrating 40 years of incredible accomplishments. One such evidence of your accomplishment is having The Faculty of Dentistry being rated as a leader on the African Continent and also recognized as a WHO Collaborating Centre. The majority of our members and potential members in the last few years have come from your School. We are absolutely excited at this momentous occasion and proud to be associated with your Institution.

So, what is in the number 40? Does Life begin at 40 for your Faculty? The answer is yes, we think the past 40 years, as much as you have been adding great value to the profession, it was also “practice time” for the next 40 years. This milestone is worth the celebrations:

In mathematics, forty is a composite number, an octagonal number, and as the sum of the first four pentagonal numbers, it is a pentagonal pyramidal number — Your Faculty is made of different and diverse elements which make you a balanced and stronger Faculty not only to South Africans but the rest of Africa. This is a true testament to the power of your School’s education as it has launched hundreds of interesting lives and amazingly fruitful careers.

In science, the number 40 is the atomic number of zirconium (Zr) — The School has over the years produced “gold-coloured” oral health practitioners that contribute towards quality oral health care to our rainbow nation. Over the years, I have met many of your graduates, they have fond memories of the one place they once called Home; they recall the School as being a magical place which contributed immensely to their life and career trajectory. We celebrate and are proud of the multitude of alumni spread locally and internationally, with some having gone on to occupy important positions in universities as well as in the private and public sectors.

In the spiritual space, forty is often used for time periods, forty days or forty years, which separate “two distinct epochs”. Your graduate community has been very active, not only about the issues that people faced 40, 30, 20 years ago, but also on new issues for this generation. Therefore, as we celebrate 40 years, we are marking the end of one epoch and the beginning of another. Life does begin at 40 after all!

40 years may have gone past, but the work still continues. This milestone presents us with an opportunity to celebrate, but also to reflect. As we look back, the School must look 40 years ahead. It must ensure that the next generation is able to deal with oral health challenges of today and provide solutions for the new challenges of the future.

In Tsonga, we have a saying “Ku tlula ka mahala ku letele n’wana wa le ndzeni”. Literally translated, this means “The way an impala jumps influences and teaches its unborn child”. The way the School chooses to face the challenges of the next 40 years will influence how relevant the Faculty remains and also determine the quality of oral health practitioners it produces. As an Association, we can only hope that your “jumping” is chosen wisely to ensure the School remains at the forefront of Oral Health Care development in the future.

As we celebrate with you, we hope that your leadership be considering and providing solutions to questions such as:
How do we train students for a new epoch, position the School to add input and respond to the needs of the National Health Insurance?
How do we make dentistry education and service provision more accessible and affordable to those in the remote areas and who cannot afford it?

What are the key future challenges and how do we prepare our students and Alumni to deal with them?

The students, oral health practitioners- in-the-making, armed with knowledge from the Faculty, should be able to answer amongst others, the following questions:
Who am I?
Where do I come from?
Where am I going?
Why am I here?
What difference can I make?

The Association wishes you a Happy Anniversary for the passing era and wishes you well for the next 40 years.

KC Makhubele, CEO, The South African Dental Association
In commemoration of more than forty years of the existence of the UWC Faculty of Dentistry.

In commemoration of more than forty years of the existence of the UWC Dental Faculty, it is with great pride that this Festschrift of the SADJ is being published. Perusal of the articles representing the various disciplines bears testimony to how far the faculty has progressed over the years. From humble and tentative beginnings, the UWC Dental Faculty has burgeoned into a world class institution incorporating all the relevant disciplines and can stand shoulder to shoulder with sister institutions across the globe.

Conveniently situated in central, populous areas, the two service platforms at Tygerberg and Mitchell's Plain draw patients and students from all strata of society–a potpourri of cultures and a true representation of our “rainbow nation”. There is however a need to address the imbalances of the past as many of our students come from disadvantaged vernacular backgrounds, funded by bursaries and nothing else. They are often unable to cope with the exigencies and demands of university education. The needs in terms of food, textbooks and accommodation are great. This can be a tremendous setback for students and detracts from their ability to do well and succeed in their studies. Even though volunteer schemes have been established to alleviate the problem to some extent, consideration should be given to establishing a more organized scheme to augment this avenue of support. These vulnerable students should be identified so that systems can be put in place to remedy the situation and in some measure, contribute to the social development of our communities.

As the Dental Faculty is a referral centre, students are exposed to a huge variety of patients which include rare and interesting cases. The Faculty strives to provide holistic care to patients while at the same time offering students a myriad opportunities to learn and to improve their skills. In order to address the ever-changing needs of the new generation of students, emphasis is placed on blended learning with the development of new and innovative educational methods, including the incorporation of technology into various aspects of the curriculum.

The University is taking active measures to spread its influence nationally and internationally by pursuing and encouraging collaborative ventures in the fields of education, research and service delivery. Looking ahead to the challenges facing us, it is of concern that the resource fund allocation granted to the institution is not commensurate with the financial needs of a university that is expanding rapidly. There is an urgent need to establish fundraising initiatives to supplement the shortfall and assist in stabilizing our ailing infrastructure, replace old outdated equipment and refurbish facilities.

Over the years, the UWC Dental Faculty has produced many learned and distinguished scholars. Some have found their niche locally and others have sought alternative opportunities. Still others, the ones that we acknowledge, pay tribute to and salute, have stayed with the institution, invested their knowledge and expertise, and nurtured what was once a nascent dental faculty into what is has now become–an institution of repute and renown.

It is now left to the new generation of staff and academics to carry the beacon further and to embrace the possibilities that the new decade offers. To quote the words of the poet Tennyson: "To strive, to seek, to find and not to yield; to follow knowledge like a sinking star beyond the utmost bound of human thought".

N Mohamed: Paediatric Dentistry, UWC
Message from the Managing Editor.

The Brouwer Route was discovered in 1611... after sailing down the West coast of Africa, (and, coincidentally, past the Cape where the future Faculty would emerge!) Hendrik Brouwer cleverly – and bravely - used the prevailing winds to drive him across the Indian Ocean towards the East Indies and Australasia... but then instead of turning around to battle his way on a reverse course against terrific headwinds he continued eastwards across the Pacific Ocean, and up the east coast of America... and to home in The Netherlands! Thus he enjoyed the benefit of westward winds on both outward and homeward legs!

Those strong winds are the ROARING FORTIES... and they blow westwards in the Southern Hemisphere, generally between the latitudes of 40 and 50 degrees. To the clippers plying their trade, to the Round the World sailors of today, those winds have been of significant assistance. We could claim that their contribution to effective trading has been immense... the route cut the passage between Europe and Java by half.

The Faculty of Oral Health Sciences at The University of the Western Cape is bravely entering its own FORTIES... there is much to celebrate in achievements thus far, the contributions to Dentistry and to South Africa have also been immense... how much to expect when those commitments, energies, enterprise and initiatives which have been developed over the years are now directed with roaring intensity into the billowing sails of the good ship UWC!

The Festschrift experience has confirmed the dedication and vitality of the Faculty. None more so than the contributions of your Guest Editor, an absolute whirlwind of action! Every congratulations to all who have contributed to this signal publication... forty years of achievement... did you reach forty articles? Well done indeed.

WG Evans: Managing editor, Email bill.evans@wits.ac.za

Message from the SADA President.

It is my pleasure to contribute to acknowledging this auspicious occasion of the UWC’s forty years of existence. Being the ‘youngest’ Dentistry Faculty in the country, following the amalgamation of the two Dental Schools in the Western Cape, it’s alumni and indeed the institution itself, must be proud of their achievement.

Oral health education and services are certainly at a cross roads, with developments in the economy and the envisioned changes the National Department of Health is introducing. It is thus incumbent on dental teachers and practitioners to strive to keep abreast of the changes that are happening at a phenomenal speed within the profession. In the education space, it is asked of the programmes to have candidates who are globally competitive and locally relevant.

This obligates the teachers to be abreast of issues that are not only ‘discipline-specific’ but are locally and economically relevant so as to assist students to be progressive professionals. Gone are the days when the emphasis was only the discipline.

And in the words of the greatest statesman – Nelson Rolihlaha Mandela:
...education is the most powerful weapon which you can use to change the world ...

UWC, with its Faculty and alumni, continue to espouse this principle, using it as a passport to the future, because tomorrow belongs to those who prepare for it today (Malcom X). You can take pride in always preparing for all the todays.

P Mlopeti: President, The South African Dental Association
Message from the Deputy Vice-Chancellor.

The 40th anniversary celebration of the Faculty of Dentistry comes at a time when the Faculty has made huge inroads in the profession, as well as in oral health care in South Africa and on the continent. Besides being the largest provider of dentists to our system, the Faculty has embraced being innovative in their learning and teaching and research-led in their scholarly work.

It is well positioned to enable students to learn with technology and to grow digital dentistry in the next few years. Their scholarly outputs continue to contribute towards the deepening of the discipline and their community engagement is second to none. I wish the Faculty and all its alumni well on this momentous occasion.

V Lawack: Deputy Vice-Chancellor UWC

Message from the Rector.

Dear Colleagues,

I am most proud to be congratulating the Dentistry Faculty on achieving the great milestone of 40 years of existence. I am sure that, as you celebrate this achievement, you are reminded of the dedication and commitment of the many students, alumni, academic and professional staff and Faculty leaders who have brought us here.

There are so many positive associations with the Faculty for me in both my capacity as Rector and as a former Deputy Vice-Chancellor, having been closely involved in the merger of the two dentistry schools of the universities of the Western Cape and Stellenbosch.

I can still recall the magnitude of the responsibility that had been placed on us to work with our counterparts from Stellenbosch, led by the late Rector Prof Russell Bolman, to chart a way forward that would lead to the successful integration of the two separate entities.

Looking back at 2002 when the merger started, I am reminded again of the mutual recognition from UWC and US that we could only deal with each other as co-partners in the creation of a new school or faculty. Those are valuable lessons for a university about the manner in which it deals with all its stakeholders.

UWC’s Dentistry Faculty already had a positive reputation for educating oral health professionals, and the merger served to strengthen the Faculty. From January 2004, the Faculty would carry the responsibility of annually producing more than half of South Africa’s oral health professionals and it has done so with great success.

Furthermore, UWC’s Dentistry Faculty has always played a significant role in providing services to communities in the Western Cape region. It has left an indelible legacy among disadvantaged communities in the Western Cape through a range of services and interventions. Through these endeavours, the Faculty lives and enacts UWC’s vision of locating itself within society and engaging with matters of significance that make a difference.

I am convinced, as the Faculty enters a new decade of existence, it will continue to uphold its formidable reputation of teaching and research, and community engagement that seeks to improve the lives of others.

I wish you great success and a deserved celebration for growing the Faculty from strength to strength.

T Pretorius: Rector UWC
Message from the Dean.

As we celebrate 40 years of excellence in the provision of oral health care services, training and research it is important that we reflect on our past. The Faculty of Dentistry of the University of the Western Cape has transformed from an apartheid institution, created to train dentists of colour, into a leading member of the Dental Training Institutions internationally.

The faculty started in 1974 with a class of 25 dental students and two oral hygiene students after the De Villiers Commission recommended that a separate training facility for dentists of colour be established, as the existing three dental schools in the country at that stage (University of the Witwatersrand, University of Pretoria and the University of Stellenbosch) together only trained two dentists of colour per year.

The new faculty was established in the Tygerberg Hospital precinct. In the early nineties – in line with the University’s commitment to community-based education and training and under the Rectorship of Prof Jakes Gerwel – the faculty relocated to the Town Centre in Mitchell’s Plain.

This move made comprehensive oral health care readily available to the Cape Flats communities, including Khayelitsha, Gugulethu, Philippi and Crossroads – and at the same time provided an excellent opportunity for students to develop clinical proficiency in the context of a community setting.

In 2004, with the mergers of universities in South Africa as proclaimed by Minister Kader Asmal the dental school of the University of Stellenbosch was incorporated into the UWC Faculty of Dentistry. A condition of the merger was that service delivery should not be compromised at any of the sites previously serviced by the two faculties. As a result the merged faculty’s footprint in the community extended throughout the Western Cape, and it became the largest faculty in the country with regards to service delivery and the training of oral health workers.

Today the faculty boasts a 46 seater simulation laboratory that is equipped with state of the art technology to assist students in their pre-clinical training, a video-conferencing facility that links the two main training sites and that also provides access to webinars on the International platform, a private practice simulation centre and world class service facilities.

Currently the faculty treats in excess of 120 000 patients a year at its seven service delivery sites, while training 90 dentists, 25 oral hygienists and specialists in Orthodontics, Prosthodontics, Maxillo-facial and Oral Surgery, Community Dentistry, Oral Medicine and Periodontology and Oral Pathology. In addition to this the faculty has an established post-graduate diploma in dentistry in all disciplines as well as structured and research MSc and PhD programmes. These are all sought-after programmes and support the World Health Organisation mandate to train the trainer.

The WHO has again accredited the faculty as a collaborating centre for the next five years, with terms of reference which include supporting the region and the continent with expertise and opportunities in the delivery of oral health care policies, practices and personnel.

In addition to service rendering and training, the faculty has established research niche areas with expertise in clinical research, laboratory-based research and epidemiological research.

Research by undergraduate and postgraduate students has consistently enabled these students to win national competitions. Included among the accolades the students received was representing South Africa over the years at Congresses of the International Association of Dental Research such as at the IADR Meeting in San Francisco (USA) in 2017, and in London (UK) in 2018.

Furthermore, staff are committed to a University-wide research proposal involving early childhood development and, along with the Western Cape government, research into the first thousand days of a child’s life once they formally enter the schooling system.

Due to the huge burden of disease with regards to oral health nationally, and in particular in the Western Cape, the faculty has been sought out as a collaborating partner with international institutions resulting in memorandums of understanding with these partners, including the University of Missouri, Kansas City, the University of Oslo, The University of Bergen, Asahi and Meika Universities in Japan and the Ministry of Health in Kuwait. In Africa the Faculty is well placed to train specialists and subspecialists for the Region and the Continent.

The achievements of the faculty over the past 40 years through it staff, students and now alumni all over the World would not have been possible without the support of the University of the Western Cape and the Provincial Government of the Western Cape. May this bilateral relationship go from strength to strength so that the faculty can continue to strive for outstanding performances in the provision of oral health care training, services and research. May it always be a beacon of hope for aspiring oral hygienists, dentists and dental specialists.

Y Osman: Dean of the Faculty of Dentistry, UWC
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Effect of diamond-like carbon coating on implant drill wear during implant site preparation.

SADJ May 2018, Vol 73 no 4 p189 - p191
M Aborass, MT Peck, H Holmes

ABSTRACT
Dental implant drills are made of different materials such as stainless steel (SS), zirconia and ceramic. Diamond-like carbon (DLC) coating has been added to increase the cutting efficiency and wear resistance. Aim: To determine the impact of DLC coating on dental implant drill wear after implant site preparation.

Objectives
To determine: a) drilling times b) geometric features and chisel integrity of drills with different surfaces after repeated use. Methods and Materials: 13 pilot drills were sourced from different manufacturers, providing five groups for testing. The drills were sequentially attached to a hand piece fitted to a drill press and used 20 times, drilling to a depth of 10mm in artificial bone. Drilling times were recorded with a digital stopwatch. SEM images were taken of the bur before and after 0, 5, 10, 15 and 20 penetrations. Results: No significant differences in drilling times were detected. The drills showed signs of wear, while coating delamination was detected in DLC coated drills. Conclusion: No significant differences in drilling times were found. SEM images showed that most of the drills revealed signs of wear after 20 uses.

INTRODUCTION & LITERATURE REVIEW
Dental implants are artificial titanium fixtures that are surgically inserted into the jaws. Through a process known as osseointegration, implants provide firm support for dental prostheses such as bridges, crowns, and dentures. Osseointegration was initially defined by Brånenmark as “a direct functional and structural connection between living bone and the surface of a load-carrying implant”. Zarb and Albrektsson proposed that osseointegration was “a process whereby clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained in bone during functional loading”. The success of dental implant treatment is dependent on achieving successful osseointegration, which is influenced by factors such as trauma during dental implant site preparation. This has been reported to affect the long-term predictability of the implant.

1. Marwa Aborass: BChD, MSc, Division of Oral Medicine and Periodontics, Faculty of Dentistry, University of the Western Cape.
2. Thabit Peck: BChD, MSc, MCro, MND, RCSEd, FDS, RCSEd, MDS, PhD, Division of Oral Medicine and Periodontics, Faculty of Dentistry, University of the Western Cape.
3. Holly Holmes: BChD, MSc, MCro, Division of Oral Medicine and Periodontics, Faculty of Dentistry, University of the Western Cape.

ACRONYMS
DLC: Diamond-like carbon.
SEM: Scanning electron microscopy.
SS: Stainless steel.

Implant-specific drills are used to prepare the host bone for fixture insertion. During the drilling process, a thin layer of necrotic tissue is formed in the osteotomy site. Excessive drilling trauma during implant site preparation causes an increased thickness of this necrotic layer, resulting in reduced bone formation and tissue maturation, reportedly leading to implant failure. Heat is generated by the drilling procedure during implant site preparation, an effect which influences bone metabolism. An increase in temperature above 47°C after one minute of drilling time leads to decreased bone regeneration. Several factors influence heat generation during the drilling procedure. These include cortical bone thickness, drilling pressure, cutting motion, irrigation, drilling time, drill speed, shape and diameter of drills. Repeated use of a dental drill can decrease its cutting efficiency.

Implant drills are made of different materials, such as SS, zirconia and ceramic. Most do not have ideal cutting efficiency and resistance to wear. Recently, diamond-like carbon (DLC) was added as a drill coating to improve the cutting efficiency, increase wear resistance and drill hardness. DLC is an amorphous carbon or non-crystalline structure, with properties similar to diamonds. Surface coating with DLC confers the advantageous properties of the diamond on the coated material surface. Studies evaluating the wear patterns of various drill materials, the effect of changes in temperature and the mass associated with these materials are well documented. However, conclusive studies comparing drill wear and drilling time specifically for DLC coated drills have not been reported. The purpose of this study was to compare the drilling time and wear of DLC coated implant drills to SS drills during implant preparation.

MATERIALS AND METHODS
This in vitro study was carried out using twenty artificial bones (Straumann® [Basel, Switzerland]) of standardized bone density and quality. A total of thirteen stainless steel and DLC pilot drills were sourced from different manufacturers and divided into five groups (Table 1). The implant drill was attached to a surgical implant hand piece (Nobel Biocare® W&H Dentalwerk Austria). The implant hand piece was fitted to a drill press with a mechanical arm to allow for controlled vertical movement (MK-dent® RT2010 Germany); and could be managed by a single operator (Figure 1). Drill speed and torque were determined by the manufacturer’s
recommendation (Osseoset 200, SI-923: Nobel Biocare® W&H Dentalwerk Austria). All implant drills were used 20 times to a 10mm drilling depth in a stabilized artificial bone block. Isotonic saline was used as external irrigation. Drill time was recorded (in seconds) for each use with a digital stopwatch. After each series of five uses, drills were rinsed in distilled water, dried using compressed air and sterilized in an autoclave (Ster-vac® gas sterilizer, 3M Medical Surgical division, Paul, U.S.A) in Tygerberg Hospital at 127°C for 40 minutes. SEM images were taken of new drills and after 5, 10, 15 and 20 penetrations (Figure 2).

Photomicrographs of SEM images were taken at 30X and 150X magnifications to document the geometric features, wear and chisel integrity of all drills at the various stages.

RESULTS

Drilling time results
Significant differences in drilling times were detected in the first four groups between the diamond-like carbon and stainless steel drills. Figure 3 summarizes the means and various drill time patterns. The first four groups show similar patterns with an initial increase in speed, followed by a gradual and steady reduction in time. The fifth group (Champion Stainless Steel) showed a dramatic and erratic increase in drilling time after the fifth preparation.

SEM analysis
All implants from groups G1, G2, G3, and G6 showed signs of wear after 20 uses. Evaluation of the drill surfaces was conducted after intervals of 5, 10, 15 uses and 20 uses (Figures 4 to 13). The first three surface examinations were done at 30X magnification and the last examination (after 20 uses) at 150X magnification. The latter revealed damage to the cutting surface and blunting of the tips. Coating delamination was detected in the DLC drills in G2 (Figure 7) and drills from G1, G3, and G5 showed irregular surfaces and a higher tip wear (Figures 4, 5, 8, 9, 12 and 13). In contrast, stainless steel drills from G4 maintained regular cutting edge surfaces, with no differences noted before or after drilling procedures (Figure 10, 11).

DISCUSSION

Introduction
Dental implant drills used for implant preparation are made of different materials including ceramic, zirconia and stainless steel. Most of these materials do not have sustained long-term wear resistance nor cutting efficiency. Recently DLC has been added as a drill coating to improve cutting efficiency, increase wear resistance and to increase drill hardness.6 The aim of this study was to determine the effect of a DLC coating on dental implant drilling time and drill wear during implant site preparation.

Drilling time
To the author’s knowledge, this is the first reported study measuring drilling time of implant drills with varying surface properties, after repeated use. The first four groups (SS Adini®, DLC Adini®, SS Megagen® and SS Straumann®) showed no statistically significant difference in drilling time after 5, 10, 15 and 20 uses. Group 5 (SS Champions® implants) showed an increase in drilling time with subsequent drill use and the average drilling time was slower compared with the other groups. This may be attributed to the low recommended drill speed of 250 rpm. The drilling time influences the amount of frictional heat generated between the drill and the surrounding bone. The long-term effect of heating bone to 47°C for 5 minutes is reported to be bone resorption, associated with an invasion of fat cells and reduced osteogenic activity.

A number of studies using high-speed rotary instruments have demonstrated that a decrease in drilling time will reduce the rise in temperature.13,14 Cordelli and Majouz15 concluded that the depth of the cavity, diameter and the flute geometry of the drill contributed to the time required for the maximum temperature to return to normal. However, further investigations are required to support this hypothesis. In addition, in the case of the Champion drills, the manufacturer recommended that the drills be used a maximum of five times at a low speed of 250 rpm, which may explain the slower drilling times seen after five uses.

<p>| Table 1: Drill numbers and composition (G1-G5) |
|---|---|---|---|---|---|</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Drill surface</th>
<th>Manufacturer</th>
<th>Drill speed</th>
<th>Number of drills</th>
<th>Drill type</th>
<th>Drill diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Stainless steel</td>
<td>Adini®</td>
<td>800 rpm</td>
<td>2</td>
<td>Pilot drill</td>
<td>2mm</td>
</tr>
<tr>
<td>2G</td>
<td>Diamond like carbon</td>
<td>Adini®</td>
<td>800 rpm</td>
<td>3</td>
<td>Pilot drill</td>
<td>2mm</td>
</tr>
<tr>
<td>3G</td>
<td>Stainless steel</td>
<td>Megagen®</td>
<td>850 rpm</td>
<td>2</td>
<td>Pilot drill</td>
<td>2mm</td>
</tr>
<tr>
<td>G4</td>
<td>Stainless steel</td>
<td>Straumann®</td>
<td>800 rpm</td>
<td>3</td>
<td>Pilot drill</td>
<td>2mm</td>
</tr>
<tr>
<td>G5</td>
<td>Stainless steel</td>
<td>Champions® implants</td>
<td>250 rpm</td>
<td>3</td>
<td>Pilot drill</td>
<td>2mm</td>
</tr>
</tbody>
</table>

Figure 3: Means of five groups with drilling times (in seconds) / drilling sequences (Osteotomies 1 – 20).

Figure 1: Drill press with surgical hand piece attached and artificial bone stabilized in lab putty.

Figure 2: SEM analysis of drills.
Figure 4: SS drill (G1) before drilling.

Figure 5: SS drill (G1) after drilling 20 times.

Figure 6: DLC drill (G2) before drilling.

Figure 7: DLC (G2) after drilling 20 times.

was detected in SS drills, implying that more wear occurred in the SS drills. Oliveria also reported signs of increased drill wear after 50 uses for stainless steel twist drills compared with zirconia drills. Significantly, dos Santos showed that drill deformation and roughness were directly proportional to the number of times the drills were used.

In this study, there was no difference with regards to wear resistance and cutting efficiency between DLC coated and SS drills after repeated use. Most drills tested were consistent up to after 15 times of use. However, SS and DLC coated drills revealed signs of wear after being used 20 times. Damage, irregular cutting surface and higher tip wear were detected in stainless steel drills from group 1 (SS Adir) and was noticeable after 20 drillings. No differences were found between stainless steel drills in groups G1 and G3 with regards to irregular cutting surface and tip wear after being used up to 20 times.

A significant finding was that delamination of DLC coated drills was observed after 20 drillings. This was seen mostly affecting the drill tips and along the cutting edges. No evidence of loss of sharpness...
Drill design, material, and speed significantly affect cutting efficiency, wear resistance and drill time. These factors should be considered during implant drill design and their combined influence evaluated during testing on bone tissue.

No significant differences in drilling time were detected in groups 1, 2, and 3 between diamond-like carbon coated (DLC) drills and stainless steel (SS) drills after 5, 10, 15 and 20 times use except for group 5. This group could not be compared with the other groups, as the recommended speed of drilling and drill design was different to the other groups. In addition, the manufacturer's instruction did not allow the drills to be used for more than five times, as opposed to the 20 times in the current study.

The SEM images revealed signs of wear after 20 uses for most of the implant drills (groups G1, G2, G3, and G5). DLC coatings on drills do not affect implant drilling time.

All drills may wear, leaving drill debris.

Further research is recommended to determine the clinical significance of the above findings.

LIMITATIONS OF THE STUDY

- Small sample size was tested.
- In Scanning Electron Microscopy (SEM), no measurable comparison could be made.
- The drill pressure and force was not standardized.
- The effect of the sterilization procedure on the wear rate or pattern of the drills was not taken into account.
- This was a laboratory-based study.

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The effect of preparation method on the fibrin diameter of leukocyte- and platelet-rich fibrin (L-PRF).

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Peck MT, Hiss D, Stephen LXG.

ABSTRACT

Introduction
The use of leukocyte and platelet-rich fibrin (L-PRF) in regenerative surgery has increased exponentially in the last decade. That success has led various centres to have introduced the biomaterial as a routine inclusion in oral grafting procedures. Evidence suggests that the physical properties of fibrin play an essential role in homeostasis of blood clots. Only a limited number of studies have investigated the features of fibrin fibre diameter of L-PRF concentrates.

Aims and objectives
To investigate and compare the fibrin network and fibrin fibre diameter of L-PRF prepared by two different methods.

Methods
Blood was collected from a single volunteer using established protocols. The resultant L-PRF clots were then prepared and examined using scanning electron microscopy. The results were subjected to statistical analysis.

Results
L-PRF prepared using the modified method had larger diameter fibrin fibres than that prepared using the official protocol. The difference was statistically significant (P<0.001). There was also a larger amount of thicker fibrin fibres observed in the modified L-PRF group.

Conclusions
Preparation methods affect the fibrin fibre diameter of L-PRF. This may have consequences that influence the biological properties of the biomaterial.

INTRODUCTION
The use of leukocyte and platelet-rich fibrin (L-PRF) in regenerative medicine has increased exponentially in the last decade. First introduced by Choukroun et al. in 2001, this autologous, blood derived platelet concentrate that has been extensively used in oral surgical procedures, with clinical success in the fields of

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ACRONYMS
A-PRF: Advanced PRF
L-PRF: Leukocyte and platelet-rich fibrin
SEM: Scanning electron microscopy

Figure 1: Modified L-PRF (left) and A-PRF (right)
An important component of the biological advantages of L-PRF concentrates, is its specific structure which comprises a dense fibrin network, with high concentrations of platelets and leukocytes interspersed within the mesh of fibrin fibres. It is thought that this allows growth factors to be trapped, and released over a prolonged period thereby enhancing healing and regeneration. Recently, the role of fibrin structure has been researched for its role in blood clots. Evidence suggests that the physical properties of fibrin fibres play an essential role in homeostasis of blood clots by affecting their mechanical and biological contribution properties. However, only a limited number of studies have investigated the features of fibrin fibre diameter of L-PRF concentrates.

With the increase in popularity of L-PRF, several authors have reported positive clinical results using L-PRF that is prepared using non-standardised equipment or materials. An example of this type of “modified” L-PRF has been clinically documented in previous publications by Peck et al. This deviation from the proposed protocol may result in structural and functional changes to the consequences to the biomaterial that is being produced. In this report, using scanning electron microscopy (SEM), we analyse and compare the fibrin network and fibrin diameter of two different methods of L-PRF preparation i.e., our modified protocol for the preparation of L-PRF, as previously described by Peck et al., and A-PRF, prepared via the recommended protocol as previously outlined in the literature.

**MATERIALS AND METHODS**

The study was conducted at the Dental Faculty, University of the Western Cape, Cape Town, South Africa in 2017. Ethical clearance was obtained from the Research Ethics Committee of the university with the following reference number: BER 16/3/31.

**Preparation of the L-PRF samples**

Thirty six milliliters of blood was obtained from a single 30-year-old healthy male volunteer via venipuncture of the left antecubital vein. Two methods were used to prepare L-PRF, i.e.,

1. Modified L-PRF: Blood samples were collected in 9ml blood collecting tubes that contain clot activator i.e., Vacutainer® 9ml serum tubes with Z Serum Clot Activator (Greiner Bio-One International AG, Germany). The blood samples were then centrifuged at 400g for 12 minutes in a standard benchtop centrifuge (PLC-03, Hicare International, Taiwan).

2. A-PRF: Blood samples were collected in 10 ml A-PRF™ tubes (Process for PRF, Nice, France), and centrifuged for 15 minutes at 3000 rpm using a dedicated benchtop centrifuge (PRF DUO™, Process For PRF, Nice, France).

After being centrifuged, the blood from both groups separated into 3 distinct layers (Fig. 1). From previous reports, the layers could be distinguished as a topmost layer consisting of cellular platelet poor plasma, Modified L-PRF/A-PRF+ in the middle, and red blood cells at the bottom of the test tube. In order to standardise L-PRF thickness, the resultant L-PRF clots from both groups were removed from the tubes, and subjected to controlled compression, using a specifically designed tool i.e., the PRF Box® (Process for PRF, Nice, France) (Fig. 2). All the samples were then transferred for preparation for scanning electron microscopy analysis.

**Preparation for scanning electron microscopy (SEM)**

All the samples were fixed using 2.5% glutaraldehyde in phosphate buffered saline (PBS) for 1 hour. Each specimen was removed and washed in PBS for 5 minutes (twice) and placed in distilled water for 5 minutes (twice). The specimens were then dehydrated serially with 50%, 70%, 90% and 100% ethanol, with each dehydration step taking 10 minutes. The samples were then transferred to the Electron Microscope Unit, Department of Physics, University of the Western Cape, for critical point drying, gold-palladium coating, and mounting for SEM analysis.

**Scanning electron microscope observation**

The surface microstructure of each specimen was analysed using the same scanning electron microscope (AURIGA Field Emission High resolution SEM, Carl Zeiss Microscopy GmbH, Jena, Germany). All measurements of the fibrin networks were carried out at 10,000 times magnification. At least 200 fibres were randomly selected from each group and measured for...
clear reflection of the various fibre groups present. It also showed that the fibrin fibre diameters were not equally distributed in each of the groups and that a wide range of fibre diameters were present (Fig 6). These fibre groups were present in both Modified L-PRF and A-PRF+, but were significantly different in their distribution for the two versions of L-PRF. Of the two groups tested, Modified L-PRF was characterized by larger diameter fibres and had a higher amount of thicker fibres when compared to A-PRF+ (Fig 6). Because of the wide range of fibre diameters noted in each of the sample groups tested, arbitrary size classes were selected to better illustrate the range of fibre diameters seen. This size selection was based on a previously published model which analysed human fibrin networks. Consequently the fibre diameters were categorised into 3 groups based on “thickness” i.e. thin (lowest thickness to 85nm), intermediate (86 - 202nm), and thick (203nm to highest). This is represented by histogram A.

**RESULTS**

Descriptive analysis of Modified L-PRF and A-PRF+ Fibrin fibre networks

Under low magnification (1000 times) both samples show similar morphological characteristics. A dense mesh of fibres was evident with scattered cells seen on the surface for each sample (Fig 3). For the Modified L-PRF sample, more irregular bodies were present, possibly signifying the presence of platelets (Fig 3). This may be characteristic of the region observed and may not be representative of the sample as a whole. No distinction in fibre architecture for the 2 groups was seen at this level of magnification. When observing the samples at higher magnification (10,000 times), the fibre mesh showed distinct characteristics (Figs 4 and 5). For both groups, the fibres were densely arranged in a netlike structure with clear spacing and crosslinking seen. Distinct differences could be noted with regards to fibre diameter, with both groups showing non-uniform fibre thickness. Thicker fibres were interwoven with thinner fibres and many of the fibres showed irregular surface characteristics indicative of platelet-fibrin fibre interaction. The presence of cellular bodies could be noted for both groups. Distinguishing between both groups solely on the basis of SEM analysis, was difficult.

**DISCUSSION**

L-PRF in its various forms has shown promising results in both in-vitro and in-vivo studies. This is attributed to the structural integrity of the biomaterial which results in a matrix that contributes to the prolonged release of various growth factors as well as provides a network for the migration of cellular components. The process of preparing L-PRF was initially documented by Choukroun in 2001. However since the original protocol was introduced, several authors have attempted to replicate the platelet concentrate using non-standardized methods. Although clinically successful, the ultrastructure of these L-PRF variants has not been reported upon extensively.

The data from this study indicates that using both the A-PRF+ protocol as well as the modified protocol for the preparation of L-PRF that we used, may yield L-PRF clots that appear similar macroscopically. Both preparation methods resulted in separation of the centrifuged blood into 3 three distinct layers as previously described. When examining L-PRF clot size, the resultant L-PRF clots appeared smaller for the Modified L-PRF group, however this was not quantified statistically. We speculate this may be due to using a 9ml blood collecting tube as opposed to 10ml in the A-PRF+ group. However, the size of the collecting tube may not be the only factor affecting L-PRF size, since recent research indicates that using different centrifuges may affect L-PRF clot size.

Compressed L-PRF clots from both groups appeared similar under low magnification (x1000), with a dense fibre network and a wide range of fibre diameters being seen. The density of the fibre networks seen in this study has previously been reported upon and is thought to be related to the compression of the clots in the PRF-Box™. When the fibre diameters were analysed as thin, intermediate, and thick, the majority of fibres in both groups were classified as thick. This differs from the findings of Vieira et al.
Previous studies that have examined the features of fibrin associated with L-PRF, have often used the mean diameter of the fibres to describe the characteristics of the L-PRF clot or are limited to a subjective description of the fibre diameter. In the present study, statistical analysis revealed that using the mean diameter, did not reflect the range and frequency of the fibre types observed. Therefore when analysing fibre diameters for Modified L-PRF and A-PRF, we identified clear groupings (Fig 6). These were statistically significantly different for the two L-PRF groups, with the Modified L-PRF showing a higher number of larger diameter fibres as compared to A-PRF (Table 1). The exact reasons for this difference in not known, but is probably due to differences in the centrifugal force, centrifugation time, concentrate make, agents present in the blood collecting tubes and shape of the blood collecting tubes. Because all the samples were taken from the same individual in a 15 minute period, the above may serve as an adequate explanation for the differences in fibre diameters seen. However one must consider that for different individuals or in instances where blood is collected from the same individual at different times, that other factors such as pH, the presence of zinc, ionic strength, concentrations of calcium, polyphosphates, fibrinogen, fibrinogen binding proteins and thrombin, may also influence fibre thickness and network density.

The tubes used to collect blood to prepare Modified L-PRF, are coated with silica. Silica is a known procoagulant. It binds to plasma proteins and has the ability to cause reversible structural changes to these molecules. This is dependent on the size of the silica particle, with smaller silica particles demonstrating the ability to shorten coagulation time and increase the activation of factor X, whilst at the same time activate platelets. The fact that silica coated tubes were used in the preparation of the Modified L-PRF, may further contribute to the morphological differences seen between the 2 groups.

The individual fibre diameters seen in the samples tested may have implications for the mechanical stability of each L-PRF clot. Clots with thicker fibres tend to be less elastic than those with thinner fibres and may be more readily degraded by the fibrinolytic system. This may have consequences for the biological behaviour of L-PRF since structural integrity and the controlled release of growth factors is thought to be a major contributing factor to its clinical success. Therefore, one might assume that because A-PRF has a lower amount of thick fibres than Modified L-PRF, that its rate of dissolution may be slower than that of the Modified L-PRF. As such, its ability to remain intact may be prolonged as compared with other platelet concentrates and may explain the extended release of growth factors as recently reported.

CONCLUSIONS

The author’s knowledge, this is the first presentation of the morphological fibre characteristics of an L-PRF clot prepared using a specific modified protocol as previously described by the authors. When compared to an established protocol, the resultant L-PRF clot appears morphologically similar to its A-PRF counterpart with a dense fibrin network interspersed with platelets and other blood cells. However, clear differences are noted for the fibrin fibre diameter with Modified L-PRF showing a higher proportion of larger diameter fibres. The reason for these differences is speculated to be associated with the different protocols used to prepare the platelet concentrates. One might therefore assume that changes in the protocol of preparation of L-PRF may directly affect its morphological structure. Whether these differences affect the clinical efficacy of these biomaterials is unclear, and warrants further research.

Disclosure policy

The authors declare no conflict of interest regarding the publication of this paper. This paper forms part of the requirements of the partial fulfilment towards the degree PhD.

References


Evaluation of dentine damage after root canal preparation with rotary NiTi instruments.

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Ahmed S, Saayman CM.

ABSTRACT

Aim
The aim of this in-vitro study was to investigate the possible damage to root canal dentine during instrumentation with four different nickel-titanium rotary instruments and stainless steel hand files.

Materials and Methods
90 permanent human mandibular molars, each having two mesial canals, were selected for the study. The mesial roots were randomly divided into six groups (n=30), with one group remaining unprepared as the control. The remaining five groups were randomly assigned to one of the nickel-titanium rotary instrumentation systems (Wave One™, ProTaper NEXT™, iRaq™, BT-Race™), and to a stainless steel hand file group. Roots were prepared and segmented at 3mm, 6mm and 9mm. Each segment was studied under stereomicroscope to detect any dentine damage.

Results
Data for the different groups were collected and summarised as percentages. Pairwise comparisons between the groups were done using Fisher’s exact test. There were no significant differences between the four NiTi groups. However, there was a significant difference between the four groups and the stainless steel group (p=0.0001).

Conclusion
Under the conditions of this in vitro study the use of all NiTi rotary instrumentation systems resulted in dentine damage whereas stainless steel hand instrumentation did not cause dentine damage.

INTRODUCTION
The objective of root canal shaping is to create a continuous taper in the canal with a small diameter at the apical foramen and enlarging to be greatest at the coronal orifice. The original
canal shape and curvature are maintained to allow for adequate irrigation and prevention of obstruction.1,2

Debridement is followed by placement of an effective root canal filling material, using aseptic and a well sealed, functional coronal restoration to prevent further entry of bacteria. Debridement on its own will not effect significant clinical reduction in bacterial growth and therefore antibacterial irrigation is an important adjunct to mechanical preparation of the root canal systems.3,4 The advent of the first nickel-titanium rotary instruments marked a revolution in endodontics, resulting in a shift from hand instrumentation to rotary instrumentation.4 Although the use of nickel-titanium instruments allows for reduction of preparation time, centred canals and standardised canals, research has shown that an adverse consequence of rotary nickel-titanium instrumentation may be damage to dentine and the creation of defects in root canal walls,1,4 as a consequence of rotational forces being applied to the root canal walls. These defects can vary from cross lines and microcracks to incomplete and complete fractures in the root canal dentine.2,10

Damage to dentine can be classified as follows:
• No defect, no lines/cracks present in dentine.
• Incomplete crack-presence of a line from canal wall into the dentine but not extending to the outer surface of root.
• Complete crack-presence of a line extending from root canal wall to outer surface of the root.
• Crazes- presence of lines that do not reach any surface of the root/outer surface of dentine and do not reach the canal wall.

During hand instrumentation, less aggressive movement is evident compared with engine operated instruments.31 Greater friction is observed between nickel titanium rotary files and root canal walls when compared with hand instrumentation, and thus the greater the amount of dentine removed, the greater the risk of causing dentine damage during instrumentation.32 The total volume of dentine removed is greater with rotary instrumentation when compared with hand instrumentation. The use of rotary instrumentation results in a greater incidence of craze lines compared with hand operation.36-37

Rotary instrumentation is associated with increased numbers of rotations and the application of rotational force to the root canal walls, which may contribute to dentine damage and dentine microcrack formation.37 Transitory stress concentrations, caused where the rotary instruments and the root canal dentine make contact, may result in dentinal defects. These stress concentrations may be transmitted through the root to the outer
surface where dentinal bonds may be destroyed.15,19-21

Specific features of rotary instrumentation and shaping procedures may influence the occurrence of dentine damage and defects. These features include, amongst others, tip design, design of cutting blade, cross-sectional geometry, tip configuration, taper (constant vs progressive), pitch (constant vs variable) and flute form.4,13,19,12,22

The incidence of dentinal defects may also be associated with the techniques followed in nickel-titanium rotary preparation (reciprocating motion, single instruments, multiple instruments and combination of different techniques).1 Other factors that may influence dentine damage is the effect of sodium hypochlorite and ethylenediaminetetraacetic acid (EDTA) on root canal dentine during canal debridement and shaping. Sodium hypochlorite may have an effect on dentine mineral content, micro-hardness and flexural strength.13-17

Irrigants can thus alter surface characteristics of dentine, EDTA is used in endodontics as a chelator, for smear layer removal and increased dentine permeability.21 The chelating action of EDTA results in the softening of calcified components of dentine and subsequent decrease in micro-hardness of dentine.13

Recently single file systems as well as NiTi instruments manufactured from M-wire were introduced. ProTaper NEXT and WaveOne are manufactured with M-wire. WaveOne is a single file system, used in reciprocating motion. ProTaper NEXT is used in rotary motion and has an off-set cross-section, which allows for a swagging motion in the canal. iRaCe and BT-Race systems are NiTi instruments used in rotational motion. iRaCe has a triangular cross-section with a rounded safety tip. BT-Race features a booster tip which is designed to allow files to follow curvature in the root without undue stress on instruments and root canal walls, while keeping files centred in the root canal.

This study investigated the effect of ProTaper NEXT (PTN), WaveOne (WO), iRaCe (iR) and BT-Race on root canal dentine, when used with 5.25% sodium hypochlorite and 17% EDTA.

MATERIALS AND METHODS

Mandibular molars were obtained from the Oral Surgery and service rendering clinics of the Faculty of Dentistry, University of the Western Cape. The teeth collected for the purposes of this study were extracted for reasons unrelated to the objectives of this study. Prior to commencement of this study, ethical clearance was obtained from the Research Committee of the Faculty of Dentistry, University of the Western Cape (Project number: 13/10/12). Every aspect of this study was conducted in accordance with the ethical and safety guidelines for handling human tissues and conducting laboratory studies, as prescribed by South African law (Health Professions Act 58 of 1974 (Health Professions Council of South Africa, 2008).

Teeth with severely curved mesial root canals were excluded from the study. The external root surfaces of all available teeth were inspected under a stereomicroscope (Nikon SMZ 10). At 12X magnification to identify any external defects or cracks, Teeth with defective roots were rejected. 90 mandibular first molars (180 mesial root canals) were finally selected and stored in distilled water. The crowns of these teeth were removed at the cemento-enamel junction (CEJ) using a diamond disk cutter (Stuers Minimot, 350μm blade thickness), under water cooling. The distal roots of the teeth were removed. The remaining mesial roots had an approximate length of 11mm. A polyvinyl silicone impression material (President Putty Collene/Whaledent) was used to coat the cemental surface of the roots to simulate the periodontal ligament space and to economically mimic the mechanism of stress distribution during debridement.

The total sample was randomly divided into six groups (n=30), with one group receiving no instrumentation and serving as the control group. The remaining five groups were randomly assigned to a NiTi rotary instrumentation system as well as to a stainless steel group.

Root segment preparation

The detailed debridement procedure for each system was as follows:

For all groups: canal patency was established with a no 10 stainless steel K-file (FKG Dentaire™). The working length was set 1mm short of that length. The glide path was established with hand files. numbers 8, 10 and 15 stainless steel K-files (FKG Dentaire™). The canals were irrigated with 5.25% sodium hypochlorite (Proteca Chemicals) during glide path establishment. 17% EDTA (Glyde File Prep™, Dentally Mallefer) was used as a lubricant during glide path establishment. After the glide path was established for each sample group, the allocated rotary nickel-titanium system was used for canal debridement, 5.25% sodium hypochlorite and 17% EDTA (Glyde File Prep™, Dentally Mallefer) was used as an irrigant and chelator during debridement. Approximately 12ml sodium hypochlorite solution was used per canal. Canals were irrigated with sodium hypochlorite after each file change, and instrument flutes were cleaned on cotton gauze after insertion in canal. The EDTA solution was used after sodium hypochlorite rinse in the canals, usually twice. Patency was confirmed between each file. Sodium hypochlorite was used as the final rinse. The Wave One endo motor and handpiece (Dentally Mallefer) was used for all canal preparation. All the NiTi rotary sample groups were prepared in rotational motion, except for the Wave One group which was prepared in reciprocating motion. One set of rotary instrument and has an off-set cross-section, which allows for a swagging motion in the canal. iRaCe and BT-Race systems are NiTi instruments used in rotational motion. iRaCe has a triangular cross-section with a rounded safety tip. BT-Race features a booster tip which is designed to allow files to follow curvature in the root without undue stress on instruments and root canal walls, while keeping files centred in the root canal.

GROUP 1: ProTaper NEXT™ (Dentally Mallefer) (n=30)

The ProTaper NEXT™ X1 Dentally Mallefer (017/04) was used for initial debridement until working length was achieved. Files were brushed with EDTA and manuvered down the glide path. This was followed by ProTaper NEXT™ X2 (025/06) to the working length. After each ProTaper NEXT™ instrument, recapitulation with a no 15 K-file was effected. 5.25% sodium hypochlorite and 17% EDTA were used during debridement.

Recommended speed: 300 rpm

Torque: 2 Ncm

GROUP 2: WaveOne™ (Dentally Mallefer) (n=30)

The single file for WaveOne™ (Dentally Mallefer) was selected accordingly and used to debride until working length was achieved. If a no 10 K-file moved to length easily, was loose or very loose, a WaveOne™ Primary file (25/08) was used. The files were used in up and down movement no more than three to four times, with little force. 5.25% sodium hypochlorite and 17% EDTA was used during debridement. Recapitulation was done with a no 15 K-file.

Recommended speed: 300 rpm

Torque: 2 Ncm

GROUP 3: BT Race FKG Dentaire™ (n=30)

BT1 (10/08) was used for finalisation of glide path and conservative enlargement of the coronal third.

BT2 (35) was used for preparation of the apical third to full working length.

BT3 (35/04) was used for final shaping of canals until full working length was reached. 5.25% sodium hypochlorite and 17% EDTA were used during debridement. Instruments were used with a long and gentle pecking motion (3-4 back and forth strokes). Recapitulation was done with a no 15 K-file.

Recommended speed: 800 rpm

Torque: 1.5 Ncm

GROUP 4: iRaCe™ (FKG Dentaire™) (n=30)

R1 file (15/08) was used to working length. Thereafter an R2 file (25/04) was used to working length to continue shaping. 5.25% sodium hypochlorite and 17% EDTA were used during debridement. Long back-and-forth strokes with the instrument were applied, with a light touch. Recapitulation was done with a no 15 K-file.

Recommended speed: 600 rpm

Torque: 1.5 Ncm

GROUP 5: Stainless steel hand instruments (Dentally Mallefer) (n=30)

All canals were prepared using stainless steel instruments to working length, and recapitulation was effected between each...
Canals were prepared to a no. 25 stainless steel K-file (Dentsply Maillefer). Once the instrument went to working length, recapitulation was done, followed by the consecutive instrument. 5.25% sodium hypochlorite and 17% EDTA were used during debridement.

**GROUP 6: Control group (n=30)**

No preparation was carried out in this sample group.

**ROOT SECTIONING**

The roots in all six groups were sectioned under water cooling at 3, 6, 9mm from the apex, using a diamond disc cutter (350 µm blade thickness) attached to Stuers Minitom. Root segments were then observed under stereomicroscope (Nikon SMZ 10) under 12X magnification and images of each section were captured at 40X using a digital camera (Leica DFC 290). The root segments were kept wet at all times and the stereo microscope examination was done immediately after sectioning of roots.

**Figure 1: Control segment**

**Figure 2: Segment with dentine damage**

The root segments were evaluated for any defect in the dentine at any level in the segment slice. Defects were categorised as: ‘no defect’ and ‘all other defects’. ‘No defect’ is defined as dentine devoid of any lines or cracks where both the external root surface and the internal root canal wall had no defects. Other defects included all lines that were observed from the root canal wall to the outer root surface (fractures); as well as any lines that did not reach either the canal lumen or the outer root surface.18

The author and an impartial second observer observed the images.

**RESULTS**

**Statistical analysis**

The results were expressed as the number and percentage of dentine damage in each group.

The study had a total sample size of 180, which was divided into six groups, each having 30 samples. Each sample was investigated at three segments; namely 3mm, 6mm and 9mm from the apex. Table 1 shows the incidence, as percentages of each sample of 30, of damage/defect observed in each group.

The control group (n=30) had zero (0) events and the stainless steel group (n=30) also recorded zero (0) events. The BT-Race group (n=30) had 17 events out of the sample, giving a 56.67% incidence of dentine damage/defects. The iRaCe group and the ProTaper NEXT group both had 18 events out of the total sample, giving a 60% incidence of dentine damage/defects. The WaveOne group (n=30) had 17 events out of the total sample, giving a 56.67% incidence of dentine damage/defects. There were no statistically significant differences between the groups: WaveOne, ProTaper NEXT, iRaCe and BT-Race. However, there is a significant difference between the four groups and the stainless steel group (p<0.0001).

**Dentine damage**

**Figure 3: Dentine damage between all 6 groups**

**DISCUSSION**

The purpose of this in vitro study was to investigate the effect of nickel titanium rotary instrumentation on root dentine, by recording the appearance of dentine damage, whether it be a defect, microcrack, crack, craze line or fracture.

The dentine damage observed in this study may be caused by the interaction of four actions on root canal dentine; namely, the mechanical preparation and shaping of canals by the different NiTi rotary systems (each with their own specific features and differences), the chemical attack of the irrigants and chelating agents on the root dentine (5.25% sodium hypochlorite and 17% EDTA), the sectioning method of the root segments and the inherent anatomy of the extracted roots.

These aspects are discussed as follows:

In this study, dentine damage was observed in all the teeth which had received nickel titanium rotary instrumentation (Groups WaveOne™, ProTaper NEXT™, iRaCe™, BT-Race™) and not in the stainless steel and control groups, which was not instrumented. This would imply that the sectioning method did not induce dentine damage, so it may be concluded that the dentine damage was likely as a result of the different rotary preparation procedures alone.

The effectiveness of nickel titanium rotary instruments during debridement is influenced by the number of rotations of the instrument in the canal. More rotations are necessary to complete preparation with nickel titanium rotary files as compared with hand instruments.16 The greater the number of rotations in the canals, the greater the chance of dentinal defects.14,15 This may explain the lack of dentine damage seen in the stainless steel hand instrument sample group in the present study, which is in agreement with the findings of Bier et al.13 Shemesh et al.16 and Priya et al.17 Hand instrumentation is of a less aggressive nature as compared with
The nickel-titanium rotary instrumentation. The lack of dentine damage in the stainless steel hand file group could be attributed to both the lack of the continuous rotational motion as well as to the 0.02 taper of hand files, when compared with the taper of the NiTi rotary instruments used in the present study. This plausible explanation is in agreement with additional previous studies, which also reported no defects with hand instrumentation.9,19

As all NiTi rotary instrument groups in this study presented with dentine damage, rotational force during preparation conceivably contributed to dentine damage.

In the present study, both rotary and reciprocating motion nickel-titanium instruments resulted in significantly more dentine damage compared with hand instrumentation (p<0.0001). This result could be related to the contact areas between the rotary instrument and the root dentine. These contacts result in momentary stress concentrations which could cause dentine damage on the root dentine surface. Greater contact stress levels are present in the root canal during NiTi instrumentation, which is influenced by the mechanical behaviour of files. According to Ociek et al.23 and Priya et al.11, a greater volume of dentine is removed during canal preparation with nickel-titanium rotary instruments due to rotational forces, and this may have an effect on the incidence of dentine damage. The resulting thinner dentine may weaken the root structure, and there will subsequently be an increased risk of fracture of roots.18 The results of the present study maintained the conclusion as determined by Shemesh et al. that nickel-titanium rotary instrumentation damages the root dentine.19

The incidence of dentine damage could possibly be connected with nickel-titanium rotary preparation techniques (reciprocating motion, single instruments, multiple instruments and combination of different techniques).19 Reciprocating motion allows for a more centred preparation compared with rational motion.21 Berutti et al.22 reported that the reciprocating motion of WaveOne aids the stress-release as the file progresses down the canal. NiTi systems with both reciprocating and rotational motion were investigated in this study; both motions resulted in dentine damage, although no statistical significance was noted between the reciprocal and rotational systems when looking at the total number of roots with dentine damage.

With increased rotational speed, greater cutting efficiency is achieved. Studies by Capar et al.24 showed that increased revolutions per minute (rpm), 500rpm being compared with 250 rpm, increased the fracture rate. The study by Capar et al. concluded that with the increased speed (rpm). In the current study, no statistical difference was noted in the amount of associated dentine damage between the rotary instrumentation using higher rpm (BT-Race™ and iRaCe™ at 800 and 600 rpm respectively) compared with the lower rpm (both WaveOne™ and ProTaper NEXT™ at 300rpm).

The extent of dentine damage may be influenced by the tip design, cross-section geometry, constant or progressive taper type, constant or variable pitch, and flute form.25 The properties and behaviour of various Nickel-titanium instruments differ according to torsional and bending characteristics, cyclic fatigue and flexibility.18 As nickel-titanium rotary instruments have various design and functional features, different manufacturer’s systems may influence the effect that these features could have on dentine.24 Topçuoglu et al.25 stated that nickel titanium rotary files with greater tapers can thus cause increased friction and stresses within the canals, compared with hand instrumentation with a 0.02 taper.14 Consequently, the design and taper of the instruments and the motion of instrumentation were variables considered in the present study.

All four groups had dentine damage in the coronal area, and this observation is in agreement with previous studies by Priya et al.21 In the coronal area (9mm from apex), WaveOne use had produced a 16.67% incidence of dentine damage, the ProTaper NEXT group recorded 26.67% dentine damage and the iRaCe and BT-Race groups were associated with an incidence of 13.33% and 26.67% respectively.

The dentine damage seen in the samples treated with the ProTaper NEXT nickel-titanium system was 26.67% in the coronal third, 20% in the middle third and 13.33% in the apical third. This decrease from the coronal third to the apical third could be attributed to the variable taper of the instrument (X1 has 0.04 taper, X2 has 0.06 taper and X3 has 0.07 taper). The ProTaper NEXT files have an off-centered rectangular cross-section which promotes a swirling motion in the canal. It decreases taper lock and screw effect. At any given time only two points of the file’s cross-section will make contact with the root canal wall.11 This may be the reason for decreasing damage in root canal from the coronal third to the apical third.

In the BT-Race™ group, 6.67% of dentine damage was noted in the apical third which may be attributed to the BT2 instrument having no taper, while BT3 has a taper of 4%. ProTaper NEXT™ has a variable taper as noted above, iRaCe™ has a 4% taper and WaveOne™ has a taper of 8%. These variations in design may have contributed to the differences in dentine damage in the apical third between the different rotary systems.

Rotary instruments with large tapers may cause more complete and incomplete dentinal cracks.22 Decreasing the taper sequence of finishing files increases the strength of the files but also increases the stiffness at the tip of the instrument and the larger and more tapered instruments should be used with caution.26 The taper of rotary files could be a contributing factor in the generation of cracks due to increased stress concentration on root canal walls.4,27 Stainless steel files have 0.02 taper and no rotational force which could contribute to the lack of dentine damage in the stainless steel group compared with the effects seen in the NiTi rotary instrumentation groups.

The stiffness of a file is related to cross-section, size, taper, method of manufacture, and material of the instrument.28 The differences between the instruments tested regarding the incidence of dentinal damage may be due to the cross-sectional design of the instruments, which influences the behaviour of the files in the canal. ProTaper NEXT has a modified rectangular cross-section, WaveOne has a modified convex triangular cross-section and both BT-Race and iRaCe have triangular cross-sections.

Both ProTaper NEXT and WaveOne are manufactured with M-tube to increase strength and resist cyclic fatigue. Any difference in dentine damage between ProTaper NEXT and WaveOne with BT-Race and iRaCe at the different segmentation levels could be attributed to the flexibility of the M-tube when compared with nickel titanium.

WaveOne is a single file system and less time is required during preparation.29 The difference at segmentation levels could be attributed to a single file used for canal shaping compared with multiple files used for canal shaping in the ProTaper NEXT, BT-Race and iRaCe preparations.

BT-Race features a booster tip which is designed to allow files to follow curvatures in the root without undue stress on instruments and root canal walls, while keeping files centred in the root canal. This allows canals to be instrumented to the correct biological size. The booster tip may be a plausible factor to explain the difference in apical dentine damage compared with the other sample groups. iRaCe features a rounded safety tip which allows for canal centering and guidance in the root canal, which may contribute towards the explanation of differences between sample groups.

The ability of dentine to resist fracture is an important structural characteristic, forming a barrier preventing crack propagation from the enamel.30,31 Thus, any factors that could result in changes to dentine structure will potentially result in the incidence of dentinal damage. The use of root canal irrigants and chelating agents in combination with nickel-titanium rotary instrumentation has a potential effect on root dentine. In this study, sodium hypochlorite solution at a concentration of 5.25% and 17% EDTA (Glyde™) was used during root canal debridement and shaping. Studies have shown that sodium hypochlorite alters the mechanical properties.
and surface characteristics of root canal dentine during canal preparation. A higher concentration of sodium hypochlorite solution enhances efficacy but also significantly reduces the modulus of elasticity and flexural strength of root dentine.

The use of sodium hypochlorite as a root canal irrigant is the most common choice during root canal treatment, but the concentration varies according to the clinician’s preference. The concentration and contact time of sodium hypochlorite on dentine microhardness is a factor to consider when looking at the effect on dentine, especially in terms of dental damage. It is tempting in the clinical situation to use a higher concentration of sodium hypochlorite. schlussky-Goldberg et al. found a higher concentration of sodium hypochlorite (5.25% and 6%) and increased contact time resulted in a greater decrease in dentine microhardness compared with the effect of a lower concentration. At these higher concentrations a greater decrease of flexural strength has been observed.

Pop et al. used 1% sodium hypochlorite and this limited the effect on dentine, so damage could be avoided mostly to the mechanical shaping. It can be deduced that an increased concentration of sodium hypochlorite may have an effect on dentine structure and consequently induce dentine damage.

In this study sodium hypochlorite was used at 5, 25% and thus the modulus of elasticity, mineral composition, flexural strength and micro-hardness of dentine could have been influenced by the irrigating and the chelating agent, which possibly contributed to the dentine damage observed. Although many studies have been conducted to evaluate the dentine damage caused by various instruments, very few have studied the effect of different irrigation solutions on dentine damage. Further investigations are required to evaluate this possibility.

Once root canal debridement is started, a smear layer forms on the root canal wall and the removal of this smear layer contributes to the success of root canal treatment. An irrigation regimen of EDTA and sodium hypochlorite is recommended for complete removal of the smear layer so that both the organic and inorganic components are removed. EDTA is used as a chelator to remove the inorganic component of the smear layer, while sodium hypochlorite removes the organic component. The concentration of EDTA is preferred at 17%. Time of exposure with EDTA also has an effect on the dentine decalcification, so increased exposure will result in greater decalcification of dentine. As chelating agents alter the calcium to phosphorus ratio, there may be an effect on the dentine microstructure. Taneja et al. found that exposure of dentine to a combination of 5, 25% sodium hypochlorite and 17% EDTA caused a reduction in dentine microhardness. Bell et al. reported that 17% EDTA also resulted in increased stresses in root dentine which may contribute to the risk of fracture. The current study relied on the same combination and concentration of sodium hypochlorite and EDTA, and although dentine microhardness was not investigated, it is clear that the effect may have been associated with the use of EDTA.

CONCLUSION

Within the confines of the present study, the following can be concluded:

1. Even though this in vitro study did not reproduce the complete clinical scenario, it confirmed that all the NITI rotary instrumentation systems studied resulted in dentine damage to varying degrees.
2. Stainless steel instrumentation did not result in dentine damage.
3. Differences were found between NITI rotary systems with regard to the amount of dentine damage and in relation to the specific third of the root (apical, middle or coronal) affected.

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**SUMMARY**

Introduction: Dental age is an indicator of the physiological maturity of growing children. Different methods for estimating the dental age in contrast to the chronological age have been proposed.

**Aims and objectives**

The aim of this retrospective study was to compare the accuracy of the Phillips and the Proffit methods in estimating the dental age in a mixed sample of South African children.

**Methods**

A random selection was completed of 100 panoramic radiographs of patients with known chronological ages, ranging between 6 and 11 years. Dental age for each radiograph was estimated using both the Phillips and the Proffit methods.

**Results**

The Phillips method underestimated the age of combined sample by four months (statistically significant p = 0.03), whilst the age of the boys sample was underestimated by six months (statistically significant p < 0.0001). For the girls’ sample, the Proffit method underestimated the age by only two days (not statistically significant p = 0.97). Proffit’s method underestimated the age of the boys by two months (not statistically significant p = 0.15).

**Conclusion**

Even though it has not previously been validated, Proffit’s description of dental development has been shown to be accurate in estimating the dental age.

**INTRODUCTION AND LITERATURE REVIEW**

Dental age (DA) is defined as “the morphological state of an individual’s dentition without reference to their actual age.” When compared with somatic, skeletal and sexual ages, DA was found to be less variable in assessing the chronological age.

The most common DA estimation methods are the Moorrees, Fanning and Hunt method, the Demirjian, Goldstein and Tanner method and the Gustafson and Koch chart. These methods were based on specific populations i.e. the reference population which has its own ethnic complexity and background. Therefore, using these methods in other populations will always carry the risk of inaccuracy. To overcome this risk, population-specific tables were suggested to match the diversity of each population.

**ACRONYMS**

DA : Dental age

**KEYWORDS**

Dental age, Physiological age, Chronological age, Estimation, Comparison, Proffit, Phillips tables, Panoramic radiograph

Examples include the specific tables which were generated for each population in the following countries: Southern Finland, India, Korea, Saudi Arabia, Pakistan and South Africa. These specific tables were tested in their own reference populations and found to be more accurate than standard methods.

The Phillips tables are population-specific tables which were designed to match the diversity of the South African population. Phillips’ tables were published in 2008 and consist of three tables (Tygerberg, Indian and Nguni) derived from 1476 panoramic radiographs of South African children from different ethnic groups (White, Coloured, Indian and Black). These tables were tested in a sample of South African children and adolescents and were found to be the most accurate method for DA estimation if the ethnic origin is known.

Proffit’s DA description has been used in dental faculties throughout the world as a teaching tool to explain the concept of DA to dental students. It has been used extensively as a clinical tool in interceptive orthodontics and in paediatric dentistry. The description consists of eight stages from DA six to DA fifteen. The description uses tooth eruption but also evaluates tooth formation and mineralization on a radiograph in order to determine the DA.

The Proffit description for DA has been widely accepted in academia because it is simple and straightforward. It has however never been tested scientifically against any of the other DA estimation methods.

The South African population is ethnically diverse and includes a significant section of the population that is of mixed ethnic origin (Census, 2011). Previous work has taken ethnic issues into account and an influence has been demonstrated. The aim of this study was to compare the accuracies of the Phillips and Proffit methods of estimating the DA from panoramic radiographs in a random sample of South African children of all races. Any ethnic influence would therefore be equal for either method, and the comparisons would be valid. An objective of this study was to assess the accuracy of the Proffit method, which is widely taught, when applied to a multi-ethnic group of South African children.
MATERIALS AND METHOD

Permission to carry out the study was obtained from the Senate Research Ethics Committee of the University of the Western Cape.

A retrospective cross-sectional study was carried out. The study population was selected from amongst the available panoramic radiographs taken from the records database of the Department of Paediatric Dentistry (University of the Western Cape).

Inclusion criteria
- Good quality panoramic radiographs.
- Patients with a chronological age between 6 and 11 years.
- The date on which the panoramic radiographs were taken had to be recorded.
- There also needed to be information regarding the gender and the date of birth.

Exclusion criteria
- Radiographs of poor quality.
- Radiographs demonstrating gross pathology.
- Bilateral congenitally missing permanent teeth. If a tooth was only absent on one side, the contralateral tooth was assessed.

The sample finally comprised 100 panoramic radiographs which were sorted according to chronological age and sex by someone other than the author. The radiographs were then divided into five groups according to the age of the patient at the time of the radiograph being taken.

Privacy of the participant data found in the folders was respected and confidentiality was strictly maintained. Informed consent had been obtained during the initial clinical evaluation.

The panoramic radiographs were saved as JPEG image files and were viewed using the Photo gallery programme.

Data collection was done using two forms i.e. one for each DA estimation method. Each panoramic radiograph was assessed using both the Phillips and Proffit criteria as described in the literature.

The sample was examined by the author only who was blinded as to the chronological age and the gender of the child when estimating the DA.

The calculation of actual chronological age was done by subtracting the date of birth from the date on which the radiograph was taken. The calculation gave the age in fractions of years which was approximated to two decimal points.

The accuracy of the tested methods in this study was defined by how closely the estimated DA was to the chronological age. A positive number was considered to be an overestimation while a negative number was considered an underestimation.

| Table 1: Distribution of the sample according to chronological age (years) and gender |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Age group      | Girls           | Boys            | Total           |
|                | N   | Mean | SD  | N   | Mean | SD  | N   |
| (5.9 - 6.9)    | 9   | 6.427| 0.228| 9   | 6.553| 0.266| 18  |
| (6.9 - 7.9)    | 9   | 7.500| 0.282| 10  | 7.401| 0.273| 19  |
| (7.9 - 8.9)    | 11  | 8.295| 0.320| 10  | 8.401| 0.323| 21  |
| (8.9 - 9.9)    | 10  | 9.215| 0.267| 12  | 9.423| 0.348| 22  |
| (9.9 - 11)     | 11  | 10.465| 0.314| 9   | 10.380| 0.218| 20  |
| Total          | 50  | -    | -   | 50  | -    | -   | 100 |

N: number of cases
SD: standard deviation

RESULTS

Intra-observer reliability

Twenty percent of the sample was re-examined after two weeks. The mean differences between the data recorded for the initial and the repeated assessments for both the Phillips and Proffit methods were not statistically significant, p-values = 0.5575 and 0.6433 respectively. The results show that the readings for both methods are reliable and unbiased.

Figure 1: Frequency of random errors of Phillips’ method in girls

![Frequency of random errors of Phillips’ method in girls](image)

Figure 2: Frequency of random errors of Proffit’s method in girls

![Frequency of random errors of Proffit’s method in girls](image)

Phillips’ method

The present study shows that Phillips’ method predominantly underestimated the age in this sample of South African girls and boys by 4 and 6 months respectively (p-value = 0.03 and <0.0001 respectively). The overall bias was statistically significant. Furthermore, for girls sample the underestimation appears to be age dependent (Figure 5 shows linear regression line with intercept = 2.354, slope = -0.318 and p-value = 0.002 which is statistically significant). The bias is positive at the smaller age groups i.e. from 6 to 8.9 years and negative at the larger age groups i.e. from 9 to 11 years. So, the older the girl, the more likely the Phillips method is to underestimate the age. However, for the boys’ sample the underestimation is not age dependent linear
Figures 1 and 2 indicate that for girls the mean error according to Phillips is greater than the mean error according to Profitt.

**Phillips’s Method**

The results of age estimation in girls and boys show that Phillips’s method underestimates the DA of girls and boys by two days and two months respectively (p-value = 0.97 and 0.15 respectively). The underestimation is not statistically significant. Furthermore, unlike the Phillips method, there is no age dependent bias (p-values for the linear regressions are 0.11 and 0.78 respectively) which are not statistically significant.

Figures 3 and 4 indicate that the mean error for boys according to Phillips is smaller than that of Profitt’s mean error (p-value of 0.002).

**DISCUSSION**

The bias demonstrated in the current study of the Phillips method is contrary to the report by Hag-Mahmoud who investigated the accuracy of the method in a sample of Sudanese children. That author found that Phillips’ method overestimated the age of girls by two and half months and underestimated the age of boys by only one month (unpublished data). This overall bias was not statistically significant. However, the difference between the present study and Hag-Mahmoud’s study could be explained by differences in age groups, age distribution across the groups, ethnic origin and statistical analysis between the two studies.

The inaccuracy of Phillips’ method found in the current study was not an expected outcome as the method was derived originally from a sample of South Africa children. However, this could be due to several reasons. The Phillips’ method is a scoring system which depends on multiple readings of the developmental stages for eight permanent teeth. Although the intra-observer reliability score showed unbiased results, subjectivity of the readings cannot be completely excluded. Furthermore, distinguishing between the different developmental stages could be very challenging especially when the tooth presented as a borderline stage. It is difficult to judge whether a half or a third of the root has formed if you don’t know the final root length. The absence of the intermediate stage (i.e. one third of the root completed) may contribute to the biased estimation.

Phillips’ method also included the mandibular third molar which is known for its variability and unpredictability. According to Miles, DA estimation using the third molar can produce an error of two years. This may have affected the scoring system and led to bias in the overall results.

**Profitt’s method**

No age dependent bias was demonstrated for Profitt’s method, the p-values for the linear regressions being not statistically significant. This means that the method was unbiased when applied to the sample.

There are no other reports in the literature to allow for comparison with the present study. Profitt published his description of DA in 1986. It has however not been compared with the other DA estimation methods in the literature. Despite the value of Profitt’s description, it has not been considered as a bona fide DA estimation method.

**Random errors**

The accuracy of age estimation does not depend only on the overall bias of the estimating procedure. The random errors associated with the overall bias are extremely important. The frequency distribution of the random errors for Phillips and Profitt are represented in figures 1 to 4.

The histograms indicate that there is no significant difference in the mean errors for the girls’ sample. However, for the boys’ sample, the p-value is 0.002 which is statistically significant.

This means that Phillips’ method will have fewer random errors.
compared with Proffit when DA estimation is done on boys. The results of this study support the argument that population specific tables may not be very accurate within the reference population because of the intrinsic variation - which is difficult to explain.

CONCLUSION

It can be concluded that if one had to choose between the two DA estimation methods for girls, Proffit’s method would be more appropriate because it underestimates the age by only two days and has the same frequency of random errors as does Phillips’ method. However, if one had to choose between the two methods for boys, the situation should be evaluated carefully. For boys, the Phillips method has fewer random errors but a larger overall bias (six months) whereas Proffit’s method has more random errors but less overall bias (two months).

The choice between the two methods should therefore depend on the purpose of the estimation. If the method is used for estimating the age in a single individual with an unknown chronological age e.g. for forensic and immigration purposes, the method with less random error would be more preferable (i.e. Phillips). However, if the age estimation method is used for age estimation in populations with a known mean chronological age e.g. epidemiological studies, the method with less overall bias is preferred (i.e. Proffit).

The accuracy of the Proffit method used in a multi-ethnic group reflects the validity of this research. This technique of dental age prediction may be used with confidence as a reliable teaching tool.

Conflict of interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

References

Screening of digital panoramic radiographs for changes in bone mineral density with advancing patient age.

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ABSTRACT
Introduction
Osteoporosis affects millions of people worldwide. Chronic and complex, multifactorial aetiology and insidious progress, creating huge medical and economic burdens it may lead to innumerable sequelae. Increased life expectancies complicate the demographics.

Aims and objectives
To assess the efficacy of digital panoramic radiographs as a triage screening tool for osteoporotic changes, using the Image J software.

Design and methods
Evaluation of 150 digital panoramic radiographs of female patients referred for routine radiological imaging and stratified into three groups by age (A: 20–40 years; B: 41–60 years, and C: >61 years respectively). The panoramic mandibular index (PMI), mandibular cortical width (MCW) and pixel intensity (PI) were recorded for each image using the Image J software (1.48v) and assessed for correlation with increasing age and between the indices.

Results
Statistically significant associations were found between the indices and with patients’ age. Abnormal (divergent) readings increased with advancing age.

Conclusions
Routine digital panoramic radiographs can provide useful preliminary information with respect to the risk of a female developing osteoporosis. There is potential for triage screening and subsequent referral, at no additional costs. The patient’s age is an important risk indicator for osteoporosis.

INTRODUCTION AND LITERATURE REVIEW
Osteoporosis is defined as ‘A medical condition in which the bones become brittle and fragile from loss of tissue, typically as a result of hormonal changes, or deficiency of calcium or vitamin D’. It has also been operationally defined by the WHO on the basis of bone mineral density (BMD) assessment.

ACRONYMS
ABONE: age, body size no estrogen
BMD: bone mineral density
CAD systems: computer-assisted diagnostic techniques
COR’s: clinical decision rules
DPA: dual-energy photon absorptiometry
DXA: dual energy X-ray absorptiometry
MCW: mandibular cortical width
MCW/MI: mandibular cortical width, also known as the mental index
OSIRIS: The Osteoporosis Index of Risk
PI: pixel intensity
PMI: panoramic mandibular index, the ratio of MCW and the linear distance between the mental foramen and the lower mandibular cortical border
QCT: quantitative computed tomography
RA: radiographic absorptiometry
ROI: regions of interest
SPA: single-energy photon absorptiometry

KEYWORDS
Digital Panoramic radiographs, triage screening, osteoporosis, bone mineral density, radiographic indices.

Increased skeletal porosity has been associated with more than 8.9 million fractures annually worldwide. These are mostly low-level and non-traumatic varieties and commonly involve the hip, vertebral and the forearm bones. The fracture risk in women shows an exponential rise following the onset of menopause, whereas the prevalence in men has been observed to increase at a more advanced age group (generally >7th decade of life).

Several pitfalls have been identified in the diagnostic accuracy of osteoporosis. Presently the most widely accepted diagnostic criterion is a T-score value of 2.5 standard deviations (SD) or more below the average BMD value for a healthy, young female between the age of 25–45 years. A T-score value between -2.5 and -1.0 SD is designated as osteopenia. Several diagnostic tools have been developed based on the above criteria such as the single-energy photon absorptiometry (SPA), dual-energy photon absorptiometry (DPA), dual energy X-ray absorptiometry (DXA), radiographic absorptiometry (RA) and quantitative computed tomography (QCT). The DXA scan is the gold standard and is the most widely

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utilized diagnostic tool. It offers high precision, a lower radiation exposure, determination time and cost as compared with a conventional CT scan and MRI (UNESC 2000). However, DXA scanning incurs high capital costs, is non-portable and currently has limited availability at primary health care centres around the world.

The search for an effective, low-cost, easily available triage screening tool has led researchers to consider the potential of dental radiographs for assessing changes in bone density. The association between osteoporosis and dental bone loss was first proposed in 1980 by Groen et al., and corroborated by various studies showing BMD values in the mandible to be comparable with calculations from the lumbar spine, femoral neck and the forearm. In addition, the mandible presents several measurable structures on dental radiographs that could demonstrate reproducible BMD values. These include thinning of the lower cortical mandibular border, decrease in density and loss of connectivity of the mandibular cancellous bone component with advancing age. Panoramic imaging is preferred as it offers several advantages. These include a view of both dental arches and lower facial skeleton in a single image, low radiation exposure, patient comfort and accessibility. Furthermore, it is routinely employed in the initial assessment of all dental patients.

Radiographic indices for triage screening: Both the trabecular and the cortical component of the jaw bones are affected in generalised osteoporosis. Several studies since 1994 have been able to demonstrate a significant correlation between BMD and the mandibular cortical width (thickness and integrity). Various radiographic indices have been developed to quantitatively calculate this bone loss, in a reproducible and objective manner. These have been broadly classified into: Morphometric (linear measurements made on a Panoramic radiograph) and Densitometric (measurement of optical density followed by comparison with a standard). This formed the basis for our selection of two morphometric indices namely, MCW/MII (mandibular cortical width, also known as the mental index) and the PMI (ratio of MCW and the linear distance between the mental foramen and the lower mandibular cortical border) for this study.

The advent of digital radiography, with superior post-processing tools, has helped in further revolutionizing the ongoing search for a sensitive screening tool for quantitative and qualitative assessment of bone density and architecture. Indices such as Pixel Intensity and Fractal analysis are being investigated for early detection of such changes.

In the present study, the efficacy of digital panoramic radiographs in detecting changes in bone mineral density was evaluated by recording and comparing three radiographic bone density indices. These included: (a) Two morphometric/ linear measurements – PMI (panoramic mandibular index) and MCW (mandibular cortical width) and (b) Digital radiographic index for measuring densitometric changes in bone that is PI (pixel intensity).

PMI* refers to the ratio between the lower mandibular cortical width in the mental area and the linear distance between the lower mandibular margin and the mental foramen’s upper or lower margin. A value of ≤ 0.30 was regarded as an osteoporotic related diagnosis. Separate studies by Taguchi et al. in 2006 and Devlin and Homer in 2002 have found MCW (the lower mandibular cortical width) measurements of <3mm to be consistent with osteopenia. PI gives a measure of the radiographic density (the blackness or whiteness of a region on the radiograph on a grey scale from zero [totally black] to the highest value [totally white]). Pixels refer to the array of small square or rectangular areas making up a digital image and having an assigned numeric value that contributes to the pixel intensity of that image. The grey scale depends on the number of binary digits or bits – the smallest unit of data on a computer. A 12-bit monitor gives a grey scale range of 212, that is, 0 to 4096. It has been recognized as a simple and useful method to detect BMD alterations.

DESIGN AND METHODS

A cross-sectional, analytical, record based study was conducted. Evaluation of 150 panoramic radiographic images taken between 2010-2012 were accessed on the databases of the UWC Centre’s digital panoramic unit- the KODAK 8000 Digital Panoramic System with a 12-bit charge coupled device (CCD) optical fibre sensor and a dental imaging software 6.12.15.0.

The present study comprised female patients stratified by age: groups A (20-40 years), B (41-60 years), and C (≥61 years) respectively. These age groups were selected based on the fact that peak bone mass is attained by early adulthood and that the age-related bone loss in an individual begins around the third decade of life. A total of fifty patients were evaluated within each of the three groups selected through a simple random sampling technique. Patients with any cystic or neoplastic (radiopaque/radiolucent) lesions in the regions of interest, metabolic bone conditions or those on long term medication such as corticosteroids, diuretics or exogenous hormones, and images with unclear delineation of the upper and lower cortical margins of the mental foramen on both the right and left sides were excluded from this study. Other exclusion criteria also included female patients below 20 years of age. To ensure standardization, only radiographs using the exposure parameters of 70-75KVp voltage, 12mA current and an exposure time of 13.9 seconds were included in the study. All the images were viewed on the computer screen attached to the unit in a room with subdued lighting. Further analysis of each of the 12-bit grey-scale image (Pixel intensity and morphometric) was done using the Java based Image-J software. The PI of each image was recorded from two regions of interest (ROI), chosen to avoid any superimposed anatomic structures or regions of alveolar bone affected by periodontal conditions (fig.1). ROI-1 represented a 0,5x0,5cm²area mesial to the gonial angle and ROI-2 represented a 0,5x0,5cm²area in the mandibular canine-premolar area mesial to the mental foramen. A mean from the two readings was calculated. The magnification factor (1:2x) of the panoramic image was taken into consideration during all the above calculations.

Figure 1: Pixel intensity analysis: ROI-1: 0.5 cm² area mesial to the gonial angle. ROI-2: 0.5cm² area in the mandibular canine-premolar area, mesial to the mental foramen.

Figure 2: Morphometric indices : PMI = a/b, MCW = a.
RESULTS

280 images were screened, but 130 were excluded due to mandibular pathology, cone cuts, ghost figures or unclear foramen margins.

Of the sample 150 films, 25 showed abnormal PMI readings and 99 showed abnormal MCW readings. Comparison of the means of these indices within the age-groups was done using ANOVA (Figure 1). The mean PI as well as the two morphometric indices (PMI, MCW) showed a statistically significant difference in their means between the three age groups. PI values declined with increasing age (p = 0.000). The $\chi^2$ test was used to show association between age group and the bone density (Figure 2). Abnormal PMI values were directly proportional to advancing patient age and were statistically significant (p < 0.001). These values were 0%, 16%, 34% for groups A, B, and C respectively. MCW readings also showed a significant correlation with age (p < 0.001) and the number of abnormal readings increased from group A to C (Group A - 20%, B - 38%, C - 60%). Pearson correlation calculation between the individual indices was observed to be statistically significant between PI and both the linear indices PMI (p = 0.003, r = 0.240) and MCW (p = 0.000, r = 0.662) (Table 1).

Discussion

Several studies have established a statistically significant relationship between the morphometric indices (PMI, MCW) and BMD and the authors have recommended their usage as a screening tool.[12, 22] The investigators of this study found a mean PMI value of 0.35. These findings are similar to other studies that reported normal PMI values to range between 0.31-0.38.[13, 23] Dzwizdrowska et al.[24] in 2002 stated that the presence of marked differences in PMI values from the mean in a given population group may be used as an indicator of changes in bone density.

The mean Mandibular Cortical Width (MCW) value obtained in this study was 3.16mm with a statistically significant difference in the values observed between the three age-groups. Devin and Homer.[25] (2002) chose a cut-off value of 3mm in their study, while Klemetti et al.[26] in 1997 suggested 4mm as the average threshold value, values below which should prompt referral for a DXA evaluation.

Pixel Intensity analysis is an easily calculable and objective index. It is sensitive enough to pick up subtle changes in the trabecular bone. It is, however, a technique-sensitive index affected by changes in the voltage and current settings of the radiographic units as well as the software used for post-processing analysis. In recent years much research has been done to develop computer-assisted diagnostic techniques (CAD systems). This is to increase the diagnostic accuracy, reduce the inter-observer subjectivity and human error[26] and save the time consumed in manual calibration of linear measurements from dental radiographs. This prompted the use of the Java-based ImageJ software (1.48v) onto which each of the digital panoramic radiographs was uploaded for automated measurement of the linear indices (PMI, MCW) following the identification of the important landmarks (mental foramen, inner and outer margins of the mandibular cortex). It also provided a sensitive tool for pixel intensity calculation from the two regions of interest (ROI’s). A positive correlation between Pixel Intensity and the morphometric indices PMI (p = 0.003, r = 0.240) and MCW (p = 0.000, r = 0.662) as well as between the two linear indices (p = 0.000, r = 0.662) was evident. There was also a strong association between Pixel Intensity (PI) and the patient’s age. These two associations support the conclusion that Pixel Intensity has potential use as a screening tool for the identification of patients with undetected bone density alterations and must be investigated in a prospective study cohort to validate its value in detecting osteoporosis.

This study confirms that age is an important risk factor for bone density alterations. The number of abnormal readings in each of the indices was observed to rise exponentially with increasing age. This finding supports the work of other researchers[27, 28] and as such has also been used in various clinical decision rules (CDR’s) such as OSIRIS (The Osteoporosis Index of Risk), ABONE (age, body size, no estrogen) and others. The overall fracture risk has been seen to rise with advancing age.[29, 30] Wachtowiak Wende[31] in 1996 also observed changes in the mandibular alveolar crest height and an increased rate of tooth loss with osteoporosis but found no difference in the level of clinical attachment in their study sample and believed age of the patient as an important determinant.

Conclusions and recommendations

Within the limits of this study, assessment of routinely done digital Panoramic radiographs can provide useful information with respect to bone density alterations and thereby a patient’s risk for developing osteoporosis. It may help facilitate early detection of a mostly asymptomatic condition before an actual fragility fracture occurs as well as in early intervention which will be beneficial for the patient.

It is recommended that further research be initiated into the Pixel Intensity analysis. The presence of various superimposed/ ghost images (airway shadow, soft palate, tonsils, hyoid bone etc) on the Panoramic radiograph make absolute standardization of PI difficult. Muscular attachments and variability in the amount of loading in different areas of the mandible also affects the mineral
content of the area and hence in the selection of ROIs for the study. Von Wovern et al. in 1982, Von Wovern and Stoltze in 1979 and Tosoni et al. in 2006 each found the mandibular inferior cortical bone in the canine-premolar region to be the ideal site for radiographically detecting osteoporotic and osteopontic bone changes. It has also been observed that broadly the usefulness of PMI as a screening tool has been studied by comparison to the change in values obtained with other quantitative variables or DXA scan results and no actual normal range of values has been established. Similar findings have been drawn by other authors. Chan & L. in 2003 pointed out this important fact, further stating that obtaining a strong correlation (r) value between two quantitative variables does not automatically imply good agreement. He also found a considerable overlap amongst the different variables used. Hence, this study suggests that these patients, especially those in group B and C, with low PMI (<0.3), MOW (<3mm) and PI, have an increased likelihood of having osteoporosis and be referred for a DXA scan.

Age is a useful clinical risk parameter for osteoporosis and as such was found to be an important determinant for PI as well as the linear measures PMI and MOW. Formatting of a clinical protocol is recommended whereby patients above 40 years of age, especially women, are routinely screened for osteoporosis thereby lessening the burden this condition places on the world community. General dentists and periodontists can also easily incorporate this into their clinical practices and be on the alert whenever older female patients with existing periodontitis present. Another added advantage is that dentists can gauge the prognosis/risk of future periodontal breakdown and tooth loss in these patients.33

References
Bond strength of metal orthodontic brackets to all ceramic crowns.

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SUMMARY
Introduction
The demand for orthodontic treatment in adult patients has increased considerably, in many cases requiring orthodontists to place attachments onto ceramic restorations.

Aim
This study evaluated, in-vitro, the shear bond strength (SBS) of metal orthodontic brackets to all-ceramic crowns.

Method
40 IPS eMax crowns and 40 porcelain-veneered zirconia crowns were manufactured. Group 1: n=20 crowns and Group 2: n=20 crowns were thermocycled. Groups 3 and 4: n=40 crowns, were not exposed to thermal changes. The facial surfaces of all crowns (n=80) were etched by the application of 35 \% orthophosphoric acid liquid for 2 minutes, followed by the application of a thin layer of a ceramic primer. After bonding, all samples were stored in distilled water for 24 hours before debonding. Data were analysed using side by side Box-and-Whisker plots, the Kruskal-Wallis test (p < 0.05) and the Bonferroni Test.

Results
Group 3: mean SBS 5.1 MPa (45.5 Newtons) to 5.8 MPa (51.9 Newtons). Group 4: mean SBS 6.4 MPa (57.3 Newtons) to 8.1 MPa (72.7 Newtons). ARI values further highlighted the negative influence of thermocycling.

Conclusion
There was no significant difference in the shear bond strengths of RellyX Unicem 2 and Transbond XT bonded to all-ceramic crowns.

INTRODUCTION
There has been an increasing interest and demand for the use of all-ceramic materials to restore severely damaged teeth or to replace lost teeth, particularly in adult patients. In the anterior region, the most commonly fabricated silica based ceramic crown is the IPS eMax crown and the most commonly fabricated high strength ceramic crown is the feldspathic porcelain veneered zirconia based crown. Although the veneered porcelain reduces the flexural strength of the zirconia based ceramic, translucency is greatly improved making it more aesthetically pleasing in the anterior regions.

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ACRONYMS
ARI : Adhesive Remnant Index
HFA : Hydrofluoric acid
SBS : shear bond strength

The demand for orthodontic treatment in adult patients has increased considerably, together with an increase in patients’ knowledge and the changes in modern lifestyle. As a result, orthodontists are frequently required to attach orthodontic attachments or fixed retainers to teeth which may have been previously restored with ceramic restorations such as crowns or veneers.

Ceramic is an inert material and does not adhere chemically to any of the currently available bonding resins. Therefore, in orthodontics, ceramic surface preparation is an essential step prior to bonding. However, mechanical alteration (sandblasting and using diamond burs) to roughen the surface of porcelain can cause irreversible damage and compromise the integrity of the porcelain crown.\textsuperscript{2} Anecdotal evidence suggests that bonding orthodontic brackets with silane coupling agents and phosphoric acid or hydrofluoric acid creates a bond of sufficient strength for orthodontic treatment.\textsuperscript{3,4}

The overall time required to place an appliance is an important factor in the cost of the treatment.\textsuperscript{5} Newer, self-adhesive cements have the potential to further simplify the bonding process.\textsuperscript{7} Reducing the steps during the bonding process will also reduce the risks of saliva contamination and the effects of humidity, both of which could have an adverse effect on the bond strength of the resin cement.

On the one hand, optimum bond strength is required for minimizing bond failures during the treatment phase, and on the other hand, the porcelain on the restored tooth should ideally return to its initial state of appearance, without any damage to its surface after the brackets are removed.\textsuperscript{8}

Although there are innumerable protocols for bonding orthodontic brackets to porcelain, there is still no scientific consensus about which of the techniques would be the ideal standard protocol for the purpose of overcoming the two contrasting requirements mentioned above.\textsuperscript{9}

Hence, the purpose of the present study was to test and compare the shear bond strength and the resultant failure pattern of two types of resin adhesive cements (RellyX Unicem 2, a self-adhesive resin cement and Transbond XT, a two step bonding resin cement) to etched and silane treated all-ceramic crowns. Additionally, a further aim of this study was to examine an alternative to etching with hydrofluoric acid, which is noxious and harmful. Instead, etching with 35\% ortho-phosphoric acid and silane coupling application as pre-treatment preparation of the all ceramic crown surfaces before bonding was investigated. Furthermore, the study tested the effect of thermocycling, included
to simulate the oral environment on the shear bond strengths. Many studies have not considered this aspect.

**AIM**

This study was conducted in-vitro to evaluate the shear bond strength (SBS) and the resultant failure pattern after debonding, of metal orthodontic brackets bonded with Transbond™ XT and ReliXtM Unicem 2 self-adhesive resin cement to pre-treated (35% ortho-phosphoric acid and silane coupling agent application) IPS eMax and porcelain veneered zirconia crowns.

**MATERIALS AND METHODOLOGY**

A typodont maxillary lateral incisor was used and prepared in a conventional manner to receive a full ceramic crown. A CAD (computer aided design)/ CAM (computer aided manufacturing) machine was used to scan the prepared tooth and to manufacture 40 IPS eMax crowns. A skilled technician prepared an additional 40 porcelain veneered zirconia crowns. Half the number of IPS eMax crown specimens (n=20) and half the number of porcelain veneered zirconia crown specimens (n=20) were thermocycled (i.e., to mimic thermal changes which occur in the mouth), from 5°C to 35°C for 500 cycles as recommended by the International Organization for Standardization (ISO 6872, 2008) (Figure 1).

Figure 1: Thermocycling apparatus used.

The remaining 20 IPS eMax crown specimens and 20 porcelain veneered zirconia crown specimens remained pristine and unexposed to thermal changes. The facial surfaces of all the thermocycled and non-thermocycled crown specimens were then etched. Etching of all the ceramic bonding surfaces was performed by the application of 35 per cent ortho-phosphoric acid liquid for two minutes, followed by a thin layer of a ceramic primer. The crowns were separated into four groups. Groups 1 and 2 each comprising 10 thermocycled etched and silane treated IPS eMax and 10 thermocycled and etched and silane treated porcelain veneered zirconia crown specimens, Groups 3 and 4 comprising the non-thermocycled combinations. A lateral incisor metal bracket with a bracket base area of 9mm² (as confirmed by the manufacturer) was bonded to each of the etched and silane treated ceramic crown specimens, the cement and technique varying with each group as follows: Group 1: ReliXtM Unicem 2 self-adhesive resin cement. Group 2: Transbond™ XT light cure adhesive primer was first applied onto the bonding surface of the crowns and then Transbond™ XT adhesive resin was used. Group 3: ReliXtM Unicem 2 self-adhesive resin cement. Group 4: Transbond™ XT light cure adhesive primer was first applied onto the bonding surface of the crowns and then Transbond™ XT adhesive resin cement was used. (Figure 2).

Figure 2: Crown embedded and bonded with a metal bracket. Labelled according to particular groups.

After bonding all samples were stored in distilled water for 24 hours before being submitted to the shear bond strength test (Figure 3). Debonding forces in Newtons (N) were determined by using a shear testing machine and the values converted into Mega Pascals (MPa).

After debonding, the surfaces of crown and resin were examined to determine the mean Adhesive Remnant Index (ARI) values and the Porcelain Fracture Index.6

**RESULTS**

Table 1 shows the SBS values in Newtons (N) and Mega Pascals (MPa) of the different resin/crown combinations of Groups 3 and 4.

Figure 4 shows the side by side Box-and-Whisker plots of the shear bond strengths demonstrating wide and overlapping dispersions of the resin/crown combinations which consequently lessens the probability of significant differences occurring between the data of the resin/crown combinations in all four groups.
strength of 5.8 MPa (51.9 Newtons). The adhesive strength recorded on the thermocycled crowns was a significant 43.8% lower at a mean shear bond strength of 3.2 MPa (29.1 Newtons). Lastly, the RelX™ Unicem Z non-thermocycled IPS eMax crown combination yielded the fourth highest mean shear bond strength of 5.1 MPa (45.5 Newtons) but dropped to a mean shear bond strength of 4.9 MPa (44.5 Newtons) (a drop in shear bond strength of only 3%) when the crown had been thermocycled prior to bonding.

The non-thermocycled resin/crown combinations showed mean ARI values of between 1.3 and 2.1 indicating cohesive fractures within the composite resin and efficient bonding of the adhesive material to the porcelain surface. However, all the thermocycled resin/crown combinations showed mean ARI values of between 0 and 0.8, indicating a bond failure between adhesive and porcelain and highlighting the negative influence of thermocycling on the bond strength of both adhesive resin cements. No cohesive fractures of the porcelain crowns were noted.

**DISCUSSION**

Optimal bracket adhesion to the bonding surface of porcelain crowns is always of concern to orthodontists because the forces applied during treatment should not result in bond failure. Glazed porcelain is not an appropriate surface for resin penetration and orthodontic bonding.19 Recommended surface treatment methods can be time consuming or even harmful to soft tissues. Hydrofluoric acid (HFA) etching is an effective surface treatment for porcelain-composite bonding.11 However, the risk of soft tissue burns and the toxic effects of HFA requires extreme care during intraoral application, causing many orthodontists to be hesitant in its use.4,12 Etching of porcelain surfaces with phosphoric acid alone does not provide shear bond strength sufficient to resist the forces applied during orthodontic treatment.10 Anecdotal evidence suggests that brackets bonded with silane coupling agents and phosphoric acid or hydrofluoric acid will have adequate bond strength for orthodontic treatment.2,4 Phosphoric acid does not etch porcelain, and it does not produce physical or topographical changes in the porcelain surface. Instead, phosphoric acid has the effect of neutralising the alkalinity of the adsorbed water layer, which is present on all porcelain restorations in the oral cavity. This enhances the chemical activity of the silane coupling agents which are subsequently applied.14,15 Silane coupling agents have been reported to enhance bond strength to porcelain surfaces.13–15 The silane reacts with the silica within the porcelain and the organic groups of the bonding resin, thus forming a bridge between the two materials.15

There are a few scientifically-validated recommendations in the literature for minimum orthodontic bracket shear bond strength. A tensile force of 60kg/cm² to 80kg/cm² has been recommended, while Newman10 stated that 14kg/cm² was the maximum that should be applied by an orthodontic appliance. Whillock et al.,22 suggested that 6-8 MPa was adequate for orthodontic attachments and this was used as the reference value in the present study.

The Adhesive Remnant Index and the Porcelain Fracture Index were also examined to establish which regime produced adequate strength for orthodontic bracket attachment to all-ceramic crowns, with the least porcelain surface damage following bracket removal. As this appears to be the first shear bond strength study on IPS eMax and porcelain-veneered zirconia crowns conditioned with 35% phosphoric acid and a silane coupling agent, there are no published values with which to compare. Shear bond strength values were compared with results from bonding orthodontic brackets to ceramic crowns conditioned with Hydrofluoric acid (HFA) and a silane coupling agent. Jivanescu and Bratu23 compared the performance of RelX™ Unicem self-adhesive resin with that of a light cured bonding system on porcelain-fused to metal crowns which were conditioned with 10% HFA, a primer and an adhesive. No statistically significant differences were found. They concluded that both materials may be recommended for bonding orthodontic brackets to ceramic surfaces, in the
current study, the shear bond strength of the RelXTrim Unicem 2 dual-cured, self-adhesive resin/IPS eMax crown combination was 5.1 MPa and 5.8 MPa for the RelXTrim Unicem 2 dual-cured, self-adhesive resin/porcelain veneered zirconia crown combination. In Group 3 and Group 4, no statistically significant differences were found in the shear bond strengths of any of the combinations. This is in agreement with a study by Bilicic et al.11 who had treated the porcelain surfaces with 9.6% HFA and a silane primer. However, Turk et al.12 reported that lithium disilicate had a higher shear bond strength than FSB30 than feldspathic porcelain restorations. Moreover, Abu Alhajja and Al-Wahadani11 observed significant differences between feldspathic and lithium disilicate ceramic restorations (IPS Empress 2—an earlier version of IPS eMax crown, with higher mean shear bond strength [SB30] reported for the feldspathic porcelain group. This may also be due to the structural differences between IPS Empress 2 crown and the IPS eMax crown. A study which used a 9.6% HFA etch and silane primer found the IPS eMax crowns to have the greatest shear bond strength.12 The ceramo-metal and ceramo-zirconia crowns had comparable shear bond strengths. This may be due to the differences in the processing methods and the molecular structure of the all-ceramic restorations. In the current study, a statistically significant difference was found between the shear bond strengths recorded in the non-thermocycled and thermocycled groups. The adverse influence of thermocycling can be seen on the measured shear bond strength values.

CONCLUSION

Within the limitations of this study, it can be concluded that:

1. There was no significant difference in the shear bond strengths of metal orthodontic brackets bonded with RelXTrim Unicem 2 self-adhesive resin cement and metal orthodontic brackets bonded with TransbondTM XT adhesive resin cement to IPS eMax and porcelain-veneered zirconia crowns which were conditioned with 35% phosphoric acid and a silane coupling agent.

2. The conditioning of porcelain crowns with 35% phosphoric acid and a silane coupling agent (which is safer to use than Hydrofluoric acid) provides a substrate which enables the satisfactory bonding of metal orthodontic brackets to all ceramic crowns, and should make it simpler for clinicians to remove the remaining adhesive from the porcelain surface after debonding.

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An in-vitro comparative micro-computed tomographic evaluation of three obturation systems.

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ABSTRACT
Adaptation of obturation material to dentine walls is essential for the success of root canal treatment.

Aim
To evaluate and compare the adaptation of gutta-percha of three obturation systems, using micro-computed tomography.

Methods
The roots of 90 central incisors were shaped with ProTaper Universal (Dentsply) files, irrigated with 1ml 5.25% sodium hypochlorite and flushed with 5ml 17% EDTA. The roots were randomly divided into: Group 1: GuttaCore obturation, Group 2: ProTaper single-cone obturation, Group 3: Thermafil obturation. All canals were sealed with AH-Plus (Dentsply). A v(i)romeik 240D micro-CT scanner was used to scan each root at 15um resolution. The size of voids and gaps observed at 1mm, 3mm and 6mm axial sections from the apex were compared, as was the volume of cement around the gutta-percha.

Results
Group 2 (ProTaper) had statistically significantly greater incidence of voids and of surrounding cement than either Thermafil or GuttaCore carrier based systems (Kruskal-Wallis p<0.001).

Conclusion
Both carrier-based techniques allowed for better sealing ability in root canals compared with single-cone gutta-percha obturation although none of the materials were gap free, especially at 1mm from apex.

Clinical Significance
Both carrier-based techniques show good sealing ability and are appropriate for daily endodontic practice.

INTRODUCTION
Endodontic materials are developing at a rapid rate with each manufacturer claiming their products are superior. The ultimate aim of a root filling is to fill the entire prepared and cleaned root canal. The success of root canal obturation does not only depend on the root canal sealer, but also on proper compression of the gutta-percha against the walls of the root canal. A hermetic seal can be obtained by good root canal obturation and sealing of lateral and accessory canals as well. Therefore, close conformation of the root canal filling material to the dentinal walls is essential for the success of root canal therapy as this prevents the formation of gaps or voids between the root filling material and the root canal walls. This will ensure the sealing of all the lateral and accessory canals that are frequently found on the root canal walls. Furthermore, dissolution of root canal sealer at the apex of the tooth may be counteracted by properly filled and well compressed gutta-percha to prevent microbial infection due to leakages.

The formation of a gap between root canal walls and the root canal filling material may allow re-infection of the root canal system, leading to treatment failures. Efficient sealing of the canals is essential in the prevention of colonization by micro-organisms within the root canal system.

The techniques commonly employed for endodontic root canal obturation include cold lateral compaction, warm vertical compaction and core-carrier techniques. These core-carrier systems are claimed by the manufacturers to enhance intimate compression of the gutta-percha against the canal wall, and the flow of the filling material into the lateral canals. The original carrier was made of metal. Due to the difficulties encountered in retrieval and in the preparation of post spaces, the original metal carriers were subsequently replaced by plastic obturators.

Recently, a new core-carrier system, GuttaCore (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) was introduced in which the Vectra (a liquid crystal polymer) or polysulphone plastic carriers in Thermafil Plus (Dentsply Tulsa Dental Specialties), were replaced by cross-linked thermoset gutta-percha, which enables the carrier (obturor) to be removed more easily during retreatment. The GuttaCore does not melt when placed in an obturator oven but softens. The core-carrier obturation technique has been regarded by some as the only genuine warm gutta-percha technique for complete filling of the apical third of the canal space. However, the quality of root canal obturation achieved by the new core-carrier system that incorporates cross-linked thermoset gutta-percha carriers has not been reported.

Thus, the objective of the present in-vitro study was to use micro-
computed tomography (micro-CT) to examine the quality of obturation in single-rooted canals obturated with the GuttaCore core-carrier system and to compare the results between similar canals obturated with the ProTaper single-cone obturation technique and with another core-carrier technique, Thermafil. The null hypothesis stated that there are no differences in the percentage of interfacial voids amongst the three obturation techniques.

MATERIALS AND METHODS

A total of ninety extracted permanent human central incisor teeth were used in this study. Roots with a curvature of less than 10 degrees were selected. Previously root canal treated teeth, teeth with root caries or root fractures, teeth with immature apices or root resorption were excluded from the study. Those teeth with canal sizes larger than the size F3 file were also excluded from the study.

Tooth preparation

To standardize root canal dimensions, the teeth were decoronated with a Diamond Cut-off wheel (Stuers, Denmark) to achieve a length of 5mm. Access into the canal was created and a size 10 hand file (K-file; Dentsply, Tulsa Dental, Tulsa, USA) was used to establish patency. The working length was calculated and set at 1mm short of the apex. A glide path was established by initially filing with number 10 and number 15 files (K-file; Dentsply, Tulsa Dental, Tulsa, USA) for all the roots. The ProTaper (Dentsply Tulsa Dental, USA) files were used to clean and shape the root canal up to the master file. Rotary files (ProTaper Universal) were used with a hand-piece attached to a speed and torque controlled motor (X-Smart, Dentsply-Maillefer) set at 300 rpm. The sequence used was ProTaper S1, S2, F1, F2, and F3 as per manufacturer’s instructions. During preparation and between each file, 1ml of 5.25% sodium hypochlorite was used as an irrigant to debride the canal. After completion of instrumentation, all specimens were flushed with 5ml of 17% ethylene-diamine-tetra-acetic acid (EDTA) and a final drench with sodium hypochlorite to rinse off the EDTA from the root canal walls and remove the smear layer. All the canals were dried with paper points and were reactivated for obturation. The roots in all the three groups were treated by a single operator and all files were replaced after five uses.

Root canal obturation

The roots were randomly divided into three groups of thirty each and each group was obturated with a different obturation technique (n=30). The roots in Group 1 were obturated with GuttaCore, Group 2 with ProTaper single-cone and Group 3 with Thermafil. AH Plus root canal sealer (Dentsply Tulsa Dental, Tulsa, USA) was used for sealing all canals. All roots were stored at a temperature of 37°C and at 100% relative humidity in an incubator for a period of 24 hours to allow complete setting of root canal sealers.

Micro-CT Imaging

A high-resolution micro-CT scanner model A vijolex 2400D (General Electric, MA, USA) was used to scan the teeth. Each root was positioned on the specimen stage and scanned with a very high isotropic resolution of 15µm, rotational step of 0.6° and a rotational angle of 360°. With a fully automated CT scan reconstruction and analysis process (datavox 2.0 software) with high precision and reproducible 3D metrology, images obtained from the scan were reconstructed to show two-dimensional slices of the inner structure of the roots. Accelerated 3D CT reconstruction technique by velo! CT software was invoked for volume visualization in 3D rendered mode analysis, for measurements of the volume of the root canal filling material and calculation of the percentage of gaps and voids present in the material. Axial sections at 1mm, 3mm, and 6mm from apex were made and two different parameters were derived: the ratio between the total area of voids/gaps in square micrometers and the total canal area in the section were calculated. In 3D surface-rendered reconstructions, the ratio between the volume of voids/gaps in cubic micrometers, and the total canal volume were calculated.

Statistical Analysis

Since the datasets from the parameters were not normally distributed even after data transformation, each dataset was analysed using the non-parametric test: Kruskal-Wallis analysis of variance. Statistical significance was pre-set at alpha = 0.05 for all analyses to explore for any significant differences between GuttaCore, ProTaper and Thermafil. The following outcome measures were assessed:

1. Total volume of voids between gutta-percha and the root canal walls
2. Total volume of cement within the canal space
3. Percentage of volume of voids to the total volume of canal space on 3D surface rendered reconstructions within the entire root canal space following obturation
4. The presence or absence of voids/gaps between the gutta-percha/cement and dentine interface on axial sections at 1mm, 3mm, and 6mm from the apex coronally.

Figure 1: Graph comparing total volume of voids, volume of cement and % voids present for GuttaCore, ProTaper and Thermafil. Units in cubic micrometers.

Figure 2: Mean total volume of voids for each obturation system

Figure 3: Mean percentage volume of voids to the total volume of canal (cubic micrometers)
RESULTS
The mean volume of voids for ProTaper single cone obturation (Figure 1) was found to be greater than that of Thermafill and GuttaCore, the statistical significance of the differences being confirmed by a Kruskal-Wallis test, p-value <0.001. The mean and median of ProTaper were greater than those of Thermafill and GuttaCore, the differences again confirmed as statistically significant (p-value <0.001).

**Figure 4:** Axial slice of root filled with GuttaCore at: a. 1mm, b. 3mm and c. 6mm from the apex.

The mean and median of the ProTaper data were greater than those of Thermafill and GuttaCore (Figures 2 and 3); the statistical significance of the differences confirmed by a Kruskal-Wallis test. (Kruskal-Wallis chi-squared = 32.551, df = 2, p-value <0.001.)

**Figure 5:** Axial slice of root filled with ProTaper at: a. 1mm, b. 3mm and c. 6mm from the apex.

GuttaCore demonstrated good sealing of the root canal and there was also sealing of the lateral canals at 1mm from the apex (Figure 4). There was also little root canal sealer between the wall and GuttaCore at 1mm, 3mm and 6mm from the apex indicating good compression of GuttaCore against the inner walls of the root canal.

**Figure 6:** Axial slice of root filled with Thermafill at: a. 1mm, b. 3mm and c. 6mm from the apex.

Voids (translucent areas seen in micro-CT images) were present in ProTaper single cone obturation at 1mm, 3mm and 6mm from the apex of the tooth (Figure 5). There was also a higher volume of cement in all the three sections of the slices (white areas in micro-CT images). The large cement volume and the abundance of voids with ProTaper single cone obturation demonstrated poor sealing of the root canal.

Thermafill achieved good sealing of the void root canals (Figure 6). There was also little root canal sealer on the section of Thermafill at 1mm, 3mm and 6mm from the apex indicating good compression of Thermafill against the inner walls of the root canal.

Thermafill not only showed good adaptability to the walls of the canal but was able to fill the lateral walls (Figures 7a and 7b).

DISCUSSION
The quality of obturation can be assessed through laboratory studies. Several in vitro techniques were developed to determine the sealing ability of root fillings: dye penetration, fluid transport, and scanning electron microscopy analyses. All have limitations of measuring voids by analysis of sectioned roots. In the past various types of dyes like eosin, methylene blue; black Indian ink and Procion brilliant blue were used to evaluate adaptation and micro-leakage of the gutta-percha. Microscopy can be used at various magnifications to determine adaptation of gutta-percha to the walls of the root canal. It is one of the oldest methods used to evaluate gutta-percha leakage and adaptation but sample preparations are technique sensitive and may be damaged during the process.

Micro-computed tomography (micro-CT) has been described as a new and promising tool in endodontics to assess the geometry of the root canal. High resolution micro-CT is an emerging technology with several promising applications in different fields of dentistry. It is highly accurate and non-destructive method for in-vitro evaluation of root canal fillings. However, micro-CT sections lack the resolution when compared with scanning electron microscopy (SEM), for the study of inter-facial gaps and intra-canal voids. SEM however, is a more destructive method of investigation and is labour intensive.

Micro-CT provides a three dimensional view of the root canal system by providing an undistorted image of the tooth. It has the highest resolution at a very low exposure compared to a conventional CT scan. The micro-CT can be a useful tool to check for gap formation between the root canal filling and the dentine walls because it is less complicated technique compared to conventional methods, specimens are not damaged and images can be viewed in three dimensions. Micro-CT imaging tool overcomes the limitations of the previously used model like dye penetration, fluid transport, and cross-sectional analysis, which are valuable techniques, but the results do not always correlate with each other. Therefore in this study, micro-CT was used as an imaging tool of choice based on its advantages that are demonstrated by the literature. In clinical situations, radiographs are frequently used to analyse root canal treatment. Intra-oral radiographs are widely used to evaluate adaptation of obturation materials but have the disadvantage of showing a two dimensional view of the image.

Under the conditions of the present study, all three obturation systems exhibited void formation when observed using the micro-CT scanned images set at 15µm resolution. As there were significant differences in the percentages of void formation between the systems tested when obturated with the GuttaCore carrier technique, ProTaper single-cone technique and Thermafill carrier technique, the null hypothesis had to be rejected.

Thermafill produced superior obturation when compared with ProTaper single-cone gutta-percha and GuttaCore, and one demonstrated the best compression when compared with GuttaCore and ProTaper gutta-percha. When the volumes of voids were evaluated, Thermafill data were significantly lower than GuttaCore and ProTaper (Kruskal-Wallis analysis of variance p<0.001). This indicated good material adaptation for specimens obturated with Thermafill. When the percentages of the volumes of voids to the canal volumes were compared, ProTaper gutta-percha recorded a higher percentage when compared with Thermafill and GuttaCore (p<0.001). The review of the literature has
shown superior obturation with thermal obturation compared with lateral condensation both in the presence or absence of smear layer. The current study was conducted in the absence of smear layer, removed from all the root canal walls using EDTA.

Apical leakage is one of the more common complications encountered in endodontic failures. A1 Plus root canal sealer was used to apically seal off all the roots in the three groups. It is classified as a resin bonded sealer and uses methanamine for polymerization. The presence of large amount of root canal sealer usually leads to root canal failure due to the dissolution of the root canal sealer by cellular fluids. The sealer coverage is influenced by the closeness of the adaptation of the gutta-percha to the walls of the root canal. A2

In the current study the quantity of sealer coverage was found to be reduced apically with Thermafil and GuttaCore obturations, indicating a good fit of the two carrier systems to the walls of the root canal. There was more sealer material apically with ProTaper single-cone gutta-percha, and indeed a significantly higher volume of cement in teeth obturated with this material. (Kruskal-Wallis, p<0.001) indicating poor sealing of the root canal. This may also account for the presence of a greater number and volume of voids found with single-cone ProTaper obturation. When there is poor adaptation of the gutta-percha to the root canal walls, the resulting gap is usually occupied by a large amount of root canal sealer. This study assessed the critical area of the root canal, the apical third. Proper obturation of this area is crucial as most canal aberrations like apical deltas and lateral canals are located there, making proper obturation difficult.

Thermafil produced the best adaptation, followed by GuttaCore and then ProTaper gutta-percha as indicated by the reduced amount of cement around the gutta-percha in all three axial sections namely at 1mm, 3mm and 6mm. Carrier-based root fillings, in particular, have a mean sealer thickness of 2μm, considerably less than the 7μm resolution capability of the micro-CT scanner. This may explain why in the majority of Thermafil obturators, fillings sealer was indistinguishable from gutta-percha.

GuttaCore was introduced into the market as cross-linked gutta-percha which has the advantage of easier removal in the root canals for post placement and during retreatment. Since GuttaCore is a fairly new product in the market, only a few studies have evaluated its adaptation to the root canal wall and its ability to seal all canal aberrations. GuttaCore produced superior obturation when compared with ProTaper single-cone gutta-percha but its performance was not superior to Thermafil obturations. Although the mean volume of cement for GuttaCore and Thermafil showed better results, canals obturated with GuttaCore exhibited more voids when compared with those filled with Thermafil. The disadvantage of presently available carrier-based obturation systems is that the volume of gutta-percha is not consistently distributed around the carrier. This might allow shedding of the gutta-percha from the carrier material when the obturator is inserted into the root canal space, possibly leading to voids. Frictional forces may generate an extrusion effect, whereby the filling material is retained at the orifice of the canal. This might possibly account for the presence of voids in GuttaCore obturation when compared with Thermafil obturation, but more studies are needed to verify this.

According to the literature, gutta-percha for dental use exists mostly in β-phase crystalline form even though some companies claim to manufacture α-phase gutta-percha. When gutta-percha is heated, between the temperatures of 42°C and 49°C, the crystalline β-phase gutta-percha is converted to the crystalline α-phase gutta-percha. Both Thermafil and GuttaCore materials are covered with alpha-phase gutta-percha. This α-phase gutta-percha becomes “gluey”, adhesive and highly flowable when heated (low viscosity) accounting for its enhanced adaptation to the root canal walls compared with beta-phase gutta-percha which has a higher viscosity. This lack of flow ability may account for the poor adaptability of single cone cold condensation technique as seen in this study. The alpha-phase gutta-percha present in both Thermafil and GuttaCore when heated increases its viscosity and thus its plasticity thereby allowing for better compaction against the canals walls.

The results of this study show a high variation in the data especially for the cold condensation ProTaper single-cone obturation technique. This is an indirect indicator of the unpredictability of commonly used obturation techniques in perfectly adapting to the canal walls and root filling materials. A similar conclusion was reached in a stereomicroscopy study undertaken to examine voids present in central incisors that were obturated with cold lateral compaction. The warm obturation system produced better results in the sealing of lateral and accessory canals in this and in previous studies. The literature has also demonstrated that Thermafil produced good adaptation to the walls of the canals when compared with lateral compaction and single-cone obturation.

CONCLUSION

Within the limitations of the present study, both carrier based techniques showed good sealing ability in root canals compared with the single cold gutta percha obturation technique although none of the materials was gap-free especially at 1mm from apex. This study shows the efficiency of carrier-based obturation systems in filling root canals hermetically compared with the cold condensation technique of ProTaper obturation. Thermafil produced good adaptation to canal walls with least amount of voids/gap formation, followed by GuttaCore and the ProTaper cold gutta-percha condensation.

Clinical Significance

This study showed the efficiency of carrier-based obturation systems in filling root canals hermetically when compared with the traditional standard cold gutta-percha obturation technique with lateral condensation. The results show good sealing ability of both carrier-based techniques making them appropriate for use in daily endodontic practice.

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Parents’ perception of psychosocial factors, health-compromising behaviours and oral health among adolescents in South Africa.

Okagbare TE,1 Naidoo S.1

SUMMARY
Introducing, the knowledge of parents regarding five health-compromising behaviours: alcohol consumption, smoking, inadequate consumption of fruit and vegetables, inappropriate consumption of refined sugars and inadequate/inrequent tooth-brushing. Their understanding of how the psychosocial factors of educational aspirations, religiosity, self-esteem and sense of coherence (propensity to cope with stress) influence these behaviours were assessed.

Design
The study design was qualitative and exploratory and the research strategy was inductive, deductive and abductive.

Methods
A non-probability purposive theoretical sampling method was employed and data were collected from five focus group interviews. Data were analysed using the grounded theory approach.

Results
The emergent substantive theory was “Mitigating adolescents’ unhealthy behaviours: Tame the taste buds and train the child positively from infancy through preadolescence”.

Conclusions
Grounded theory brought to the fore the need for parents to make conscious efforts to properly train their children from infancy through preadolescence with positive adolescent health-outcome expectancy.

INTRODUCTION
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KEY WORDS
Qualitative research, Adolescents, Psychosocial factors, Health-compromising behaviours, Parents’ perceptions, Oral health, South Africa.

There are few published studies on the psychosocial factors associated with health-compromising behaviours among adolescents in the African region. Some studies focused on a single behaviour,1 others on multiple health-related behaviours, but none have addressed the perceptions of parents regarding unhealthy behaviours. There is also little research on the religious coping mechanisms that are used by adolescents and whether race has any influence in shaping coping mechanisms. Furthermore, in recent public health approaches, health promotion research has moved away from studies on the association between diseases and their risk factors to the association between the psychosocial determinants (the root causes of the causes) of diseases and their risk factors.2

Much research has been conducted on the roles of peer pressure, socioeconomic factors3 and demographic characteristics associated with unhealthy behaviours.4 However, research has found that socioeconomic factors (education and household income) and peer pressure alone do not fully explain health-related behaviours and the inequalities in oral/general health in most adolescent populations.3

In addition, studies on marital status have identified that being a single parent and/or divorced has substantial negative effects on the well-being of adolescents.5,6 This is so in South Africa, where women head nearly half of all the households.7 Moreover, adolescents from intact families whose parents lack the appropriate skills in parenting also engage in health-compromising behaviours. Marital status as well as socio-economic status or positioning should therefore not be a hindrance or a yardstick in the nurturing of adolescents in health-enhancing behaviours. Every parent/caregiver should be empowered with the necessary skills and strategies that are effective in their circumstances to create an enabling environment for their adolescent children to develop healthy behaviours. Furthermore, apart from the associated poor oral health, adolescent unhealthy behaviours may have serious general health implications such as future obesity, diabetes and cardiovascular disease.8

The role of an adolescent’s self-esteem, self-efficacy,9 religiosity, sense of coherence (SOC) and mastery over relative economic and social positioning among others are important in resisting negative peer pressure10 and may provide further explanations for observed oral/general health inequalities and health-related behaviours.
The aforementioned factors appear to be linked to parental perception of these factors as they relate to their adolescents’ oral health. It is imperative therefore, for the present study to explore the perceptions of parents of the psychosocial factors that are associated with these health-compromising behaviours.

**METHODS**

**Study design and sampling procedure**

The design for this study was qualitative and exploratory and the research strategy was inductive, deductive and abductive. A non-probability purposive theoretical sampling method was used.

**Profile of the study participants**

The sample size of 37 was determined by theoretical saturation. The group of 37 included 22 fathers, one grandfather, 10 mothers and 3 grandmothers. Thirteen had tertiary education, 14 some high school education and 10 less than high school education. The recruitment yielded 25 Blacks, seven Coloured, three Indians and two Whites. Thirty church attendees and seven Muslims were among the participants.

The participants were aged between 28 and 75 years. Each of the five focus groups (minimum of six participants per group) was homogeneous in the sense of shared living experience but diverse in terms of professions. Although no attempt was made to achieve a racially representative sample, the study endeavoured to accommodate participation from both the semi-rural (Katlehong in East Rand/Ekurhuleni Municipality and Soweto in Johannesberg Municipality) and urban/metropolitan settings (Alberton in East Rand/Ekurhuleni Municipality, Hillbrow in Johannesburg Municipality and Gezina in Tshwane Municipality) in order to ensure that the data were not skewed. It was also for this reason that members of the four racial groupings in South Africa (Black, Coloured, Asian/Indian and White) were recruited and the views of the two largest global religious movements (Christianity and Islam) obtained. This was therefore, a double-layer design, which included geographic areas as the first layer and different audiences as the second layer.

**Data collection**

The interviews of the five focus group participants who met the criterion for the study, which was being a past/current parent or caregiver to an adolescent, were conducted between the months of March and November 2015. After informed consent was obtained, each participant was requested to complete a short questionnaire on demographic characteristics. A semi-structured guiding questions schedule, which was developed to ensure consistency in data collection, was used, while allowing for the sessions to be flexible in order to optimize the natural flow of conversation in the groups. The interview guide included a series of open-ended questions to reduce the chance of priming and bias, allowing the participants to express themselves without reservation. The questions were designed to elicit discussion among participants regarding the psychosocial factors they perceived to be associated with the health-compromising behaviours of alcohol consumption, tobacco use, inadequate consumption of fruit and non-starchy vegetables, inappropriate consumption of refined sugars and inadequate/infrequent tooth-brushing related to oral health among adolescents in South Africa. The language of a layperson was used to reduce any likelihood of inhibition. The participants were exhorted to take turns to respond to questions to ensure that each participant had an equal opportunity to contribute. The venue of each focus group interview was accessible and acceptable to all the participants. The average length of the five focus group interviews was 1 hour 45 minutes due to the nature of the topics and participants.

**Data analysis**

The data analysis of this study used the grounded theory methodology. It involved the analysis of the transcripts using the Open (Substantive) and Axial Simultaneous Coding method (First and Second Cycle coding processes) and was employed from the pure coding to integrated data analysis. This was then followed by Selective and Theoretical coding (putting the concepts into a theoretical framework) in order to suggest a substantive grounded theory. An independent coder, a specialist of Community Dentistry was also engaged to reduce bias.

**Ethical considerations**

This study protocol was subject to review and approval by the Senate Research Ethics Committee of the University of the Western Cape, South Africa (Ref No. 11/1/55). Pseudonyms were used to protect the identities of participants who were given information about the study and shown the ethical approval for the study. They then read and signed the informed consent forms after the purpose of the study had been explained clearly by the researchers and understood by the participants. Permission was obtained at the commencement of every interview from each participant for the use of an audio recorder. They were also informed that their participation in the interview was entirely voluntary, that anyone may refuse to answer any question and that anyone may withdraw from the interview at any time without question or consequences.

**RESULTS**

The results of the data analysis, derived using the grounded theory methodology, were articulated in two inter-related substantive categories that in turn explained the core category and core concerns of the participants which were given expression in terms of the following two metaphoric concepts:

1. **Engendering the development of healthy behaviours from infancy**
2. **Providing enabling environments and reinforcement for the retention of healthy behaviours from early childhood through preadolescence**

The following excerpts from the contributions of the study participants illustrate these two metaphoric concepts:

"Nobody takes the child and shows them how to brush in circles, how to brush at the back. They watch somebody doing it and they think okay, oh that's what you do."  

"The best thing is if they are trained from small. If they don’t know what sugar taste like, they won’t miss it. And if the child is trained to eat healthy things it is not bad or is not non tasty because that’s all the child knows. But once you expose the child to the other side then you will see, quickly, the veggies will go away (laughed)."

"Ok, I think that obviously if a child that has been taught to look after themselves, then they will eat healthy and have all those good habits and a greater self-esteem...will practice good behaviours."

"Charity begins at home. The way you train your child is the way you will find him outside."

"So something must be done early because I think in my culture we must just tame it when it is still young."

The participants unanimously acknowledged that parents’ realization and ability to tame the taste buds of their growing infants, train and nurture their mindsets (indoctrination) through early childhood and preadolescence were crucial in the development and retention of health-enhancing behaviours into adolescence, especially with the provision of an enabling environment and the required support structures at home.

Two substantive categories were identified:  

1. Adolescent identity crisis as illustrated by the following excerpts from the participants:  
   "Yes, adolescence, I will say is the...the wild years of...any human being."
   "You are still a child, but you want to be like an adult hence, you end up making wrong decisions and being disrespectful and all that."

2. Another category was that of the parents who were mentally and emotionally drained from trying to cope with their adolescents' health and personal development, as illustrated by the following excerpts from the participants:  
   "You talk to them and try and reason and then you'll find they are at the back...and don’t want to listen...sometimes I find it difficult to nudge them into doing what they should."
   "When they are doing something we don’t want them to be doing, what do you say? We cannot always watch them and be there for them."

3. The third category highlighted the perceived lack of support and resources from community health practitioners, as illustrated by the following excerpts from the participants:  
   "We don’t have enough clinics or have enough people who can be there to help them."
   "They are not equipped...they are not ready to assess and respond to the issues of our children..."
“Oftentimes it is peer pressure actually, for them to get involve in unhealthy behaviours, whatever, that might mean to them, be it smoking, be it taking drugs, be it drinking, partying, usually it is peer pressure. Because their friends are doing it, they also want to do it.”

“I think you know, most kids they like to experiment. You know they see somebody doing this and they say ok let me try it.”

“Adolescents are very rebellious and...they don't care about anyone, anything. They just want what they want...”

The consensus of the participants was that adolescence could be described as the 'wild years' when a child thinks he or she is an adult and engages in a lot of experimenting, succumbs easily to peer pressure, tends to be rebellious, loves outrageously authority and lies to get permission or approval for the 'bad' things he or she does.

ii. Adolescents’ unhealthy behaviours and potential modifiers are illustrated by the following:

“Yes, it would be kind of imitation because they want to imitate you smoking...they start smoking, then it became a habit...cannot pull yourself out of it.”

“Adolescents prefer doing a lot sugary stuff, they love to eat sweets and ice creams...and other sweet things.”

“These days kids don’t like vegetables – they don’t like it. They hate it.”

“I think they don’t worry about brushing...adolescents, they don’t brush properly because of laziness...”

As illustrated in the excerpts above, the study participants identified alcohol consumption, tobacco use, excessive consumption of refined sugars, inadequate consumption of fruit and vegetables and inadequate oral care as their major concerns with regard to adolescent unhealthy behaviours that affected oral health.

“The children that are academically ambitious are focused and aware of the dangers, so they don’t allow themselves to be sucked in to these dangerous things. They focus on studies and career.... Other kids are living for today, day by day.”

“Religion, it depends on what religion you are involved in because there are many religions and some might even promote smoking. So to say that religion can be a good influence, it depends on what religion it is.”

“The only thing I want to say is that self-esteem enables an adolescent to have the ability to do what he feels is right and not what he feels is wrong and be able to overcome his inclinations and basically goes from reaction, do thing rationally instead of emotionally.”

“If the adolescent cannot cope with the stress may be the unhealthy behaviours will be used as a bulwark against the stress.”

The study participants indicated that academic ambition, self-esteem and propensity to cope with stress protect adolescents against unhealthy and risky behaviours while the influence of religion was debatable. Other potential modifiers identified are illustrated in the excerpts below:

“Different race groups eat different things...we are all from the same country, we are born here but everybody eat differently... because of the culture and the race you come from.”

“Look, if the parents are not the examples, kids learn by what they see more than what you tell them. You tell them don’t drink and don’t smoke but you drinking and smoking. Let me tell you, they are going to follow what they see and not what they hear.”

“Somebody with a proper upbringing has got a good support around him or her. So by the time you reach your adolescent age you would have formed certain behavioural patterns that will help you recognize unhealthy behaviours.”

“You, see we can try to teach healthy things at home...but outside, when they at school they are eating chocolates, eating snacks...”

“I think the young ones, they get bad habits because it is advertised everywhere. You see it in billboards...so they think is a good because it is being advertised everywhere.”

“Unhealthy stuff is freely available number one...so they don’t even need to be influenced. ...Open the fridge and you find carbonated sugar drinks... open the cupboard there are sweets and biscuits. So as parents we promote it by buying these things and make it available. There are no restrictions on unhealthy foods, you can buy what you want and nobody will stop you.”

“I think we must look at affordability...it may be is all about priorities. Some people rather buy clothes and other things than fruit...they say it is expensive. But if you compare fruit and a pair of shoes, they will rather buy a pair shoes.”

“Adolescents want to sleep a lot. I know. I’ve got two daughters... everything is last minute-run to the bathroom, jump in the shower, use the toilet...everybody has a hectic lifestyle. They don’t take time enough to brush their teeth and also to brush correctly.”

“Nobody takes the child and shows them how to do brush in circles, how to brush at the back. They watch somebody doing it and they think ok, oh that’s what you do.”

Adolescents’ race/culture, parents as role models/their unhealthy behaviours, adolescent upbringing/home environment, neighbourhood/society and schools, advertisements, marketing, negative mass and social media, availability and affordability of unhealthy products were all cited as contributing factors to adolescents’ unhealthy behaviours as indicated above.

Mitigating adolescent unhealthy behaviours

“Parents need to know first. Not every parent knows what is good, what is bad and what is right. A lot of parents teach children exactly what they know and a lot of time what they know is not the right thing. It all comes down to giving the right advice.”

“And when they need help they should ask, even if we need to seek professional help, we must provide as much help as we can afford as a family. We will stand by them and then not judge...give them the opportunity to be able to overcome any issues.”

“Quality time and yes, parent should spend quality time with their kids... that is very important.”

“When you are a parent you need to let your kids be free with you. They must tell you everything, their problems...it is helpful for them.”

“I think that it is important that we have a relationship that is open, that is not too authoritarian because it gives opportunity for children to open up to you and to let you know the troubles and problems that they might be having.”

“I think you need all the help that you can get ...it takes a village, the schools, a community to raise a child.”

Parental control, permissiveness and over-indulgence of adolescents were cited by participants as contributing factors to adolescents’ unhealthy behaviours. Parents were expected to be knowledgeable about unhealthy behaviours and to provide the right parent-child relationship and an enabling environment for both development and retention of health-enhancing behaviours. Relationships should not be too authoritarian but close and good enough for the adolescents to trust their parents, be open to them and to listen and be receptive when their parents try to educate them instead of going to outsiders. A parent could not do this alone
- they need one another, professionals and other institutions such as the schools, governmental and non-governmental organisations.

Challenges faced by parents of adolescents
“With me raising my children by myself... they don’t listen. They know everything.”

“Once they leave your house, you basically have got no control. The decisions they make should be based on how they were trained at home but you’ve got no control...”

“The media is a big problem, social media.”

“There are many challenges, the biggest challenge is that, we don’t know what they want or we don’t understand them anymore.”

“They are exposed to too much, even the ones that have been brought up well ... still get tempted because there are so many unhealthy behaviours ... They are easily influenced, so the challenges are unbelievable.”

The participants stated the challenges they faced were many and daunting. These included peer pressure, the negative influence of mass and social media, the child rights law of the South African government and adolescents who did not listen to adults. Parents did not understand their adolescents, did not know what they wanted, they grew up too fast and they had their preferences which often clashed with what their parents thought was right for them. Once they left the home, parents could not protect them from bad influences. The emergent substantive theory generated from the data of this study was “Mitigating adolescents’ unhealthy behaviours: Tame the taste buds and train the child positively from infancy through preadolescence”.

DISCUSSION
Consistent with the observations generally reported in adolescent literature, the parents in this study regarded the adolescent period as the ‘wild years’ when children think they are sufficiently mature to make informed decisions regarding their future, often undermining parental roles and frequently making wrong decisions. The parents indicated that adolescents see themselves as adults and as a result are disrespectful. They emulate things that adults do but are still children. The participants also expressed the opinion that adolescents succumb easily to peer pressure because they prefer to be socially acceptable among friends and peers; they also like experimenting and have the tendency to imitate unhealthy behaviours they consider “cool”. The consensus of the parents was that adolescents are impatient, rebellious, selfish and stubborn. They indicated that it is in the character of adolescents to be mischievous or naughty, to try to outdo their parents and that they may be to get permission or approval for forbidden activities. An experimental study conducted in 2008 considered how peer pressure had a dominant influence on the adoption of potentially harmful habits by impressionable adolescents, youths and young adults. The group of 316 individuals revealed that with advancing age the tendency to take risks diminished, that the group tended to focus on the benefits rather than the risks and that amongst adolescents the effects of peer pressure were greatest.

The parents expressed concern and displeasure over adolescents using money to buy alcohol as a means of escaping from the realities of life instead of buying healthy foods. This concern among parents in Gauteng Province is a reflection of the reality of their daily lives. The Second South African National Youth Risk Behaviour Survey of 2008 reported that the proportion of adolescents who have ever used alcohol in Gauteng Province was 86.1% compared to the national average figure of 48.6%, while 11.9% of adolescents reported having had their first alcoholic drink before the age of 13 years. With regard to tobacco use, parents asserted that adolescents probably start smoking by imitating those who smoke and/or by experimenting with cigarettes. They later become addicted or unwilling to stop smoking. The Centre for Disease Control and Prevention has reported that most adult smokers started experimenting with cigarettes or began smoking as adolescents. Imitation is most likely to be out of curiosity, because curiosity is a significant characteristic of adolescent development that frequently expresses itself in ways which will incur disapproval. Other probable reasons why adolescents imitate those who smoke are the various attractions such as its perceived association with maturity, glamour and friendship, as well as the seeming pleasure it offers those who overcome the initial revulsion of the body to the pharmacological effects of cigarette smoke. Adolescents’ unwillingness to stop tobacco use is possibly due to addiction to nicotine, especially when reinforced by easy availability of cigarettes, perceived positive associations and the belief that stopping the habit is extremely difficult. Many parents also expressed concern regarding the inappropriate consumption of refined sugars by adolescents. It is plausible that this inappropriate consumption of refined sugars is likely lead to high prevalence of caries and obesity among adolescents in South Africa.

The parents ascribed adolescent inadequate oral care to laziness and tooth-brushing in a hurry due to lack of time, which resulted from waking up late in the morning after overindulgence in video games and television viewing among other factors. The parents also lamented that nobody spent time to teach or train them how to brush their teeth properly when they themselves were young. However, it has been suggested that adolescents’ psychological predisposition and family environment are likely to significantly influence their tooth-brushing behaviour. The question of parents on how to promote good oral health was investigated in a study conducted in The Netherlands. Relying on interviews with six focus groups the study came to conclusions which would be supported by all interested in Oral Health Promotion, namely to provide clear education on oral health, to ensure early referral for dental treatment, to monitor school diet arrangements and to encourage parental support. Participating in the study were groups from the Dutch population, and the Turkish and Moroccan immigrant groups, so agreement between these parents reinforces the recommendations.

It is pertinent to emphasise that brushing teeth after eating sugary food may not entirely prevent the harmful effects, although prolonged exposure to an acidic environment will certainly be reduced. Rather, it is better to brush before a sugary meal or snack to remove plaque, reduce the bacteria and hence the quantity of acid production. Brushing thoroughly twice a day with fluoride toothpaste is an important oral self-care activity known to be associated with lower risk of dental caries and periodontal disease. However, adequate removal of dental plaque has more to do with the quality of brushing rather than its frequency.

The parents indicated that academic ambition, self-esteem and propensity to cope with stress (FOC) protect adolescents against unhealthy and risky behaviours while the influence of religion was debatable. The role of academic ambition may be explained by one’s ability and motivation to work hard to attain goals including higher education or a healthier body. On the other hand, low educational aspiration is associated with health-compromising behaviours such as inadequate/infrequent tooth-brushing. A Scandinavian study involving over 9000 respondents found a strong association between erratic tooth brushing frequency and other health-compromising activities. Adolescents without self-esteem are likely to be influenced easily, and to easily give in to peer pressure. They may do things they do not want to do, trying to please others or trying to fit in. The parents also stated that some adolescents do unhealthy things such as smoking cigarettes and taking drugs to prop up their self-esteem. The parents’ position is in agreement with the findings of a systematic review study which showed high self-esteem is to be positively associated with eating healthily, being a non-smoker, and having low alcohol use. This study went further to recommend school programmes to encourage learners to develop the preferred approach to develop self-esteem without relying on unhealthy “props”. 
Alamian and Paradis also assert that adolescents with high self-esteem are less likely to have multiple behavioural risk factors. Conceivably, adolescents who have low self-esteem are less likely to brush for cosmetic reasons as they already have a negative perception of their self-image. The parents were also in agreement that SOC protects adolescents against unhealthy behaviour because most of the adolescents use unhealthy behaviours as coping mechanisms or as outlets against stress, although some adolescents who can cope with stress indulge in unhealthy behaviours such as smoking cigarettes because it is a popular social activity. This sentiment expressed by parents in our study is consistent with the findings of other research that reported significant association between SOC and health behaviours such as alcohol consumption,15 dietary habits,29 smoking cigarettes,29 and quality/frequency of tooth-brushing. Parental dependence on nicotine was found in a retrospective study in the United States to be strongly associated with the development of dependence among family adolescents.24 The statistics were derived from the National Survey on Drug Use and Health, 2004 to 2012. It was found that race and ethnicity did not influence the relationship between parent usage and offspring usage. It may be of pertinence that in the current study, the parents also argued that apart from races eating differently, they did not perceive race as a dominant influence on an adolescent’s attitude towards unhealthy behaviours. A dominant factor that the groups all agreed on was that unhealthy behaviours of the parents have significant effects on their adolescents’ tendency towards such unhealthy behaviours, because parents are powerful role models and their children emulate them as they grow up to be adults.35-36

The parents were also unanimous regarding the role of upbringing and the home environment among adolescents in the formation and retention of healthy behaviours such as the consumption of fruit/vegetables and unprocessed natural foods in place of the consumption of processed and refined foods. The provision of an enabling environment for the development and retention of health-enhancing behaviours cannot be over-emphasised. The significant influence of neighbourhoods, societies and schools on the adolescent attitude towards unhealthy behaviours, which could be either negative or positive, was mentioned too. On the negative side, for example, this observation was similar to the finding of another study that reported that children from immigrant Mexican households abandoned traditional foods prepared at home in favour of the higher-calorie foods, beverages and snacks available at school.37

Parents held the view that advertisements on billboards, television, newspapers and other media, which showed unhealthy behaviours, exerted an enormous influence on adolescents. Exposure to food-related television advertisements has been found to produce alterations in belief systems as to the desirability of foods high in calories and low in nutrient density.28 One study pointed out that commercials advertising healthy food make up only 4% of the food advertisements shown during children’s viewing time.28 Another report cited television advertising as influencing adolescents to adopt unhealthy lifestyle choices such as and cigarettes and alcohol,29 although not all television programmes were considered to be bad.

Negative mass and social media influence via the Internet was also reported by parents as a significant factor driving adolescents’ unhealthy behaviours. This was consistent with the finding of Donahue, Haslins and Nightingale which indicated that parents were concerned about their adolescent children drowning in media messages, especially in respect of negative health behaviours that threaten their health and well-being. A major cause that use has exploded. In Canada for example, the average adolescent by the stage of his/her high school graduation will have spent more than 8000 hours watching television and in the classroom.42 Furthermore, Vlahi asserted that the primary effects of media exposure on adolescents were increased high-risk behaviours, including alcohol and tobacco use. A study suggested that advertising increases beer consumption and in countries such as Sweden, a ban on alcohol advertising led to a decline in alcohol consumption.42

In South Africa the recent promulgations banning smoking in public places has proved a successful and well-received regulation. The influence of the media and passive advertisements or passive promotions on the psychosocial development of adolescents is indeed profound.43 The parents also pointed out that giving too much spending money to adolescents, the easy availability of unhealthy products at home and in the shops, and their affordability attract adolescents to such products. The foods high in fat and refined sugars are cheaper per unit energy when compared with foods rich in protective nutrients such as fruits and vegetables, although some parents indicated that healthy eating is also a matter of priority and not only affordability.

In order to mitigate the adolescent unhealthy behaviours of alcohol consumption, smoking cigarettes, inadequate consumption of fruit and vegetables, inadequate oral care and inappropriate consumption of sugars, the parents in the present study indicated that parental control, permissiveness and overindulgence of adolescents were contributory factors that must be addressed. They suggested that parents need to be knowledgeable about what constitutes unhealthy behaviours and seek professional help when necessary. In addition, they should carry out their parenting duties with love, provide support all the time and avoid being too authoritarian. The parents acknowledged the importance of being open with their adolescents and of spending quality time with them. They also indicated that parents should form close and good enough relationships for their adolescents to trust them and be open with them instead of going to outsiders. They wanted their children to listen and be receptive when they tried to educate them. A healthy parent-child relationship and ease of communication enhances adolescent disclosure which is very important.34,44

The parents also lamented that they did not understand their adolescent children. One of the reasons was that they were not sure exactly what they wanted, but there may be a biological explanation. The adolescent brain functions differently from that of an adult brain when processing decisions and solving problems.45 This may be the reason why adolescents occasionally behave in an impatient, impulsive, irrational, or dangerous manner. At times, it seems that they do not think things through or fully consider the consequences of their actions. Scientists have identified a specific region of the brain called the amygdala which is responsible for instinctual reactions including fear and aggressive behaviour. This region develops early in life. However, the frontal cortex of the brain that controls reasoning and helps us think before we act, develops later. Adolescents differ from adults in the way they behave, solve problems and make decisions because their actions are guided more by the amygdala and less by the frontal cortex of the brain. Studies show that the brain continues to develop and mature throughout childhood and adolescence and well into early adulthood; hence adolescents act differently from adults.34,44

This is probably the reason adolescence is characterized by a strong tendency to experiment with risky behaviours and the courage for such experimentation is much greater at this stage than in later life.45 These brain differences do not mean that adolescents cannot make good decisions or tell the difference between right and wrong. However, the awareness of these differences can help parents, teachers, advocates and policy makers understand, anticipate and manage the behaviours of adolescents.

The parents in the present study unanimously acknowledged that their opportunities and ability to tame the taste buds of their growing infants, to train and nurture their mindssets (indocilation) through early childhood and preadolescence was critical in the development and retention of health-enhancing behaviours into adolescence, especially with the provision of an enabling environment and needed support structures at home and throughout the school system. This view supports an earlier report which states that eating habits formed during childhood are likely to continue into adolescence and taste preferences are a major consideration.46
This study generated a substantive theory that provides, with its novel contents, a more effective and holistic approach to the problem of adolescent unhealthy behaviours than previous theories. It went beyond the risk factors approach to comprehensively address the root causes of adolescent unhealthy behaviours. It identified new concepts related to adolescents’ health-compromising behaviours and connected these new concepts in a unified manner from the interview data. The new theory provided a new perspective on parental participation in the mitigation of adolescents’ unhealthy behaviours through the investigation of parents’ perceptions of the psychosocial factors associated with adolescent behaviours of alcohol consumption, tobacco use, excessive consumption of sugars, inadequate consumption of fruits and vegetables and inadequate oral care.

As expected from a grounded theory the proposed theory has put forward unconventional, novel ideas and unique perspectives that clarify the important and central role parents are expected to play with regard to adolescents’ unhealthy behaviours. It radically emphasised the need for parents to start this role in earnest with their infants. These practices have the potential to facilitate the mitigation of the adolescent unhealthy behaviours of excessive sugar and inadequate fruit and vegetables consumption.

**Study Limitations**
The limitations of this study included:
Potential selection bias: non-response or purposive selection may have excluded parents who hold views that were not represented in the focus groups.

Reporting bias: with focus groups interviews, there is always a risk of socially desirable answers or parental responses may have been influenced by the opinions and perceptions of more vocal parents.

A limitation of qualitative research is that the results are not generalisable to the larger population because of the use of non-probability, purposive sampling strategy. Generalisability may also be compromised by the small number of research participants.

In order to minimise these limitations and enhance the quality of this study, the researchers endeavoured to gather rich data through purposive selection of information-rich participants and theoretical saturation of data. These limitations notwithstanding, the present study provides useful information on parents’ perception of the psychosocial factors associated with health-compromising behaviours related to oral health among adolescents in South Africa.

**CONCLUSIONS**
This qualitative study elucidated the real concerns of parents who realized how critical was their management of their offspring in influencing the susceptibility of the child to indulge in health-compromising behaviour. It brought to the fore the need for parents to be good role models and to make conscious efforts to properly train their children from infancy through preadolescence with positive adolescent health-outcome expectancy. Parents showed a comprehension of the multiple factors which influence the behaviour of adolescents. Whilst the role of educational aspirations and educational aspirations as most influential, the contribution of religion was regarded as not so relevant. In the face of numerous challenges including peer pressure and mass/social media, parents are expected to play a pivotal role in the mitigation of adolescent unhealthy behaviours. A parent cannot do this alone. Parents need one another, professionals and other institutions such as schools, governmental and non-governmental organisations to work together. These policy makers and effective interventions to strengthen public health efforts to improve oral and general health of South Africans. They could also form the basis of future research.

**References**
Does smartphone connectivity impact on undergraduate dental students’ environmental stress?

Khan, S.¹

ABSTRACT
Introduction
Several studies have suggested that smartphone addiction has negative effects on mental health and academic performance and may contribute to the development of stress.

Aim
To determine the prevalence of smartphone addiction and its impact on stress levels of students registered for the degree BChD in 2017 at the University of the Western Cape.

Objectives
To establish the impact of smartphone addiction and associated stress levels on student performance.

Methods
A cross-sectional descriptive study with a convenience sample of dental students, based on a self-administered closed-ended questionnaires: Dental Environment Stress and Smartphone Addiction Scale. The responses were statistically analysed.

Results
Ethical clearance was obtained for the study. The Mann-Whitney test output indicates no difference in attachment between smartphone and non-smartphone owners (p<0.015). Students agreed that mobile devices could be used for academic purposes but not that this usage be made compulsory.

Conclusion
More stress is experienced in certain domains and students displayed some degree of attachment, not addiction, to their smartphones. Serious impacts may be experienced by non-smartphone owners.

INTRODUCTION
Mobile devices keep us connected to the world, even though some may question the quality of this connection. Cell phones, smartphones, tablets, and computers must be appreciated as useful. They are a necessary addition to our tools of communication, having multiple functionalities which extend to application within the academic environment. In that scenario, it is not just about the communication between students and staff, but notes may be downloaded and assessments conducted via these devices. Indeed, the acquisition of these very expensive IT units may become compulsory when they are required for assessments. Cell phones may then be seen as an asset in the lives of young people and their day-to-day activities, including academic. However, the insistent demands and the consistent presence of these devices may exacerbate the already stressed dental environment experienced by students. An added stress occurs when acquiring and maintaining these expensive technological devices. Paradoxically, the use of cell phones was expected to have reduced the stress in the first place.

Stress is defined simply as a reaction to a stimulus that disturbs our physical or mental equilibrium and is generally a part of life. It is when the stressors become chronic, that there may be detrimental effects on the health and quality of life of individuals. Difficulties may be experienced in controlling these stressors when mobile devices are used. Consider the tensions involved, for example: keeping up with happenings via social media, wanting to create a social media persona, lack of privacy in social media, just being connected or separation anxiety when without a phone. Moreover, several destructive behavioural characteristics have been observed in the lives of young individuals with constant exposure to these devices, namely; phone-addiction, sleep deprivation, poor academic performance and increased stress development.

Stress-related research amongst dental students has been conducted globally. Several studies related to stress experienced by dental students have been conducted over the years at the University of the Western Cape (UWC). The researchers explored different aspects that could cause stress and/or increase the stress levels of students. The cohorts that were included had very different demographic features, for example:

1. Hendricks, Joshi, Cramble and Moola (1994) determined the “perceived sources of stress among black dental students in South Africa (SA) prior to the democratic elections.” This study, conducted more than 20 years ago, reported that non-academic (cultural and ethnic differences) rather than academic problems added more to students’ stress levels.
2. Naidoo et al. (2008) and Pau et al. (2009) determined the “emotional intelligence and its relation to perceived stress”
by conducting a multinational survey across seven different countries (including RSA) which also included a qualitative study amongst English students.2-4 Differences in stress levels between countries and institutions were found as also reported in another study (Abahem et al., 2011).2,4 The differences highlighted were age, gender, educational background and satisfaction with career choices.2 A significant inverse relationship between emotional intelligence and perceived stress was detected, implying that students can indeed cope with the stressful demands of their career choice. More so, that emotional intelligence is important in professional competence, and thus has a key role in the selection of students to study Dentistry.2,4

3. Amongst the students of 2010, Wilson et al. (2019) determined their environmental stress levels and risk of burnout as these could contribute to a decrease in efficiency.5 This particular study found that dental stressors increase and reach a peak as students progress to their clinical years. The conclusions were that high levels of perceived stress in the particular academic environment subsequently resulted in psychological morbidity and emotional exhaustion among dental students, possibly predisposing them to professional burnout and decreased productivity.3,4

Students in different dental environments have experienced an increase in stress levels with differing factors (both academic and non-academic) contributing to the problem.1,3,4,6,16

Within RSA, the protest actions that took place in the 2015 and 2016 academic years certainly added another dimension to the stress levels of students, impacting on their studies which could not proceed in an academically conducive environment. At such times of restricted contact, smartphones and computers may be expected to aid and assist communication and to improve accessibility. However, an already stressful setting may be further exacerbated if accessibility is affected, for whatever reason.

Smartphone use may serve as an aid or may impact as a non-academic stressor, its effects and impact on the lives of the UWC dental students have not yet been determined.

AIM
To determine the prevalence and addiction to smartphone use and to assess its impact on the stress levels of students registered for the degree BChD in 2017.

OBJECTIVES
To determine
1. the prevalence of stress resulting from the current dental environment among dental students attending the UWC Faculty of Dentistry,
2. the prevalence of smartphone addiction among the dental students,
3. the correlations between stress levels, current protest actions and the use of smartphones and its impact on students’ learning across the different study levels at UWC’s Faculty of Dentistry.

Null Hypotheses
1. Stress levels do not differ amongst currently registered dental students from different ethnic or cultural backgrounds, genders and study levels.
2. Students are not addicted to smartphones and their use does not increase their stress levels

Materials and Methods
A cross-sectional descriptive study with a convenience sample including undergraduate dental students registered for 2017 was conducted over a period of three months at the Faculty of Dentistry, UWC, SA. Data was obtained using two self-administered, closed-ended questionnaires:

1. A dental environmental stress (DES) questionnaire which was adapted from a previous study.2 It was also modified for RSA and translated to the medium of communication. The first questionnaire focussed on determining the stress levels of all dental students registered for 2017. The DES questions related to stress are categorized into seven main domains:5 Self-efficacy and Beliefs (SEB), Faculty and Administration (FA), Workload (W), Patient Treatment (PT), Clinical Training (CT), Performance Pressure (PP) and Social Stressors (SS), Protest actions (PA).

2. A Smartphone Addiction Scale to determine the dependence of students on their smartphones and the impact on their stress levels and learning.2,17

The second questionnaire, focused on the technological devices, such as smartphones (including cell phones), which are required by students and their addiction to that technology.17 The questionnaire was a validated and shortened version of the Smartphone Addiction Scale (SAS-SV) which has been tested for reliability.17

Additional questions were related to any protest actions (PA) which had been experienced by students previously. The answers were analysed to correlate the impact on the stress levels of participants. Specially designed questionnaire forms were distributed to the registered undergraduate dental students after information had been provided and their consent obtained to participate in the study. Responses from questionnaires were recorded using 4-point Likert scales: Not Applicable, No Stress, Moderate Stress, Severe Stress and Strongly Agree, Agree, Disagree or Strongly Disagree respectively.17 These responses were combined as described by Al-Sowayh and by Kim et al. to produce indices of stress and of addiction.17

Basic student demographic data were also obtained from questionnaires. Statistical analysis included descriptive statistics (frequency distributions, mean and standard deviation calculations) and appropriate non-parametric tests for association between domains and other variables (e.g. Wilcoxon Rank Sum, Kruskal-Wallis and Mann-Whitney U tests). Regression analysis were executed according to the purpose(s) of the study.17

RESULTS
Ethical clearance was obtained from the UWC Ethics Committee (Registration Number: 13/7/16). All participants signed a consent form according to the Declaration of Helsinki before participating in the study.19

Demographic Data
The response rates for the different classes by year were relatively consistent at about 90%, except for Class 5 where the rate dropped to 52%. For this reason, a weighting was applied to each student to correct this deviation from the population class proportions which were used with all calculations. The weightings are calculated as population proportion/sample proportion as shown in Table 1.

Students’ responses related to the DES questions indicated that stress was experienced in the SEB, W and PP domains as well as in those areas related to protest actions (PA) (Table 2).

Results from a Wilcoxon signed rank test clearly showed a significant bias towards females who experienced a greater prevalence of stress than their male counterparts (p=0.00001). A Mann-Whitney U test was also conducted, using the weighted average stress indices of males against females in all domains. The results showed extreme significance in all except the SS domain, which showed no gender difference (Table 3 and 4, Figure 2).

With regards to differences in stress levels between classes, it was no surprise (as in previous studies) that the fourth year class displayed positive levels of stress in the overall and average index (Table 4). The fifth year students experienced much stress in the
Table 1: Weight calculations per class.

<table>
<thead>
<tr>
<th>Class</th>
<th>Population</th>
<th>Population proportion</th>
<th>Sample per Class</th>
<th>Class Sample proportion</th>
<th>Weights per Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>96</td>
<td>0.22</td>
<td>83</td>
<td>0.24</td>
<td>0.94</td>
</tr>
<tr>
<td>Class 2</td>
<td>89</td>
<td>0.21</td>
<td>79</td>
<td>0.23</td>
<td>0.92</td>
</tr>
<tr>
<td>Class 3</td>
<td>83</td>
<td>0.19</td>
<td>76</td>
<td>0.22</td>
<td>0.89</td>
</tr>
<tr>
<td>Class 4</td>
<td>79</td>
<td>0.18</td>
<td>68</td>
<td>0.19</td>
<td>0.95</td>
</tr>
<tr>
<td>Class 5</td>
<td>81</td>
<td>0.19</td>
<td>43</td>
<td>0.12</td>
<td>1.54</td>
</tr>
<tr>
<td>Total</td>
<td>428</td>
<td>1</td>
<td>349</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Average response to certain stress questions.

<table>
<thead>
<tr>
<th>Stress Questions</th>
<th>A5</th>
<th>A10</th>
<th>A11</th>
<th>A13</th>
<th>A28</th>
<th>A31</th>
<th>A34</th>
<th>C9</th>
<th>C11</th>
<th>C13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>0.03</td>
<td>0.43</td>
<td>0.50</td>
<td>0.59</td>
<td>0.77</td>
<td>0.07</td>
<td>0.39</td>
<td>0.42</td>
<td>0.06</td>
<td>0.40</td>
</tr>
<tr>
<td>Weighted Average</td>
<td>0.08</td>
<td>0.43</td>
<td>0.50</td>
<td>0.60</td>
<td>0.77</td>
<td>0.07</td>
<td>0.41</td>
<td>0.42</td>
<td>0.12</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Key
A5: Clinical requirements
A10: Examinations and Quizzes
A11: Fear of being unable to catch up if falling behind
A13: Fear of failing course or year
A28: Lack of time to do assigned work
A31: Mental adjustment problems
A34: Patients late or not showing for appointments
C9: Effects of protest actions
C11: Impact of protest action on clinical work
C13: Effect of protest action on my learning at University

![Stress Levels Graph]

**KEY:**
SEB: Self-Efficacy Beliefs
FA: Faculty and Administration
W: Workload
P: Patient Treatment
CT: Clinical Training
PP: Performance pressure
SS: Social Stressors
MS: Mobile Stressors
PA: Protest Action

**Figure 1:** Weighted average of stress indices

PA domain (having been exposed to protests in both 2015 and 2016), whereas the third year class experienced greater stress in the W and PP domains than did the fifth years. The differences in stress levels across classes were found to be significant (p<0.000) from the results of the non-parametric Kruskal-Wallis tests for most domains except the SS and SEB domains.

**SMARTPHONE DATA**
Most students owned either a cell phone (35.8%) and/or a smartphone (92.2%); a Mann-Whitney U test output indicates no difference in attachment between smartphone and non-smartphone owners (p=0.618). Only five students had no smartphone, tablet or computer but this does not imply they
had no access to these devices for academic purposes. Gender differences were again observed across questions (similar to the results of stress prevalence), but the Mann-Whitney U results indicated females displayed significant levels of agreement for questions related to ‘missing work’ (p=0.024), ‘cannot not stand not having phone’ (p=0.0001) and ‘having phone on my mind’ (p=0.0009) (Table 5).

Students’ responses related to addiction are significantly in agreement only with questions referring to ‘cannot stand not having phones’ and ‘using phones longer than intended’, yet they don’t perceive themselves to be addicted.

Responses from students indicated agreement (86.5%) of being attached to phones and of experiencing stress (95.7%) when losing phones. Students mostly agreed that mobile devices could be used for academic purposes (73.9%) but not that this should be made compulsory (40%); though this is not the major cause of their stress, Students’ responses indicated they would be stressed (78.7%) when compulsory assessments are conducted using this

<table>
<thead>
<tr>
<th>Indices</th>
<th>Rank Sum Female</th>
<th>Rank Sum Male</th>
<th>U</th>
<th>Z</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEB stress index</td>
<td>46850.00</td>
<td>14225.00</td>
<td>8869.00</td>
<td>4.419742</td>
<td>0.000010</td>
</tr>
<tr>
<td>F/A stress index</td>
<td>46090.50</td>
<td>14984.50</td>
<td>9628.50</td>
<td>3.536259</td>
<td>0.000406</td>
</tr>
<tr>
<td>W stress index</td>
<td>46600.00</td>
<td>14475.00</td>
<td>9119.00</td>
<td>4.128931</td>
<td>0.000095</td>
</tr>
<tr>
<td>P stress index</td>
<td>45522.50</td>
<td>15196.50</td>
<td>10195.00</td>
<td>2.875537</td>
<td>0.003426</td>
</tr>
<tr>
<td>CT stress index</td>
<td>46809.50</td>
<td>14265.50</td>
<td>8909.50</td>
<td>3.160729</td>
<td>0.001423</td>
</tr>
<tr>
<td>PP stress index</td>
<td>45566.50</td>
<td>15152.00</td>
<td>10152.00</td>
<td>2.692719</td>
<td>0.002998</td>
</tr>
<tr>
<td>SS stress index</td>
<td>43303.50</td>
<td>17771.50</td>
<td>12415.00</td>
<td>1.512712</td>
<td>0.061344</td>
</tr>
<tr>
<td>MS stress index</td>
<td>45214.00</td>
<td>18561.00</td>
<td>10505.00</td>
<td>2.251667</td>
<td>0.025109</td>
</tr>
<tr>
<td>PE stress index</td>
<td>46103.50</td>
<td>14972.00</td>
<td>9616.50</td>
<td>3.550979</td>
<td>0.000383</td>
</tr>
<tr>
<td>Overall stress index</td>
<td>47082.50</td>
<td>13992.50</td>
<td>8365.00</td>
<td>4.690196</td>
<td>0.000035</td>
</tr>
<tr>
<td>Average stress index</td>
<td>47324.00</td>
<td>13751.00</td>
<td>8395.00</td>
<td>4.971199</td>
<td>0.000019</td>
</tr>
</tbody>
</table>

**Table 3:** Mann Whitney U test output for difference between genders in each index.

| Table 4: An overall view of average stress prevalence across gender, class and domain |
|-----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Ave for first year males                      | -0.18  | -0.65  | -0.11  | -0.08  | -0.63  | -0.17  | -0.07  | -0.25         |
| Ave for second year males                     | -0.17  | -0.65  | -0.07  | -0.01  | -0.61  | 0.04   | -0.57  | -0.30         |
| Ave for third year males                      | -0.16  | -0.35  | -0.04  | -0.14  | -0.10  | 0.02   | -0.71  | -0.35         |
| Ave for fourth year males                     | -0.11  | -0.20  | 0.05   | -0.23  | -0.05  | 0.18   | -0.50  | -0.15         |
| Ave for fifth year males                      | -0.33  | -0.40  | -0.14  | 0.03   | -0.33  | -0.20  | -0.68  | -0.65         |
| Ave for first year females                    | 0.00   | -0.61  | 0.12   | -0.91  | -0.60  | -0.18  | -0.67  | -0.13         |
| Ave for second year females                   | -0.01  | -0.57  | 0.06   | -0.94  | -0.53  | 0.02   | -0.64  | -0.05         |
| Ave for third year females                    | 0.00   | -0.19  | 0.20   | -0.08  | 0.23   | 0.29   | -0.64  | -0.01         |
| Ave for fourth year females                   | 0.11   | 0.07   | 0.33   | 0.14   | 0.32   | 0.38   | -0.57  | -0.02         |
| Ave for fifth year females                    | -0.01  | -0.15  | 0.10   | 0.08   | 0.25   | 0.27   | -0.68  | -0.17         |

**Table 4:** An overall view of average stress prevalence across gender, class and domain.

**Key:**
SEB: Self-Efficacy Beliefs
F/A: Faculty and Administration
W: Workload
P: Patient Treatment
CT: Clinical Training
PP: Performance pressure
SS: Social Stressors
MS: Mobile Stressors
PA: Protest Action
to smartphones, though not explicit addiction. Significant correlations were observed between DES domains of W, PP, SS, overall and average indices and smartphone addiction questions of ‘cannot stand not having phones’ and ‘not give up using phone even if daily life affected’ as well as being ‘attached to phones.’

The regression analysis for each index significantly contributing to the prevalence of stress provided results as follows:

a. **Self-Efficacy Beliefs (SEB) stress index**

The overall stress average was negative, but for questions related to ‘fear of unable to catch up’ and ‘fear of failure’ the results indicated high average responses to stress. Correlations with these questions are significantly related to ‘compulsory use of mobile devices.’ That implies that students who experienced stress when the use of mobile devices become compulsory had a higher SEB stress index. The ‘fear of failure’ with a new medium or increased rate of failure due to increased difficulties might provide some related explanations.

b. **Workload (W) stress index**

Overall stress averages were positive for this domain, and the type of stress is related to gender, class, ‘cannot stand not having phone’ and if ‘phones are used for academic work.’

c. **Performance Pressure (PP) stress index**

PP stress is significantly related to gender, class (females in the senior classes) and ‘using phone too much.’ The students who experience greater stress in the PP domain are those who admitted ‘using their phone longer than intended.’

d. **Protest Action (PA) stress index**

Stress prevalence was the highest for this domain and it was significantly related to gender, class and smartphone ownership. As has previously been indicated, senior female students and those who do not own a smartphone displayed a higher stress index in the PA domain. The reasons for these responses could be varied; owners could view the situation regarding protests at any time or find distractions on their smartphones or they may be concerned at not being able to do assessments via this medium.

**Table 5: Average levels of agreement to Smartphone Addiction Scale questions**

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>B4</th>
<th>B5</th>
<th>B6</th>
<th>B7</th>
<th>B8</th>
<th>B9</th>
<th>B10</th>
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</thead>
<tbody>
<tr>
<td>Average</td>
<td>-0.06</td>
<td>-0.36</td>
<td>-1.39</td>
<td>0.66</td>
<td>-0.01</td>
<td>-1.15</td>
<td>-0.84</td>
<td>-0.87</td>
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<tr>
<td>Weighted Average</td>
<td>-0.12</td>
<td>-0.38</td>
<td>-1.42</td>
<td>0.62</td>
<td>-0.03</td>
<td>-1.18</td>
<td>-0.84</td>
<td>-0.94</td>
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<td>-1.18</td>
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<tr>
<td>Ave for males</td>
<td>-0.45</td>
<td>-0.43</td>
<td>-1.35</td>
<td>-0.02</td>
<td>-1.20</td>
<td>-1.48</td>
<td>-0.96</td>
<td>-1.01</td>
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<td>-1.32</td>
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<tr>
<td>Weighted Ave for males</td>
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<td>-0.46</td>
<td>-1.38</td>
<td>0.00</td>
<td>-1.22</td>
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<td>-0.96</td>
<td>-1.06</td>
<td>0.70</td>
<td>-1.37</td>
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<tr>
<td>Ave for females</td>
<td>0.10</td>
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<td>-1.41</td>
<td>0.94</td>
<td>-0.79</td>
<td>-1.01</td>
<td>-0.70</td>
<td>-0.81</td>
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<td>-0.82</td>
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<td>-0.80</td>
<td>-0.88</td>
<td>1.26</td>
<td>-1.10</td>
</tr>
<tr>
<td>Average for first year</td>
<td>0.01</td>
<td>-0.57</td>
<td>-1.36</td>
<td>0.18</td>
<td>-1.14</td>
<td>-1.29</td>
<td>-1.23</td>
<td>-0.89</td>
<td>1.00</td>
<td>-1.31</td>
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<tr>
<td>Average for second year</td>
<td>0.65</td>
<td>0.22</td>
<td>-1.14</td>
<td>0.95</td>
<td>-0.57</td>
<td>-0.71</td>
<td>-0.70</td>
<td>-0.71</td>
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<tr>
<td>Average for third year</td>
<td>-0.22</td>
<td>-0.46</td>
<td>-1.33</td>
<td>0.86</td>
<td>-0.96</td>
<td>-1.26</td>
<td>-0.92</td>
<td>-0.92</td>
<td>1.28</td>
<td>-1.00</td>
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<tr>
<td>Average for fourth year</td>
<td>-0.26</td>
<td>-0.49</td>
<td>-1.53</td>
<td>0.96</td>
<td>-0.78</td>
<td>-1.04</td>
<td>-0.41</td>
<td>-0.40</td>
<td>1.09</td>
<td>-0.97</td>
</tr>
<tr>
<td>Average for fifth year</td>
<td>-0.88</td>
<td>-0.65</td>
<td>-1.84</td>
<td>0.23</td>
<td>-1.23</td>
<td>-1.63</td>
<td>-0.91</td>
<td>-1.77</td>
<td>0.53</td>
<td>-1.85</td>
</tr>
</tbody>
</table>

**Key**

- B1. Missing planned work due to smartphone use
- B2. Smartphone use affecting concentration in class
- B3. Physical body pains due to smartphone use
- B4. Cannot stand not having smartphone
- B5. Feeling Irritated and fretful when not holding smartphone
- B6. Smartphone on my mind even when not using it
- B7. Will not give up smartphone use even if daily life affected
- B8. Constantly checking phone to know what’s happening on social media
- B9. Using smartphone longer than intended
- B10. People around me say I use my phone too much

**CORRELATION BETWEEN STRESS LEVELS AND SMARTPHONE ADDICTION**

Comparing the results from both questionnaires, students indicated an increase in stress mostly across the SEB, W, PP and PA domains and they also agreed to a level of attachment to smartphones, though not explicit addiction. Significant correlations were observed between DES domains of W, PP, SS, overall and average indices and smartphone addiction questions of ‘cannot stand not having phones’ and ‘not give up using phone even if daily life affected’ as well as being ‘attached to phones.’

**DISCUSSION**

It is accepted that smartphones are an indispensable and necessary tool used especially for connecting and communicating between people, in addition to the many other services provided.
Research has also shown that dental students experience stress throughout their career, and that an increase in stress levels is observed amongst senior females in their clinical years.1,4-8
The current study is in agreement with these findings. Exploring different conditions affecting student learning such as emotional intelligence, cultural differences, burnout, disruptions within the academic setting such as protests and the impact of smartphone use (either social or compulsory academic) will allow researchers to understand their learning needs more comprehensively.1,4-7

The benefits of smartphones have been established, including their use in the academic setting as an alternate or additional aid in pursuing reading material and in conducting assessments. The role of smartphones in creating anxiety, especially with regards to attachment to the device, lack of privacy, affecting their daily lives and academic performance has also been documented.1-7

The current study records the advantage of smartphone use for academic purposes and the disadvantage of attachment further exacerbating student stress levels. However, no significant addiction to smartphones was discovered, and thus any destructive behaviour as referred to in other studies are not anticipated with this cohort of students.1-7

The interest in using smartphones for academic purposes must be explored further as these could be of major benefit especially during times of disruptions, for assessments may be conducted online. However, as the results indicated that more stress was experienced by non-smartphone owners, it would be prudent to engage students on this issue before any demand for the use of the devices became compulsory. Smartphones and maintaining them is a costly matter, thus these discussions must take place between students and the institution before finally is reached.

The other related issue of concern would be the role of educators who will need to explore varied assessment options when conducting these via smartphones or online. Senior students may be relieved somewhat if theoretical assessments are conducted via this medium, but being aware that clinical work quotes may not be completed may still be a source of major stress for them, especially during periods of disruptions as previously experienced.

CONCLUSION
More stress is experienced in certain domains related to work, performance and failure; both internal (ability to cope with work) or external (protests) factors may negatively influence these domains. There is some degree of attachment by students to their smartphones, though significant addiction has not been explicitly proven; however, can it be concluded that students are not addicted to smartphone use. Serious impact may be expected should compulsory use be implanted for both non-smartphone owners and educators, though this aspect was not researched.

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15. Dahan H, Bedos C. A typology of dental students according to their experience of stress: A qualitative study, J Dent Educ 2010, 74(2) 95-103.
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SADJ May 2018, Vol 73 no 4 p234 - p238

Isaacs Q,1 Khan S,2 Dhaya D,1 Cader R.4

ABSTRACT
Staff are encouraged to complete research and to ensure that these projects translate into quality publications. Such studies are required to have scientific merit and should inform clinical practices.

Aim
To determine the barriers to publishing research and to critically evaluate completed publications.

Method
Ethical clearance was obtained from the Biomedical Research Ethics Committee (Registration No: 14/3/23). This was a cross-sectional descriptive study investigating the publications for the period 2005-2012. Questionnaires were administered via SurveyMonkey. e-mailed or staff were given copies to complete. Data were captured and analyzed in Microsoft Excel. Publications were critically analysed to determine the structure applied, recognising the academic scope of the respective journals.

Results
Responses to the questionnaire were received from 30 staff members and one postgraduate student. Eighty six (72.3%) registered research protocols had resulted in a publication. Failure to publish was attributed to: time-constraints, lack of resources and rejection by editors. Publications were mostly case reports (31%), cross-sectional studies (19%) and literature reviews (17%).

Conclusions
Barriers in translating research into publications were identified; these should be addressed to further improve support to for staff. The publication rate, linked to the quality of the study, differed per department.

INTRODUCTION
The directive from institutional management structures to staff is to increase research and subsequently the rate of publication as subsidies to the University are based on this output.1 More importantly, conducting research is an essential component of academic growth and development and self-directed lifelong learning.2,3 Furthermore, rigorous research is a pre-requisite for optimal teaching in the academic domain and as such ensures improved patient care through technological and clinical advances, namely evidenced-based dentistry.2,4

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4. R Cader BChD (UWC), PDD Med., Ed (UCJ), MS: Public Health (UWC); Lecturer, Department of Oral Hygiene, (UWC)

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ACRONYMS
A-PR: advanced PRF
L-PRP: leukocyte and platelet-rich fibrin
SEM: scanning electron microscopy

According to Kitchin and Fuller (2005), translating research into a publication should be a natural progression.6 Besides the financial implications (both the benefits and expenses), staff are expected to ensure that this process occurs regularly and frequently, as part of their conditions of employment. Academic institutions will be regarded as, or measured as, successful, depending on their research output and subsequent rate of publications.7 Increasing the number of publications, both nationally and internationally, makes research available to a wider audience and ensures the internationalization of the institution.8

There are, however, a number of factors that may influence the progression of research to publication. The literature highlights several reasons why the rate of publication has been of concern to institutions and other researchers.9 Most of this is due to a phenomenon called publication bias, defined as selective publication of research, which commonly occurs in clinical research.3 This is attributed to the fact that positive results are readily published, circulated earlier and in journals with higher impact factors.4 The literature states that publication bias can be reduced by pre-registering a research project with an Ethics Committee.5 It has also been shown that by registering clinical trials with well-designed protocols on trial registries and/or other similar sites and by publishing these registrations, publication bias may be reduced.6 There are nevertheless still a number of contributing factors that restrain the progression from research to publication including the following: lack of time (too busy to publish), lack of support, research is not worthy of publication, too self-critical of their own research, cannot accept criticisms and lack of resources being the commonest.6

Evidence-based research, in any discipline, is produced by primary researchers using rigorous, reliable and valid methodologies.8,10 Research should also be relevant to clinical practice and at the same time allow secondary researchers to critically appraise work using validated tools as occurs when systematic reviews are conducted.11 Depending on the thoroughness with which studies are undertaken, described as having rigorous methodologies, critical observers can establish a benchmark for the type of research conducted at the institution and the consequent publications.12,13 A disciplined, structured approach can serve as a guide to young researchers but at the same time, may allow the more established investigators to reflect on their past practices and this could encourage improvement if indicated.

The basis of dental research is formed by the combination of biomedical and materials studies. Most projects at dental institutions are laboratory-based and very few, if any, are clinically-related research.12,13 It is important to establish whether the
research, which is creating evidence, is credible. Only then can the specific, proven research be used to change teachings and clinical practices at teaching institutions and in private and public settings.

Methodologies employed in dental research include studies of different designs, for example, systematic reviews, descriptive, cross-sectional, cohort, randomized and non-randomized controlled trials. Reliability may be interpreted by categorizing study designs according to the levels of evidence. The evidence based pyramid is an example of this where high quality evidence such as systematic reviews and randomized controlled clinical trials are at the apex of the pyramid, followed by cohort, case-control and cross sectional studies. Case reports and laboratory study designs are at the base of the pyramid, representing lower levels of evidence. Analyses used by researchers may also include those of a qualitative and/or a quantitative nature.

According to research conducted by Palese, Coletti and Dante (2012), the design of the study essentially impacts on the rate of publication. For example, a systematic review (with or without a meta-analysis) is published faster than any other study design type. Grossman, Mogotsi and Cleaton-Jones (2008) make reference to the rigor that should be followed in research which would ensure that research is published in accredited journals. It has therefore become common practice for journals to request the completion of checklists or consensus statements when submitting a publication, for example, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), Transparent Reporting of Evaluations with Non-randomized Designs (TREND) and Consolidated Standards of Reporting Trials (CONSORT) which is an indication of the value of such thoroughness. The reasoning is to give credence to the structure of the study as reported in the publication and to ensure reduction of bias. Thus a quality study with high quality evidence should be translated into a quality publication and within a peer-reviewed accredited journal.

This background formed the basis in formulating the following research questions which are translated into the aim and objectives of the study:

- What are the barriers experienced by researchers to publish quality publications?
- Do the publications produced by UWC’s Faculty of Dentistry staff and students demonstrate that a structured approach was used in their research?

The aim of this study was to determine the barriers related to publishing and to critically evaluate publications of staff and students at UWC’s Faculty of Dentistry. The objectives were:

1. To determine the outcome of all research protocols registered for the period 2005-2012.
2. To explore the barriers to the publication of completed research which had been conducted by staff and students.
3. To critically evaluate publications to establish the rigor and structure related to the research, using a standardized checklist.

**METHODOLOGY**

The first part of the study investigated why research at the University of the Western Cape (UWC) Faculty of Dentistry is not readily published, yet many research projects are registered and completed. The second part of the study critically evaluated the publications related to the rigor with which the research was conducted and whether this was adequately reported. A checklist was thus formulated for this aspect using several validated statements and/or checklists as a guide.

A cross-sectional descriptive study was conducted, investigating the data related to all completed research and subsequent publications for the period 2005-2012. UWC Research and Development Committee was approached for a list of research protocols that had been registered and a list of publications that had been produced by staff and students of the Faculty of Dentistry for the period 2005-2012. The principal investigators also scoured all online search engines for publications by UWC staff and students for this period.

The project was registered with UWC Biomedical Research Ethics Committee (Registration No: 14/3/23) and all participants completed consent forms according to the Declaration of Helsinki.

For the first part of the study, the researchers (including both those who have and those who have not yet published) were asked to complete a questionnaire related to their research and/or publication experience(s). For the second part of the study, the principal investigators critically evaluated all accessed publications for the study period by completing the formulated checklist for each publication. Aspects which were examined were related to research question, study design, sampling, reporting of results, generalizability of results and conflict of interests. The work for the study was divided within the group of four members, and each aspect of the checklist and questionnaire was checked. Disputes were resolved by discussion between two of the researchers and where consensus could not then be reached, the group made a decision.

Discussions with regard to study design, type of research, statistical analyses were conducted with the statistician prior to conducting the study. Power calculations were not required as all staff and students who had published research were included in the study. Data were captured in Microsoft Excel and analyzed by the statistician and the primary researchers.

**RESULTS**

Responses to the questionnaire were received from 30 staff members and one postgraduate student who had all engaged in research during the period of 2005-2012. All Departments at the Faculty were adequately represented with 74.2% dentists, 16.1% oral hygienists, 3.2% from Radiology and 6.5% from the Research Institute. Of the 31 participants, 23 had a BChD degree, seven had an MSc, 14 held an MChD, seven were PhD qualified and five had obtained a postgraduate diploma in Dentistry. The oral hygienists included one with a Master’s degree and one with a Doctorate.

There were 119 registered research protocols for the period 2005-2012, and 86 (72.3%) had resulted in a publication (Figure 1).

**Figure 1: Rate of publication**

The benefits with regard to publications identified by respondents include: funding; which could be used for other work at the institution, academic recognition amongst peers, academic development, enquiries from other researchers related to research and invitations to present research at conferences (both nationally and internationally). Most of these research projects were published in accredited journals and as conference proceedings which ensure financial benefit.
of individuals and other personal reasons shared above. Detailed analysis of the publications using the designed checklist may provide some answers to the varied prevalence of output per department; this will be explained further.

In accord with the guidelines of most journals, abstracts were included for the majority of publications, but the format differed; it was either in summary form or had a structured outline. The aim of the study was always shared, but the objectives were not always clearly outlined. The inclusion of a research question with the patient, intervention, comparison and outcomes (PICO) format and/or its derivatives were never used.1

A total of 291 publications were critically evaluated. The most popular format for study design was a case report (31%) and this increased the rate of publications for these departments, particularly in Oral Medicine and Periodontology, Radiology and Oral Pathology. The Department of Community Health produced mostly literature reviews (17%) and cross-sectional studies (19%), with the Department of Restorative Dentistry producing the most laboratory studies. Only one systematic review was conducted for this period and only two randomized and non-randomized clinical trials were completed (Figure 3).

Sample size estimation is an important step when conducting clinical patient-based or laboratory-based research.13 Thus completing power calculations to include an adequate number of participants/samples will ensure reliable results and more importantly confirm applicability of outcomes.15 For most of the

### Table 1: Descriptive statistics of included publications per department

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<tr>
<th>Article Type</th>
<th>Maxillofacial/Surgical</th>
<th>Paedodontics/Orthod</th>
<th>Oral Medicine</th>
<th>Restorative</th>
<th>Community Dentistry</th>
<th>Radiology/Pathology</th>
<th>Oral Hygiene</th>
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<td>Articles</td>
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### Abstract:

- Power Calculations: 1, 0, 0, 2, 0, 0, 0
- Not Applicable: 33, 6, 39, 3, 34, 45, 2, 8

### Sampling:

- Randomized: 1, 1, 0, 0, 0, 1, 0, 0
- Controlled: 0, 2, 0, 0, 2, 0, 1, 0
- Convenient: 3, 3, 38, 7, 23, 48, 3, 1
- Random: 0, 0, 0, 6, 10, 0, 0, 0
- Purposive: 0, 3, 4, 0, 2, 6, 2, 7
- Not applicable: 32, 5, 3, 26, 44, 0, 1, 4
Figure 3: Study design types per Department at the Institution

DISCUSSION

Questionnaire-based studies are considered useful for obtaining quick and easy responses and information related to any topic. Non-response from participants could be attributed to disinterest and the nature of the method employed or their skepticism of the researchers’ intentions.8 In addition, participants are also reluctant to respond as questionnaires are often time-consuming. It was no different with this study; the response rate was poor even with such an important topic which affects all staff at the institution.21 Efforts were made to increase the response rates by sending out a limited number of reminders via the online survey and in this way reducing the bias.

Some of the benefits of publishing according to the individual and to the institution, as reported in the literature, were also mentioned in the study questioned.14,15 Other advantages mentioned by respondents were, enquiries received from other researchers related to the research and invitations to present research at conferences (both nationally and internationally). These opportunities contribute to acknowledgement of the institution and internationalization in some circumstances.2

The list of barriers to publishing was also similar to that reported in the literature.9,22 Lack of time and support (related to finance and resources) were dominant reasons though barriers to ready publication such as type and quality of study, sample design and rejection by editors may have considerable influence.

Analysis of the publications indicated only one systematic review and a few randomized clinical studies. The majority of publications considered in this study were case reports, cross-sectional and laboratory study design types. According to Feijs et al. (2014), who investigated the top one hundred most cited articles in dentistry, the type of study designs predominantly included were case series and reviews.31 Publication of laboratory research can be attributed primarily to the Restorative Department.19

The majority of publications in this study can therefore be categorized as those with a low potential when referring to the evidence pyramid, were thus mostly from the base of the pyramid and an indication that the quality of research needs to be addressed.32,33 As mentioned previously, study design and structure contribute to publication success.32,33,34

This study highlights the importance of monitoring the papers produced by researchers. The quality of the study needs to be assessed using the techniques of critical appraisal in order to achieve a requisite level of authority and credibility.33 Such studies are indeed required to provide scientific support and to inform clinical practices.34 Associated barriers to publication may be correlated and if addressed, the publication rate is likely to be further advanced.

CONCLUSIONS

Publications such as literature reviews and case reports formed the bulk of the publications and highly ranked quality evidence was minimal. Barriers in translating research into publications were identified which should be addressed to further improve support to staff and students and in turn will enhance the publication rate. Departments varied in their publication rates, and this is related to the quality of the research produced.

Conflict of Interest: None

IMPLICATIONS FOR RESEARCH

• Barriers identified should be addressed with the aim of further increasing the rate of publication,
• Research studies (laboratory-based, patient-based and clinical studies) should be reported and appraised using
standardized checklists and
• Studies from the top end of the hierarchical evidence pyramid, considered to be rigorous studies, should be conducted to ensure more ready acceptance by accredited journals and appropriate translation into clinical practice.

References
Osteogenesis Imperfecta type III: A report on the unusual phenotypic features of six individuals of Cape mixed ancestry heritage.

SADJ May 2018, Vol 73 no 4 p239 - p242

Chetty M, Roberts T, Stephen LXG, Beighton P

ABSTRACT

Osteogenesis imperfecta type III (OMIM 259420) is a severe autosomal recessive disorder in which frequent fractures and progressive limb and spinal deformity result in profound physical disability. The condition is heterogeneous and dentinogenesis imperfecta (DI) is an important syndromic component of some types of OI III. Other maxillofacial and dental manifestations also have significant implications in terms of management.

The prevalence of Osteogenesis imperfecta type III (OI III) as a category of the inherited connective tissue disorders in South Africa is of paramount importance. Although autosomal recessive (AR) OI is rare worldwide, it has emerged that the frequency of OI III is relatively high amongst the indigenous Black African population of South Africa. A review of the literature revealed a paucity of information regarding the dental and craniofacial manifestations of the disorder in this ethic group. For these reasons, the central theme of this report is the identification, documentation and analysis of these features in five individuals with OI III in SA.

In an overall study, a total of 64 Black African affected persons were assessed. In a nested study five persons of Cape Mixed Ancestry (CMA) and three Indian individuals were investigated.

The five CMA patients had the phenotypic features of classical OI III, specifically severe fracturing, stunted stature, white sclerae and moderate to severe DI. Their general health was reasonably good and longevity was a major factor. One person, the prototypic OI III patient described in SA, was 61 years of age. Each of these individuals had massive mandibular prognathism with dental and skeletal Class III malocclusions.

ACRONYMS

AR: Autosomal Recessive
CMA: Cape Mixed Ancestry
DI: Dentinogenesis Imperfecta
OI: Osteogenesis imperfecta type I
OI: Osteogenesis imperfecta type III

KEY WORDS

Craniofacial, Dental, Osteogenesis Imperfecta

INTRODUCTION

In South Africa, a developing country, the allocation of resources in terms of specialized dental facilities is limited. Socio-economic barriers also exist, restricting patient access to dental care.

The previously neglected dental and craniofacial abnormalities documented in this study emphasizes the importance of a raised level of awareness in terms of dental management and the possible challenges that may be encountered.

Osteogenesis imperfecta (OI) is a heritable bone fragility disorder characterized by decreased bone quality and quantity and variable bone deformity.

Osteogenesis imperfecta type III (OI III) (OMIM 259420) is a severe autosomal recessive (AR) disorder in which frequent fractures, and progressive limb and spinal deformity result in profound physical disability. The condition is clinically and genetically heterogeneous, and maxillofacial and dental manifestations have significant implications in terms of management.

The historical evolution of knowledge concerning Osteogenesis Imperfecta (OI) has been chronicled in successive editions of Victor McKusick’s magisterial book ‘Inheritance of Connective Tissue’. In the mid-nineteenth century, Lobstein documented the adult form of OI while Vrolik described the lethal infantile type. At the beginning of the 20th century, Looser of Heidelberg introduced the terms ‘OI tarda’ and ‘OI congenita.’ These designations have remained in use in clinical medicine.

With the onset of clinical genetics in the 1960’s, the autosomal dominant (AD) mode of inheritance of OI-tarda was well

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established. In OI-congenita, the consistent normality of
the parents and the occasional recurrence in siblings
was suggestive of autosomal recessive (AR) inheritance.³ By
the late 1980’s, however, discoveries in collagen
biochemistry and later in molecular biology conclusively
indicated that OI-congenita resulted from new dominant
mutations, ⁴,⁵

The prevalence of Osteogenesis imperfecta type III
(OI III) as a category of the inherited connective
tissue disorders in South Africa is of paramount
importance. Although the autosomal
recessive (AR) OI is rare worldwide, it has emerged that
the frequency of OI III is relatively high in the indigenous
Black African population of South Africa.⁶

In South Africa and Zimbabwe OI III was found to be fairly
common in the indigenous Black African population.⁶ The
affected individuals originated from the Sotho, Pedi, Swazi,
Zulu and Tsawane linguistic groups among others and a ratio
of OI I to OI III at 1 to 6 was estimated in this population
group.⁶ It was suggested that the reason for this high
prevalence is that the unaffected heterozygote may have a
biological advantage in the African environment and
that the mutation for OI III in Africa occurred more than
2000 years ago in West or Central Africa prior to migration to
present-day Southern Africa.⁷

Two doctoral studies which emanated from a collaboration
between UWC Faculty of Dentistry and UCT Department of
Human Genetics were carried out in the field of thin bone
disorders, in particular Osteogenesis Imperfecta.

The aim of one PhD project undertaken in the late 1990’s was
to determine whether Dentinogenesis imperfecta (DI) is a
diagnostic discriminant for OI and to ascertain the prevalence
and severity of DI in various families with OI type I (OI I).⁸,⁹ In
order to fulfill this objective, more than 400 patients with OI I
were assessed.

In 2016, in another PhD, 72 individuals with a confirmed
diagnosis of OI III were assessed. The focus of the study was to
investigate and document the oro-dental features in affected
Black African persons in SA. Five individuals of Cape Mixed
Ancestry (CMA) heritage presented with the phenotypic
characteristics of OI III. Three Indian persons with an
unusual form of autosomal revertive
OI were also investigated. A total of 72 individuals with the OI III
phenotype were assessed.

The number of affected individuals that were included in
these studies made up the largest series in the world.

The CMA group of affected individuals were phenotypically
defined as having OI III with short stature and multiple fractures.
They differed from the majority of the Black African persons with OI III by
virtue of their longevity and presence of DI. Their molecular status
also differed as they were negative for the determinant mutation in
FKBP10 described in exon 5 which is frequently identified in Black
African persons.⁶ For these reasons, the phenotypic, craniofacial
dental manifestations of this unique group of individuals are
presented and discussed in this report.

Table 1: Clinical Findings of Cape Mixed Ancestry persons

<table>
<thead>
<tr>
<th>Affected Individual</th>
<th>Date of Birth</th>
<th>Age When Seen (Years)</th>
<th>Affected Relatives</th>
<th>Gender</th>
<th>No. of Fractures</th>
<th>Height (cm)</th>
<th>Mobility</th>
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<td>20/04/1952</td>
<td>63</td>
<td>5</td>
<td>F</td>
<td>&gt;50</td>
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<tr>
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<td>F</td>
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<tr>
<td>CPT4</td>
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<td>28</td>
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<td>F</td>
<td>&gt;50</td>
<td>95</td>
<td>Walks with an aid</td>
</tr>
<tr>
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<td>28</td>
<td>0</td>
<td>F</td>
<td>&gt;50</td>
<td>95</td>
<td>Walks with an aid</td>
</tr>
<tr>
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<td>20/12/2001</td>
<td>13</td>
<td>0</td>
<td>F</td>
<td>&gt;20</td>
<td>80</td>
<td>Chairbound</td>
</tr>
</tbody>
</table>

AGE, GENERAL PHYSICAL CONDITION,
DENTINOGENESIS IMPERFECTA AND
MOLECULAR FINDINGS

Individuals are represented by alphabetical-numerical designations
pertaining to the investigation centre and the chronological order
in which they were assessed.

The affected persons examined at the University of the Western
Cape (UWC) dental school were members of the Cape Mixed
Ancestry population group and were designated CPT2, CPT3,
CPT4, CPT5 and CPT6 (Figure 1 – Figure 10). Their clinical data
are presented in Table 1.

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dental manifestations of this unique group of individuals are
presented and discussed in this report.

Figure 1: CPT 2, Aged 22 years in calipers
Figure 2: CPT 2, Aged 62 years. She is chairbound

Each person had limited oral opening and all their teeth were
discernible consistent with moderate to severe DI. Their sclerae
were white in every instance and there was no hearing loss. None
of the individuals had received bisphosphonate therapy.

Figure 3: The Pedigree of the Kindred (Horan and Beighton, 1975). CPT 2 was the proband

Comment
It is of interest that all five affected persons were female. CPT 4 and CPT 5 were twins. The disorder occurred sporadically in
the other affected individuals except in the family of CPT 2. The
phenotypic features and radiographic manifestations of each
patient are described in the brief case reports which follow.
CASE REPORTS

CPT 2

Forty-two years ago, affected individuals in five interrelated families were reported.12 These persons were the prototypic OI III affected persons described in South Africa. CPT 2, then 22 years of age and now aged 60 years (Figure 1 and Figure 2), was a member of one of these families. In one family, two of 14 siblings had OI while in the other, four of thirteen individuals were affected with OI. The original pedigree of the kindred is shown in Figure 3.

These families shared the common CMA genetic heritage but there was specific information that they also had Black African, Scottish and Indian heritage. The fathers of the affected siblings were an uncle (II-1) and nephew (III-3) who married sisters (III-1 and III-4). Despite the reported absence of consanguinity, it can be assumed from pedigree data that the parents shared a considerable percentage of their genes. The parents and their progenitors were unaffected.

The Proband, CPT 2, had sustained several fractures by the age of two years and in early childhood had been institutionalized at a home for disabled children in Cape Town until 14 years of age. In 1975, at the age of 22 years, she was documented as being 105cm in height with severe scoliosis and pronounced bowing of the femora and humeri. At that time, she walked with the aid of long leg callipers and crutches (Figure 1) and she had minimal bluing of the sclerae.

A cone beam CT was requested by a maxillofacial surgeon after CPT 2 was referred for an evaluation of pain in the region of her right TMJ which was exacerbated when chewing. She also experienced intermittent tingling and numbness in her right arm. Frequent sinus infections and nasal obstruction were also troublesome. Her hearing and mental faculties were normal.

CPT 3

CPT 3 was the only affected person in her family. Her non-consanguineous parents and a male sibling were normal. In 2014, at 21 years of age, she was 90cm in height, and was chairbound with severe scoliosis and pronounced bowing of her femora and tibia (Figure 5). She had slight difficulty hearing but her sclerae were normal.

Figure 6: Panorex of CPT 3. The apparent image distortion is evidence of craniofacial abnormality and consequence difficulty with patient positioning. All teeth show features of severe DI. The lamina dura is absent and there is severe generalized osteoporosis of her craniofacial bones.

She gave a history of severe DI in her primary dentition and this was also evident in her secondary dentition (Figure 5). Deposits of interdental calculus were present and during oral prophylaxis, moderate gingival bleeding was observed.

As a young woman, she was understandably concerned about the appearance of her teeth and was referred to the Department of Restorative Dentistry at UWC. A previously obtained panorex radiograph was made available to the authors (Figure 6) and a CBCT was requested by the attending prosthodontist.

Figure 7: CPT 4 and CPT 5 are twin sisters, aged at 22 years. Marked kyphoscoliosis and prominent mandibular prognathism is evident.

The presence of DI in all of her teeth was confirmed on a panorex radiograph (Figure 6). Optimal radiographic images of any kind were impossible to obtain due to the difficulty of positioning her due to the short stature and chairbound situation.

CPT 4 and CPT 5

CPT 4 and CPT 5 are twin sisters (Figure 7) and are the only affected persons in their family. Their parents were unaffected and non-consanguineous. There was no history of the disorder in any of their parents’ progenitors. The sisters were 93cm in height and both had marked kyphoscoliosis.

Figure 4: CPT 2. An intraoral picture. Her teeth are yellow and moderately translucent.
were all moderately discoloured, translucent and multiple carious lesions were observed. Mandibular prognathism was also present.

Due to non-cooperation from CPT 6, it was impossible to obtain dental radiographs.

**DISCUSSION**

The four adult affected individuals of CMA heritage, namely CPT 2, CPT 3, CPT 4 and CPT 5, ranged in age from 21 years to 63 years and had severe physical deformities. They achieved an average height of 95cm and each of them had experienced 50 or more fractures. Although none of these individuals had received bisphosphonate therapy, longevity was a major feature. CPT 6 at age 13 years had already experienced 20 fractures and was chairbound.

A dental history of severely discoloured primary teeth with attrition and early exfoliation was reported by each of these persons. The colour of the crowns of their secondary teeth varied from yellow to brown and they were opalescent. There was chipping, fracture and focal loss of the enamel. Radiographic images confirmed the presence of bulbous crowns and almost complete obliteration of the pulp chambers. The roots of the teeth were thin and short.

Extensive dental intervention, management and appropriate referral was necessary due to the longevity of the individuals, the severity of the disorder and the extent of their DI.

These observations suggest that the underlying gene defect has the same or a similar effect on bone and dentine. In this cohort of affected persons, a positive correlation between the severity of the disorder and the presence and severity of DI was apparent. Several authors have documented the association between DI III and the expression of severe DI III. These findings are, however, contrary to those observed in the Black African persons with the homozygous and compound heterozygous FKBPP3 molecular genetic status and Indian persons with the unknown molecular status.

Permission to reproduce the photographs was granted.

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**Reference**


SADJ May 2018, Vol 73 no 4 p243 - p244
Temiola D., Holmes H., Mulder Van Staden S., Stephen L., Afroghesh A.

CASE REPORT
A 50-year-old female was referred to the Oral Medicine Clinic at the University of the Western Cape, Oral Health Centre, Tygerberg campus, by her general practitioner. She presented with a three year history of a painless swelling on the inner aspect of her lower lip. The patient recalled episodes of trauma to her lower lip from a protruding upper incisor tooth. The patient had diabetes and hypertension, which were both well controlled with medications.

Intra-oral examination revealed a 2 x 1cm non-tender, firm, dome shaped bluish swelling on the lower labial mucosa, which did not blanch on palpation (Figure 1).

Figure 1: Lesion on the labial mucosa

A clinical diagnosis of mucocele was suspected, however, since mucoceles are seldom encountered in middle-aged patients, the differential diagnosis also included vascular (hemangioma and lymphangioma) and fluid-filled mucocele-like salivary gland tumours, such as mucoepidermoid carcinoma. An excisional biopsy was performed under local anaesthesia, and the patient was prescribed 0.2% chlorhexidine digluconate oral rinse and 500mg Paracetamol four times daily post-operatively.

Histological examination disclosed an angiomyoma (vascular leiomyoma). The lesion consisted of prominent thick-walled blood vessels with dilated and slit-like lumina (Figure 2). Mature smooth muscle cells were arranged in bundles and whorls around blood vessels. There were also aggregates of mature adipocytes, which appeared to represent a form of degenerative metaplasia (Figure 3).

Figure 2. The image shows prominent thick-walled blood vessels with dilated and slit-like lumina (H & E, x10).

ACRONYMS
MD: moderately differentiated
OSCC: Oral squamous cell carcinoma
PD: poorly differentiated
WD: well differentiated

KEY WORDS
Oral Squamous Cell Carcinoma, Oral Cancer, OSCC, Epidemiology
is rare and non-destructive. Any recurrences must be considered as possible "smooth muscle tumour of uncertain malignant potential." Therefore, long-term follow-up after treatment is required.

CONCLUSION

Oral angiomyolipomas are rare, benign smooth muscle neoplasms. As oral angiomyolipomas are highly vascular, they appear clinically as blue, fluid-filled lesions, closely resembling mucoceles. However, in an adult patient, dentists should also consider vascular (lymphangioma, hemangioma, and pyogenic granuloma) and other salivary gland lesions (mucoepidermoid carcinoma and myxoid pleomorphic adenoma). The prognosis of oral angiomyoma is excellent. Recurrence is rare, but when evident the clinician should be encouraged to reconsider the lesion as a possible "smooth muscle tumour of uncertain malignant potential." Therefore long-term follow up after treatment is required.

References

The use of a digitally pulsed, high power diode laser for the treatment of physiological gingival pigmentation.

Booley A.B.,1 Peerhay F.2, Mulder R.,3 Mulder van Staden S.4

INTRODUCTION
Gingival pigmentation, whether focal or diffuse, may be of aesthetic concern to patients. Establishing the underlying aetiology of the pigmentation is essential to ensure that the correct management is performed.1 Oral pigmentation is relatively common and can have a variety of clinical presentations.2 The characteristics of the pigmentation such as the location, colour, distribution, duration, surface characteristics and presence of cutaneous lesions are important features to consider in reaching a diagnosis.2 Investigation of the patient’s dental, medical, familial histories and social habits are factors to consider. Possible aetiologies of oral pigmentation include traumatic, reactive, exogenous foreign bodies, drug-induced, neoplastic, genetic dysfunction and systemic disease associations.2 A biopsy and laboratory studies are often required to reach a definitive diagnosis. Pigmented lesions that have a recent onset, have increased in size or cannot be explained by local factors require a biopsy to establish a diagnosis.1

Physiological oral pigmentation is associated with an increase in melanocyte activity, not an increase in melanocyte number.2 Melanocytes are specialized, unicellular, dendritic, melanin-producing cells derived from the neural crest during embryogenesis. Melanocytes reside in the basal and suprabasal layers of the epidermis and oral epithelium.2,4 Keratinocytes are the predominant cell type found in the epidermis and oral epithelium.4,5 The primary functions of keratinocytes are the formation of a protective barrier and re-epithelialization at sites of injury.5 Wounds to the skin or oral mucosa will be repaired in part by the migration of keratinocytes.

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ACRONYMS
CO2: carbon dioxide laser (10800 nm)
Er:YAG: Erbium-doped Yttrium Aluminum Garnet Erbium laser (2940 nm)
Nd:YAG: Neocinum-doped yttrium aluminum garnet (1064 nm)

Figure 1: Algorithm for the diagnosis and management of pigmented lesions of the oral cavity.

After an injury and barrier disruption, neutrophils, monocytes and macrophages are recruited to the site of injury. The expression of several growth factors and cytokines results in the activation of the keratinocytes.6 The keratinocytes from the wound margins will dissolve their hemidesmosomal connections, detach from the basement membrane and migrate across the exposed connective tissue to achieve re-epithelialization.6,7 A single layer of keratinocytes migrate from the wound edges within a few hours of tissue injury. Wound healing in the oral cavity occurs more rapidly than in skin. The normal wound healing process consists of specific phases namely inflammatory, proliferation, remodelling and maturation. The inflammatory phase involves haemostasis and inflammation, which starts at the moment of injury and continues for four to six days. The proliferation phase involves re-epithelialization, angiogenesis, granulation tissue formation and collagen deposition (takes place from day four to day 14 after injury). The maturation and remodelling phase starts from day eight after injury and proceeds for about a year.6,8
Keratinocytes and melanocytes reside together in the basal layer of the oral mucosa, forming a keratinocyte-melanocyte unit. Melanocytes are cells capable of synthesizing amino acid tyrosinase, a (liver-containing enzyme) which initiates events leading to melanogenesis (i.e., the synthesis of melanin). Melanocytes produce melanin in membrane-bound organelles namely melanosomes. These melanosomes are transmitted via melanocytic dendritic processes to the keratinocytes in the keratinocyte-melanocyte unit. Melanogenesis is genetically determined and there are differences in the degree of pigmentation between racial/ethnic groups. Melanocytes produce two types of melanin — i.e., eumelanin (large, brown/black granules) and pheomelanin (yellow red granules). The ratio of eumelanin to pheomelanin determines the color and degree of pigmentation observed clinically.

Physiological gingival pigmentation can present in varying shades of brown to black depending on the depth and type of melanin deposition in the mucosa by melanocytes. The degree of physiological gingival pigmentation can increase with age and the colour intensity can be influenced by factors such as hormonal fluctuations, smoking and medications the patient is taking. Physiological pigmentation affects males and females equally, presenting as asymmetrical, solitary or diffuse brown macules. Clinically, physiological pigmentation affects mainly the attached gingiva; however, pigmentation has also been noted in other sites such as the fungiform papillae on the dorsum of the tongue.

Physiological pigmentation of the gingiva generally occurs in a symmetrical, bilateral pattern and does not extend beyond the mucogingival junction. The diagnosis of physiological pigmentation can be made clinically (after ruling out other potential aetiologies, refer to Figure 1) and treatment is not required, unless it is of a cosmetic concern.

The techniques that are most frequently employed to treat physiological gingival pigmentation include the use of a scalpel, cryosurgery, bur ablation, electrosurgery and laser ablation.

Laser ablation has been recommended as an effective technique to treat gingival pigmentation. Numerous lasers are commercially available for treatment such as the CO₂ laser, Er:YAG, Nd:YAG and various diode lasers (805-980 nm). During laser depigmentation the endogenous melanin serve as a chromophore that absorbs the laser wavelengths of 351-1064 nm, resulting in elimination of the pigment.

**CLINICAL CASE REPORT**

A 22-year-old male presented with gingival pigmentation to a general dental practitioner with experience and training in using dental lasers. The patient did not find the dark appearance of his gingiva aesthetically pleasing. He stated that the dark areas on his gingiva had been present since childhood.

The clinical examination demonstrated physiological gingival pigmentation in both the upper and lower arches (Figure 2). The pigmentation was also clearly visible due to the patient’s high smile line. The patient had no medical history of significance and was a cigarette smoker (four cigarettes per day).

Different techniques can be employed to eliminate pigmented areas with lasers. The “non-surgical” technique involves the non-initiated laser tip not making contact with the tissue, although the laser beam still has the necessary effect on the melanin. The treatment protocol followed to manage the abovementioned patient was a “surgical” depigmentation technique utilizing a 400 micron initiated tip, with a paint brush motion over the pigmented epithelium, allowing direct contact with the tissue. The area of contact with the diode tip was air-cooled. A constant high volume suction was employed to remove the plumes generated by the lasing procedure. Water irrigation was also applied to cool the tissue between lasing.

**Assessment of the areas of pigmentation**

A clinical assessment of the grade of gingival pigmentation was done in accordance with the Dummell-Gupta oral pigmentation (DOPI) index.

The scoring criteria for DOPI is as follows:

- 0 = pink tissue, no clinical pigmentation
- 1 = mild light brown tissue, mild clinical pigmentation
- 2 = medium brown or mixed brown and pink tissue, moderate clinical pigmentation
- 3 = deep brown/ blue-black tissue, heavy clinical pigmentation

The Hedin melanin index was used to describe the extent of the pigmented area.

The Hedin melanin index was scored as follows:

- 0 = no pigmentation
- 1 = one or two solitary units of pigmentation in the papillary gingiva
- 2 = >3 units of pigmentation in the papillary gingiva without formation of a continuous ribbon
- 3 = ≥1 short continuous ribbons of pigmentation
- 4 = one continuous ribbon including the entire area between the canines.

**CLINICAL PROCEDURE PERFORMED**

**Step 1**

A critical step in treatment of physiological gingival pigmentation is to establish the base colour of the tissue, by assessing the mucosa on the inside of the lip. The normal pink colour of the mucosa will be easily distinguishable from the gingival pigmentation (Figure 2). One can then compare the base colour of the oral mucosa to the colour of the gingival tissue and this evaluation establishes the severity of the gingival pigmentation by using the DOPI and Hedin melanin indexes.

A critical factor to bear in mind is that the darker the pigmentation, the greater the affinity the 810nm diode laser exhibits to the melanin chromophores.

**Step 2**

Local infiltration of anaesthetic solution was administered in both the anterior upper and lower arches in order to ensure that the patient felt no discomfort from the heat produced by the laser. A reported advantage of laser depigmentation is a reduced need for local anaesthesia, allowing a decreased amount of local anaesthetic solution.

A soft tissue digitally pulsed diode laser (Claris, Flexion AG, Germany) with a wavelength of 810nm a 10mm was used with an initiated 400-μm diameter tip. The average power of five Watts was emitted in pulsed mode with a pulse duration of 10μs in contact with the pigmented tissue. The maximum frequency of 60 Hz was set on the laser (and due to the digital pulse, 20 000 such interval cycles occurred every second). The pulse energy delivered to the tissue was 0.48mJ. With these settings, the laser beam interacts with the gingival tissue and the tissue has a period where it can “cool” down during laser use. This phenomenon in which the tissue is allowed to cool in the remaining time of the cycle is known as thermal relaxation. The exposure duration was 2-5 minutes per quadrant.

Dental Laser Safety regulations were adhered to as required.

**Step 3**

The laser tip was moved over the tissue at a clinical hand speed that allowed a tissue interaction of “gentle” sloughing of the surface tissue. The power setting of the laser was adjusted based on the preferred hand speed of the clinician and in order to achieve the clinically visible level of sloughing. This entire process of depigmentation for both the upper and lower arches took approximately 20 minutes. The immediate post-operative result is illustrated in Figure 3.

Once the gingival pigmented areas were lased and cooled, the tissue was vigorously wiped with a wet cotton roll to remove the sloughed tissue. The patient remained comfortable and pain free throughout the procedure.
**CASE REPORT**

**Step 4**
The post-operative instruction to the patient was that he should rinse his mouth with a salt water mouthwash twice per day for three days.

**Step 5**
A post-operative consultation was conducted at 21 days and again at six months after the diode laser depigmentation procedure.

### Table 1: The DOPI and Hedin Index for gingival pigmentation.

<table>
<thead>
<tr>
<th>Treatment interval</th>
<th>DOPI</th>
<th>Hedin</th>
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<td>Before treatment</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Follow up (21 days)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Follow up (60 days)</td>
<td>2</td>
<td>3</td>
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**RESULTS**
The gingival pigmented areas treated were assessed before treatment, 21 days and six months post-operatively. The gingival unit assessed for DOPI included the interdental papilla with half the marginal gingiva on either side of it and the associated attached gingiva. The Hedin melanin index total scores were recorded for the mandible and maxilla (Table 1).

**Figure 2:** Pre-operative photographs

**Figure 3:** Immediate post-operative photographs

**Figure 4:** 21 Days post-operative photographs

**Figure 5:** Six Month post-operative photographs

An improvement was noted after 21 days and six months following laser depigmentation as illustrated in Figures 4 and 5.

**DISCUSSION**
Although the depigmentation technique using a scalpel has been considered as being the gold standard, the major disadvantage is that this technique is painful and results in excessive bleeding during, as well as after, the procedure compared with laser treatment.

Furthermore, the healing period with the scalpel technique is on average between 7-10 days provided that the exposed lamina propria was covered with a periodontal pack.

The reported advantages of laser depigmentation include easy clinical application, short treatment time, easy gingival reshaping, haemostasis, negligible post-operative pain and elimination of the need for a periodontal dressing. Disadvantages of laser surgery include delayed type of inflammatory reaction, which may take place with mild post-operative discomfort lasting up to 1-2 weeks. Re-epithelialization is delayed due to lack of wound contraction when compared with conventional surgery. The management of gingival pigmentation using the CO₂, Er:YAG and diode lasers has been shown to be more effective and less traumatic than the mechanical technique of using a scalpel with a number 15 blade. Repigmentation of treated tissue may occur over time. The literature reports that occurrence of repigmentation with the scalpel technique is 21.4% and with laser therapy 22.8%. Partial repigmentation is reported in about half of the patients after two to four years in most treatment techniques. The exact mechanism of repigmentation is not understood and the literature addressing this issue is limited. It may be attributed to the migration of active melanocytes from the adjacent pigmented tissues to the treated areas. The Er:YAG laser has been documented to be associated with an up to 30% recurrence of gingival re-pigmentation in six months. The diode laser (810 nm) has a marked advantage over the Er:YAG laser, as the diode laser is reported to record a lower recurrence rate.

**CONCLUSION**
Laser ablation of physiological gingival pigmentation has been reported to be an effective treatment modality. A high powered diode laser with a high frequency and short pulse width can be used to successfully treat gingival pigmentation.

**References**


CASE REPORT

A 49-year-old female was referred from the Dermatology department to the Oral Medicine Department at the University of the Western Cape (UWC), Oral Health Centre, Tygerberg campus. The patient complained of a sore mouth and difficulty in brushing her teeth. She had been diagnosed with epidermolysis bullosa acquisita (classical type) 12 years ago and was being managed by her Dermatologist with topical and systemic steroids (Dovate® ointment and 10mg prednisone daily).

The extra oral examination revealed extensive sloughing of the skin of the hands, chest and back. The hands showed atrophic scarring, skin fragility and nail loss on numerous fingers, which also demonstrated restricted movement (Figures 1, 2).

The patient had limited mouth opening because of scarring related to repeated episodes of ulceration (Figure 3) and poor oral hygiene. Her gingiva was inflamed (Figure 4). The middle to anterior dorsal surface of her tongue was atrophic, smooth and erythematous, while the posterior dorsal tongue had white yellowish plaques (Figure 5). The orthopantomogram demonstrated multiple carious teeth with generalised, severe horizontal bone loss (Figure 6).

An appointment was scheduled for a scaling as well as extraction of root remnants and teeth with a hopeless prognosis. The patient was booked for a follow-up at the Oral Medicine and Periodontology Department two weeks later, but failed to return for her appointment.

DISCUSSION

Epidermolysis bullosa (EB) is a group of inherited blistering diseases, which can be present from birth, or be acquired and manifest in adult life.\(^1\) The first description of a patient with a bullous disease reminiscent of EB (with no associated familial history) was reported by Elliot in 1895.\(^2\) In the early 1970s, Roenigk et al. proposed the first diagnostic criteria for EBA.\(^2\)

ACRONYMS

BMZ : basement membrane zone  
DEJ : dermal-epithelial junction  
DF : Direct immunofluorescence  
EBA : Epidermolysis bullosa acquisita  
EB : Epidermolysis bullosa  
ELISA : enzyme linked immunosorbent assay.  
IBD : Inflammatory bowel disease  
IF : Indirect immunofluorescence  
SLE : Systemic lupus erythematosus

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![Figure 1: Atrophic scarring and skin fragility on the back of the hands, nail loss and deformity of numerous fingers.](image)

![Figure 2: Severe sloughing and scarring, with restriction of movement.](image)

The diagnostic criteria included:

1. Spontaneous or trauma-induced blisters resembling hereditary dystrophic EB  
2. Adult onset of the disease  
3. No associated family history for EB  
4. Exclusion of all other bullous diseases\(^2\)
EBA is a rare, autoimmune, sporadic, subepithelial, mucocutaneous blistering disease, which usually occurs in adulthood. Skin fragility, non-inflammatory tense bullae, milia, and extensive scarring typically characterize EBA. Otherwise, EBA may manifest as an inflammatory bullous eruption reminiscent of bullous pemphigoid or another sub-epithelial autoimmune blistering disorder.

Limited numbers of paediatric cases of EBA have been reported, but it is adults who are most commonly affected. Increased risks for EBA development based upon gender, ethnicity or geographic location have not been definitively established in the literature.

Pathogenesis
Although the pathogenesis of EBA is not clearly defined, evidence reveals that it involves an autoimmune process (type III hypersensitivity) with the production and deposition of antibodies against type VII collagen, which is a major constituent of the anchoring fibrils (adhesion structures in the dermal-epidermal junction - DEJ). This theory concept is based upon several observations:

- Direct immunofluorescence microscopy of peri-lesional skin from patients with EBA showed antibody deposition at the basement membrane zone (BMZ).
- Indirect immunofluorescence (IF) revealed antibodies against type VII collagen in the serum of patients with EBA.
- Immuno-electron microscopy detected antibody deposition in the lamina densa area of the BMZ, a site consistent with the location of anchoring fibrils.
- Declining numbers of normal anchoring fibrils were present in the DEJ in EBA, a finding consistent with epidermal blistering and skin fragility.
- Animal models indicate that passive transfer of antibodies against type VII collagen can induce clinical features consistent with EBA.
- Serum levels of type VII collagen antibodies identified by ELISA correlate with the severity of skin lesions.
- Patients with bullous systemic lupus erythematosus (SLE), which is also accompanying with antibodies against type VII collagen, develop sub-epidermal blistering.

CLINICAL VARIANTS
Classical EBA manifestations were firstly defined as non-inflammatory, mucocutaneous bullae with accompanying skin fragility. EBA may also present as an inflammatory blistering disease characterized by descriptions that resemble bullous pemphigoid, linear IgA, bullous dermatosis, mucous membrane (cicatricial) pemphigoid, or Brunsting-Perry pemphigoid. The classical and bullous pemphigoid-like subtypes are the most common presentations of EBA.
**Classical (non-inflammatory) EBA**

Patients with classical EBA present with skin fragility and non-inflammatory tense vesicles and bullae, which rupture quickly and develop erosions. The parts that are frequently subject to minor trauma are the most common locations for lesion progression, such as the hands, feet, knees, elbows, and lower back. These blisters usually heal with scarring and milia (small epidermal inclusion cysts).1,5

Mucosal involvement is common in classical and also in inflammatory EBA. It can be subclinical with associated pain or itching, or may present as adhesions or erosions on the oral, nasal, pharyngeal, laryngeal, esophageal, ocular, or ano-genital mucosa.6

Nail loss, alopecia, fibrosis of fingers and hands, and esophageal stenosis may manifest in severe cases.1,5

**Inflammatory EBA**

These subtypes of EBA are similar to other autoimmune sub-epithelial blistering disorders. Compared to classical EBA, skin fragility is not a characteristic feature.1

- **Bullous pemphigoid-like EBA**
  This disorder shares the clinical manifestation with bullous pemphigoid that is the most common autoimmune subepithelial blistering disease.1,4 Unlike the non-inflammatory lesions of classical EBA, the condition manifests with widespread tense bullae with infarcted or ulcerated skin. The lesions are common in the trunk, extremities and skin folds similar to bullous pemphigoid. Scarring and milia are not obvious findings.5

- **Mucous membrane pemphigoid-like EBA**
  This may appear as a mucous-predominant disorder with clinical manifestations that are similar to mucous membrane pemphigoid.1,4 The initial disease findings are erosions and scarring on the mucosal surfaces of the mouth, upper oesophagus, conjunctiva, anus or vagina.5

- **IgA bullous dermatosis-like EBA**
  This has clinical, histologic, and direct immunofluorescence (DIF) manifestations that resemble IgA-mediated bullous dermatoses.1 The clinical manifestations may present with the annular distribution of vesicles and bullae characteristic of linear IgA bullous dermatitis. Associated mucosal involvement is common.1,5

- **Brunsting-Perry pemphigoid-like EBA**
  The disorder resembles Brunsting-Perry pemphigoid, which is a rare sub-epithelial blistering disorder.2 It presents as vesicle-like bullous eruptions, primarily appearing on the head and neck and heals with scarring.1,5

**DIAGNOSIS**

EBA resembles other sub-epithelial blistering disorders in some clinical, pathologic and immunohistologic features. Establishing a diagnosis can be challenging. Once the initial assessment suggests the presence of an autoimmune sub-epithelial blistering disorder and reveals findings consistent with EBA, additional investigations may be utilized to verify the diagnosis.1

**Initial patient evaluation**

The evaluation should include the following:1

- A full patient history and complete skin examination which involves an evaluation of the morphology and distribution of skin lesions

This assessment assists in limiting the differential diagnosis. For example, a diagnosis of classical EBA must be considered in adults who present with consistent clinical manifestations. These include skin fragility and trauma-induced tense bullae, which result in milia and scars, with no family history of any hereditary blistering disorder. Because of the numerous EBA’s morphologies, the probability of EBA should still be considered when clinical descriptions indicate any other sub-epithelial blistering disease.

- A biopsy for routine histopathology and direct immunofluorescence (DIF)

A tissue biopsy of affected skin or mucosa must be taken for routine histologic examination to define the level of blistering. A peri-lesional skin or mucosal biopsy for DIF should also be obtained to identify autoantibody deposition. A punch biopsy of 4mm is classically used to retrieve tissue specimens.

- **Immunofluorescence at basement membrane zone (BMZ)-split skin**

Once the clinical, histologic and DIF results are reliable with an autoimmune sub-epithelial blistering disease, immunofluorescence on skin artificially split within the BMZ is helpful to rule out bullous pemphigoid and linear IgA bullous dermatosis, thus narrowing the differential diagnosis to EBA and a few other uncommon disorders.

Indirect immunofluorescence (IIF) microscopy on salt-split skin is a simple and reliable tool compared with DIF, which helps to sub classify subepidermal autoimmune bullous diseases into ‘roof’ and ‘floor’ binding conditions.1 EBA is a standard floor-binding sub-epidermal autoimmune bullous disease. On the other hand, the floor binding of salt-split skin is not only revealed in EBA but also in anti-laminin 332 mucous membrane pemphigoid and anti-p200 pemphigoid.7

EBA shares clinical manifestation with other multiple disorders. Eight of these disorders, frequently mistaken with EBA, are listed below:1,5

- Bullous pemphigoid
- Linear IgA bullous dermatosis
- Porphyria cutanea tarda
- Bullous systemic lupus
- Recessive dystrophic epidermolysis bullosa

**Management**

Treatment strategies are determined by the clinical presentation. However, a multidisciplinary approach is necessary, including a nutritionist, dermatologist, hematologist, plastic surgeon, ophthalmologist, cardiologist, gastroenterologist, dentist, nurse and an occupational therapist.1

The first line of treatment in most of EBA patients is colchicine because of its efficiency and less associated side effects.1,5 Colchicine is a familiar microtubule inhibitor, which also plays a role in regulating autoimmunity by inhibiting antigen presentation to T cells. Colchicines in high doses have been reported to be effective for both classical and inflammatory EBA patients.6 Diarrhoea is an adverse effect which limits its use in EBA patients with inflammatory bowel disease (IBD).1

Rituximab is a monoclonal antibody, which targets CD20 on both mature and immature B cells.11 As a result of destroying B cells, the circulating antibodies and B cells are reduced, leading to an increase in immunosuppression.8

Cyclosporine, an immunosuppressant, is often considered in the treatment of EBA.11 Studies have revealed that some EBA patients responded to cyclosporine use, however, patients require high doses (6mg/kg) of the drug. Cyclosporine has long-term toxicity, but is a valuable treatment modality in patients who are non-responsive to EBA therapy.5

Systemic glucocorticoids in high doses have proven to be successful in the management of some EBA patients.14 Other immunosuppressants such as methotrexate, azathioprine, and cyclophosphamide may also be used.13 Prednisone and dapsone may also assist some EBA patients.5

Photopheresis was efficient in a cohort of EBA patients, including one in a critical condition. Photopheresis is used to treat mycosis fungoides and Sézary syndrome (which is a malignancy of skin-homing CD4+ T memory T cells that is clinically described as erythroderma, lymphadenopathy, and blood involvement) and numerous autoimmune bullous disorders.5
Blister formation following mild-mechanical trauma characterizes most of major types of EB and most EB patients may reveal systemic complications, such as genital, ocular and oropharyngeal infections with difficulty in swallowing.¹³

Implications for the oral health worker
EB patients need particular precautions during dental treatment due to the probability of soft tissue injury during their examination of the oral mucosa and skin. These patients are predisposed to dental caries as a result of their cariogenic diet; poor oral hygiene worsened by pain and limited mouth opening.¹⁴ Regular visits/contact with the oral health team can help to avoid complex procedures and treatments.¹⁴

Several alternative treatments are often used as first aid therapies for blisters. Aloe vera gel application decreases the sub-dermal temperature, affords a refreshed sensation, promotes antimicrobial activity and diminishes the healing period. Bioteine® mouthwash minimizes blister formation by providing oral moisturizing and salvia stimulation, providing buffering capacity and antimicrobial activity.¹⁴

Nowadays, researchers are investigating treatments such as gene and cell therapy, intradermal injections of allogeneic fibroblasts, recombinant protein infusions and stem cell transplantation. Other developing treatments for EB patients are focusing on the improvement of wound healing and good quality of life.¹⁵

It is essential that all EBA patients receive supportive care to decrease the possibility of skin trauma and to improve quality of life. This supportive care involves appropriate wound management and approaches for preventing trauma. Patients should be educated that harsh soaps, vigorous rubbing of skin during washing specifically with hot water, may aggravate the lesions and result in trauma. The application of sunscreen may reduce the exacerbation or stimulation of new lesions due to prolonged sun exposure. Finally, the patient should be well informed to recognize superinfections of the skin and to seek urgent medical care should they develop.

References
Hypohidrotic Ectodermal Dysplasia: Genetic aspects and clinical implications of hypodontia.

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ABSTRACT
Hypohidrotic Ectodermal Dysplasia (HED) is a rare genetic disorder, characterised by a distinctive facies, hypotrichosis and hypohidrosis. Hypodontia/oligodontia is a significant component of the condition, contributes to aesthetic and functional problems and may require special dental management. Furthermore, specific dental changes may alert the practitioner to the possible diagnosis of HED. Contemporary investigations to elucidate the molecular pathogenesis of HEDS have drawn attention to the disorder. For this reason, we have reviewed the genetic basis of HED and in particular hypodontia/oligodontia in the light of our own experiences and provided a literature search. Different approaches to the dental management and treatment options in hypodontia/oligodontia in HED are also included.

The Ectodermal dysplasias (OMIM 305100) are a group of more than 150 hereditary disorders that affect tissues and organs derived from the ectodermal germ layer. The most common variants of ED are the hypohidrotic and hypohidrotic (anhidrotic) forms. The distinguishing feature between the two types is the presence or absence of sweat glands. Persons affected by Hypohidrotic Ectodermal Dysplasia (Christ-Siemens-Touraine syndrome) have characteristic features, including frontal bossing, a depressed nasal bridge / saddle-shaped nose and hyperkeratosis. The congenital absence of teeth results in excessive resorption of the alveolar bone, a reduction in the height of the face and full lips. Fine, pigmented, linear wrinkles around the eyes are frequently seen. Symptoms arising from failed mucous production are common, including upper respiratory infections, otitis, dysphagia and bronchitis. Specialised radiographic techniques can be used to detect the reduced sizes of all craniofacial bones. Apart from the otoaryngeal changes, general health is usually good, and the intellect is unimpaired.

The inheritance of HED is by either an autosomal, dominant, autosomal recessive or X-linked pattern. Four gene mutations are linked to the pathogenesis of HED. TheEDA1 gene mutation is associated with the X-linked variant and EDAR, and EDARADD mutations are associated with the autosomal dominant and autosomal recessive forms. WNT10A mutations have been linked to HED patients who have distinct phenotypic expressions including striking dental changes without facial changes.

ACRONYMS
Hypohidrotic Ectodermal Dysplasia (HED)

KEY WORDS
Dental, Genetic, Hypodontia

HED is uncommon. Nguyen-Nielsen et al. reported the frequency of HED in the Danish population to be 1.6 per 100,000 in molecularly confirmed affected persons. The primary dental feature, hypodontia/oligodontia, occurs in both dentitions and may lead to mastication problems, impaired speech and poor aesthetics. Xerostomia as a result of hypoplastic salivary glands may predispose the existing teeth to dental caries. For these reasons, dental management is an essential aspect of the well-being of affected persons.

CASE REPORT
A South African male of mixed ancestry was referred to the Faculty of Dentistry, University of the Western Cape. At the time of his assessment, he was 20 years old. A diagnosis of HED was based on his phenotypic manifestations. He had two affected siblings with similar abnormalities.

Extraoral examination
The affected individual had sparse silky hair, scant eyebrows, the tip of his nose was narrow, and the nasal bridge was flattened. The skin covering his forehead, cheeks and chin was dry. He had prominent, pigmented wrinkles under the eyes. Thick lips were evident and the helices of his ears were flattened [Figure 1]. His facial profile was straight [Figure 2].

Intracranial examination
The size of his oral cavity was normal relative to the size of the face. His palate was within normal limits, but several teeth were missing in both the maxillary and mandibular dental arches [Figure 3].

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The following management options were considered:

Option 1
- A root canal treatment on the right maxillary second premolar and submerge the root to preserve the bone for a dental implant in the future
- Restoration of the remaining teeth apart from the left maxillary second premolar, which would be extracted.
- Restoration of function and aesthetics with a removable partial denture

Option 2
Similar to treatment option one except that the function and aesthetics would be restored by the placement of dental implants and fixed dental prostheses.

Option 3
Similar to option one apart from function and aesthetics would be restored by an overdenture supported by implants.

Option 4
Extraction of all remaining teeth which would be replaced by complete upper and lower dentures.

Based on financial constraints, the first management option was chosen.

DISCUSSION
The most common form of HED is inherited as an X-linked trait, with a spectrum of phenotypic expression. The disorder is associated with a mutation in the EDA1 gene which is coded for ectodysplasin A, a transmembrane protein belonging to the tumour necrosis group responsible for the development of ectodermal tissues. The EDA1 gene is located on Xq12-q13.1. Chromosomes and deletions in these loci are responsible for HED. The full spectrum of the disorder is usually expressed in males. Phenotypic expression is variable and less severe in females.

Hypodontia, the most significant dental feature, refers to a hereditary disorder where one or more teeth fail to develop. When six or more teeth are developmentally absent, the condition is referred to as oligodontia. In HED, tooth agenesis affects both the primary and secondary dentition. Hypodontia/oligodontia results in poor articulation, compromised aesthetics and inefficient mastication. Xerostomia may exacerbate the problem and increase the risk of dental caries. A lack of dentition results in atrophy of alveolar bone and a resultant decrease in the height of the face. When present, the erupted teeth are misshaped, and the incisors and canines often appear conical. The cosmetic appearance of the dentition is unsightly and may affect the psychological well-being of the affected person.

Hypodontia/oligodontia may occur as part of a genetic syndrome or as a non-syndromic isolated trait. Several theories have been proposed to explain tooth agenesis. Whilst early investigators viewed the environmental and genetic aspects of hypodontia/oligodontia in isolation, the process is in fact multifaceted, as with so many disorders. Environmental influences play a minor role during the initial stages of tooth formation but may be important if they are persistent. Local factors including dental caries may affect the chronological sequence of tooth maturation. During the transition from the primary to the permanent dentition, which usually occurs during puberty, epigenetic influences such as hormonal changes may suppress tooth development.

Hypodontia/oligodontia can occur as a consequence of aberrations during any stage of tooth morphogenesis. Mutations in genes responsible for either tooth formation or maturation can result in changes in the number, shape or structure of one or more teeth in either the primary or secondary dentition or both.

Genetics of hypodontia/oligodontia
There are more than 300 genes responsible for tooth formation and maturation. Several researchers have associated mutations
in MSX1, PAX9, AXIN2, EDA, EDAR, EDARADD and WNT10A with hypodontia and oligodontia in mice. Moreover, these authors suggested that the regular expression of these genes may be imperative for the formation and development of the normal tooth germ.\textsuperscript{3,10-13} Mutations in similar genes expressed during the various stages of odontogenesis have been associated with the agenesis of specific teeth and with patterns of innervation in humans. Apart from their role in initiating the development and positioning of teeth, these genes belong to signalling pathways that regulate the morphogenesis of other organs. Their mutations therefore affect the development of structures beyond dental morphogenesis resulting in syndromic developmental disorders. Abrasions in the MSX1 and AXIN2 genes are associated with tooth agenesis and with systemic features including cleft palate and colorectal cancer.\textsuperscript{14}

**Figure 4:** Congenital tooth agenesis with resorbed mandibular ridge, gingival recession and dental caries

MSX1 gene provides the instructions for proteins that regulate the activity of other genes. The gene belongs to a group of homeobox genes responsible for cell division and differentiation during embryogenesis. The MSX1 gene is found at 4q16.3-p16.115 and is expressed in regions of condensing ectomesenchyme in the tooth germ.\textsuperscript{16} The gene is responsible for regulating the Bmp2, Bmp4, and Lef1 via the Wnt/\beta-catenin signalling pathway. Underexpression of MSX1 results in accelerated odontoblastic differentiation, early cessation of tooth development and impaired cell division in mice. Mutations are also responsible for severe forms of hypodontia in humans.\textsuperscript{11} MSX1 mutations have been linked to oligodontia and\textsuperscript{14} and autosomal dominant\textsuperscript{10,13} and autosomal recessive variants of hypodontia.\textsuperscript{10}

PAX9 is a member of the paired box (PAX) family of transcription factors and is found on the long arm of chromosome 14 locus 14q12-q13.\textsuperscript{12} The gene is expressed in the mesenchyme of the developing tooth.\textsuperscript{12} Although PAX9 is essential for the formation of the mesenchyme throughout odontogenesis,\textsuperscript{12} its levels are highest during the early stages of tooth development.\textsuperscript{22} The gene regulates the expression of MSX1 via BMP4 and also plays a critical part in fetal development and in the progression of malignancies.\textsuperscript{25} Mutations in both coding and non-coding regions of the gene have been reported involving exons 1, 2, 3 and 4. These have been associated with the termination of tooth development at the bud stage.\textsuperscript{26}

Heterozygous mutations in PAX9, have been associated with non-syndromic tooth agenesis in humans.\textsuperscript{27} mainly autosomal dominant and recessive, non-syndromic, familial oligodontia forms.\textsuperscript{28} Aberrations in PAX9 gene are also associated with peg-shaped laterals\textsuperscript{29} and microdontia incisors.\textsuperscript{29}

AXIN2 or axis inhibitor protein 2 is a gene located on the long arm of chromosome 17 (17q25-q24).\textsuperscript{30} The gene plays a role in cell growth, proliferation, and differentiation. Axis inhibition protein regulates the Wnt signalling pathway and controls cell-to-cell communications during embryogenesis. Gene mutations have been associated with several forms of hypodontia\textsuperscript{30,31} discovered an association between mutations in the Wnt, signalling regulator AXIN1, oligodontia and increased susceptibility to colorectal cancer in a large Finnish family. The authors proposed that tooth agenesis, and in particular, severe oligodontia could be an indicator of predisposition to cancer. Mostowska et al demonstrated mutations in AXIN2 in hypodontia and oligodontia.\textsuperscript{31}

EDA (ectodysplasin 1) is a gene situated on Xq12-q13.1 and mutations are involved in isolated, non-syndromic X-linked and sporadic hypodontia.\textsuperscript{32} Mutations in this gene also cause X-linked HED, the features which have been extensively described in this manuscript.

The tooth is a complex organ derived from both ectodermal and mesenchymal germ layers. The same genes responsible for tooth development are involved in the growth and development of the other tissues derived from the ectoderm. Hence, factors that disrupt the expression of these genes not only interfere with dental development but may also influence the development of the other ectodermal organs including the hair, nails, skin and glands.

**Clinical implications of genetic aberrations in hypodontia and oligodontia**

The study of the genetic basis of tooth agenesis gave rise to the development of experimental tooth restoration techniques including tissue scaffolding\textsuperscript{34} and tooth engineering.\textsuperscript{35} Furthermore, the association of genes such as AXIN2 and PAX9 with both tooth agenesis and certain types of malignancy indicate that tooth agenesis could serve as a potential genetic marker for the early diagnosis of cancer.\textsuperscript{14,36,37}

**CONCLUSION**

The dental manifestations of HED may cause functional, aesthetic and psychological problems. Oral rehabilitation is costly and protracted and may influence dental management. Salivary gland aplasia or agenesis may complicate dental changes and precipitate or aggravate caries in the remaining dentition. Hyperthermia, a concomitant finding in HED and AED may compound dental management. Mutations in genes responsible for HED are implicated in tooth agenesis and certain types of malignancy. Oral health professionals may be the first to encounter individuals with HED and therefore require a sound knowledge of the clinical features and genetic basis of the condition.

Permission to reproduce the photographs was granted.

**References**

Radicular cyst associated with a primary molar in the maxilla: Case report.

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ABSTRACT
Radicular cysts in the primary dentition are reported to be very rare, especially in the maxilla. Asymptomatic lesions often go unnoticed, becoming very large in paediatric patients. They are regularly misdiagnosed due to the tendency for the cyst to envelop the permanent successors. The following case reports on a 10-year-old boy who presented with a very large radicular cyst in the maxilla arising from a primary molar. The lesion encompassed several permanent successors, extended to the infra-orbital rim, and expanded into the maxillary sinus, resulting in nasal septal deviation. Treatment included enucleation with histopathological confirmation of a radicular cyst. Healing was uneventful.

INTRODUCTION
Radicular cysts have been shown to be the most common jaw cyst, contributing 52.3% of the total.1 In contrast, the lesion is considered to be very rare in the primary dentition, with a reported prevalence of only 0.5%-3.3% of all radicular cysts.2-4 The lesion is classified as an inflammatory cyst of odontogenic origin.5 The development of a radicular cyst in primary teeth is identical and histologically indistinguishable from the process affecting permanent teeth.6 The lesion originates from inflammatory activation of epithelial root sheath residues, otherwise known as the cell rests of Malassez.2,4,6 Chronic low-grade inflammatory irritation in the periapical area of a tooth with a necrotic pulp and a pre-existing apical granuloma can result in a cystic lesion.3 The high prevalence rate for caries in primary molars is considered to be the most common cause of the infection and these are also the teeth most likely to be affected.2,7 These lesions are often asymptomatic and rapidly increase in size becoming very large in children who have less dense bone compared with adults.1,8,9 Large lesions often envelop the permanent successors resulting in misdiagnoses.1,4,10

CASE REPORT
A 10-year-old boy was referred to the Department of Maxillofacial and Oral Surgery, Faculty of Dentistry, University of the Western Cape, Tygerberg Hospital in July 2017. At the initial visit he presented with a slow-growing expansile lesion on the right side of the face in the infra-orbital area. Intra oral examination revealed carious teeth in all four quadrants. The swelling appeared to originate in the right maxillary canine region. The patient was otherwise healthy with no medical history or known allergies. A pantomograph (Figure 1, A) was performed revealing a large ill-defined, homogenous, radiolucent lesion in the right maxilla, causing tooth divergence, impaction, follicle displacement, envelopment of permanent successors, extension to the maxillary sinus. Several carious lesions were evident. Computed Tomography (CT) axial slices (Figure 1, B) showed a large, thin walled, circumscribed cystic lesion of intermediate density in the right maxilla, containing a tooth and causing significant expansion of the buccal cortex. The maximum dimension measured 40 mm x 30 mm on axial slices. Figure 1, C shows the medial wall of the lesion expanding towards the nasal cavity causing deviation of the nasal septum to the left. The left maxillary sinus and some left ethmoidal cells showed intermediate density filling, indicative of mucosal secretions. The radiographic diagnostic report provided a differential diagnosis consisting of a Dentigerous cyst, Radicular cyst, Ameloblastoma and Odontogenic Keratocyst. Surgical treatment was performed under general anaesthesia. A crevicular and releasing incision was made to reveal a thin egg shell-like cortex. Removal of the cortex facilitated enucleation with inclusion of the impacted permanent successors. The specimen measured 40 mm x 30 mm x 20 mm. Copious irrigation was performed and closure achieved with 2/0 Vicryl®. Unrestorable and retained primary teeth were extracted. Patient follow-up and healing were uneventful. Macroscopic histopathological examination revealed a cystic lesion containing teeth. Microscopic sections showed an inflamed cyst wall lined by variable hyperplastic layers of epithelium with odontogenic origin. Diagnosis of a radicular cyst was confirmed.

DISCUSSION
Radicular cysts involving the primary dentition are most often associated with mandibular molars and endodontically treated teeth compared with the maxilla.1,10-12 There is a slight male preponderance and the cysts most commonly occur between ages of 3 to 19 years.11 In a survey of 1300 recorded radicular cysts over a 25 year period, only seven was documented to originate from a primary tooth. An extensive review, published in 1983, of literature dating from 1898 only 28 similar cases were found.12

KEYWORDS
Radicular cyst, primary dentition, molar, maxilla, pantomography, computed tomography, enucleation.

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Figure 1. A, Pantomograph shows an ill-defined, homogenous, radiolucent lesion in the right maxilla, causing tooth divergence, impaction, follicle displacement, envelopment of permanent successors, extension to the maxillary sinus (red arrows) together with several carious lesions. B, CT axial bone window presents a large, thin walled, circumscribed cystic lesion of intermediate density in the right maxilla containing a tooth and causing expansion of the buccal cortex (yellow arrow). C, CT axial soft tissue window. Observe the medial wall of the lesion expanding towards the nasal cavity, causing deviation of the nasal septum to the left (green arrow).

The reason why the radicular cyst is considered rare is unclear but may be due to misdiagnoses, or may be undiagnosed, under reported, resolution of lesion due to exfoliation, endodontic treatment or extraction without histological analysis.2,6,15,16 Primary teeth pulpal lesions are more likely to spread to the inter-radicular area rather than apically.17 The lifespan of a primary tooth is short and drainage of apical infections occurs much more readily due to the lower resistance of surrounding structures.27 It will have been reported that endodontically treated teeth have a high prevalence for developing a radicular cyst;1 this may be due to the nature of therapeutic agents used during primary tooth pulp therapy and it is recommended that endodontically treated primaries be observed until exfoliation.21,31,34,35 Lesions are often misdiagnosed as a periapical granuloma when radiographically an apical radiolucency is observed or as a central giant cyst when a succeeding permanent tooth is encompassed in the lesion.4,11 Displacement of permanent tooth buds can be significant, such as to the floor of the orbit in the maxilla and to the inferior border in the mandible. Lesion growth can be 4-5 mm annually.4,15 Histopathological features include the presence of non - keratinized stratified squamous epithelium which may demonstrate hyperplasia, exocytosis or spongiosis. The wall consists of dense fibrous connective tissue with inflammatory infiltrate. Inflammatory cells infiltrate the epithelial lining as well the fibrous connective tissue. The cystic lumen may be filled with fluid and cellular debris. Other features such as clusters of giant cells, foreign endodontic material, Rushton’s hyaline bodies in the lining and foam cells may be observed occasionally.5,15,17 Multidisciplinary co-operation between the treating clinician, radiologist and pathologist is imperative. Considering all features and findings has been suggested to facilitate reaching the correct diagnosis.19 Clinical features may include mandibular buccal cortical expansion, presence of a non-vital tooth, and an asymptomatic lesion associated with a primary tooth. Radiographically a well-defined unilocular radiolucency may be seen, associated with a primary tooth, and with displacement but no involvement of permanent successors. Surgically no association with permanent successors will be found and histological confirmation of a cystic epithelial lining may suggest radicular cyst of the primary dentition.18,21,28 Treatment of these lesions varies between operators and is dictated by the size of the lesion. Essentially management consists of removal of the offending tooth with either enucleation, marsupialization or in combination.29 Complete removal of the cystic lesion with its lining via enucleation is considered the treatment of choice, as marsupialization has disadvantages such as multiple visits and the leaving the remainder of pathological tissue in situ. Marsupialization may be beneficial in the primary dentition to decompress the cystic lesion and preserve the underlying successors, possibly resulting in eventual eruption.31 Intermediate removable appliances may be constructed to facilitate function and to prevent debris entering the cavity. Some cases show rapid healing and eruption of underlying permanent successors without the necessity of a removable appliance.32

CONCLUSION

The rarity, size, location and extensions of the present case makes it notable. Early diagnosis is imperative when a radicular cyst is suspected in a paediatric patient. These lesions can rapidly become large, affecting surrounding structures. A multidisciplinary approach to achieve the correct diagnosis and successful treatment is recommended.

References
The assessment of osseous changes in the temporomandibular joint using Cone Beam Computed Tomography.

ABSTRACT

Introduction
Clicking of the temporomandibular joint (TMJ) is not a normal occurrence. The clinical finding of chronic clicking of the joint can signify osseous changes and early signs of degenerative joint diseases.

Aim
To compare osseous changes seen in the mandibular condyles of patients presenting at the Oral Health Centre, Tygerberg Campus, with and without clicking of the temporomandibular joint.

Methods
From amongst patients routinely attending the Oral Health Centre, a sample of 25 were selected as presenting with asymptomatic clicking of the temporomandibular joints. A matched sample of patients who did not demonstrate clicking was collected as a control. The mandibular condyles of both groups (N=100) were examined for erosions, flattening, lipping, sclerosis and osteophyte formation.

Results
The prevalence of sclerosis of the right joint in the study group was statistically significantly higher in comparison with the control group (P = 0.002). Age and gender showed no statistical significance between the two groups.

Conclusion
Osseous changes were found in both the control and study groups but were more consistently found amongst those having asymptomatic clicks of the temporomandibular joints.

INTRODUCTION
There is a misconception amongst patients and practitioners that clicking of the temporomandibular joint (TMJ) on opening and/or closing does not warrant treatment unless there is associated pain. A click is however a clinical manifestation of disorders of the TMJ known as internal derangement – which relate to abnormal positional relationships between the mandibular condyle, the articular eminence and the articular disc that separates them. The important consideration is that chronic derangement of the joint frequently results in osteoarthritis.

ACRONYMS
TMJ: Temporomandibular Joint
TMD: Temporomandibular Joint Disorders
CBCT: Cone Beam Computed Tomography

KEY WORDS
Cone Beam Computer Tomography, TMJ, TMD, Clicking, degenerative joint disease

or closing does not warrant treatment unless there is associated pain. A click is however a clinical manifestation of disorders of the TMJ known as internal derangement – which relate to abnormal positional relationships between the mandibular condyle, the articular eminence and the articular disc that separates them. The important consideration is that chronic derangement of the joint frequently results in osteoarthritis.

A click can present at almost any stage during normal motion and function of the TMJ and can vary in audibility and severity. The associated derangement can displace the articular disc in anterior, posterior, medial or lateral directions. When the displaced disc returns to its proper position, force may be exerted on the osseous structures of the TMJ resulting in compensatory or abnormal response. There is a possibility that a disorder of the TMJ, which is a chronic process, can result in disease progression if left untreated. The importance of diagnosing the early stages of derangement and treating the signs and symptoms could prevent or reduce the chances of degenerative joint diseases like osteoarthritis.

The presence of erosions, sclerosis lipping, osteophyte formation and flattening of the condyle are indicative of an active degenerative procedure and their recognition is possibly diagnostic of the risk of future disease.

MATERIALS AND METHODS
The study group comprised 25 patients (50 joints) who presented for routine dental treatment and, on examination, had demonstrated asymptomatic clicking of the TMJ. These patients consented to CBCT examination and were then referred to the TMJ clinic. The control group comprised 25 patients (50 joints) whose records were drawn from the files and who had been evaluated for treatment other than for temporomandibular joint disorders (TMD). The control group was contacted telephonically...
To confirm they presented no symptoms and were made aware of their records being used anonymously. Study group patients were exposed to low-dose, high-resolution cone beam computed tomography using a Newtom® VGI CBCT machine. Similar radiographs were available in the files of the patients in the control group. Three-dimensional reconstructions of the condyles were made to allow full examination of the shapes of both the right and left condyles. Hence, 100 joints were examined. Osseous changes of the condyles that were recorded included: erosions, flattening, lipping, sclerosis and osteophyte formation. The patient’s gender and age were recorded to allow for correlation with the findings. P-values were obtained using Chi-squared test applied to a cross tabulation for each variable by group.

RESULTS
The mean age for the control group was 35.04 years and for the study group, 30.64 years. Neither age nor gender demonstrated any statistically significant significances in analysis. The relative prevalence of each of the variables examined are presented in Table 1, and graphically in Figure 1. In every instance except lipping, which showed equal findings for the right condyles, the study group recorded higher figures. However statistically significant differences were demonstrated only in the variable of sclerosis affecting the right condyle (p = 0.002).

<table>
<thead>
<tr>
<th>Osseous change</th>
<th>Study</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosions R</td>
<td>44%</td>
<td>36%</td>
</tr>
<tr>
<td>Erosions L</td>
<td>44%</td>
<td>32%</td>
</tr>
<tr>
<td>Flattening R</td>
<td>48%</td>
<td>40%</td>
</tr>
<tr>
<td>Flattening L</td>
<td>72%</td>
<td>56%</td>
</tr>
<tr>
<td>Lipping R</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Lipping L</td>
<td>16%</td>
<td>4%</td>
</tr>
<tr>
<td>Sclerosis R</td>
<td>72%</td>
<td>24%</td>
</tr>
<tr>
<td>Sclerosis L</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>Osteophyte R</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Osteophyte L</td>
<td>8%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Figure 1: Relative prevalences (%) of the various osseous changes observed in study versus control groups.
DISCUSSION
Osseous changes were observed in both the study and the control groups. In general, the study group demonstrated more evident changes with erosions (44%-32%), flattening (72%-40%) and sclerosis (72%-24%) being the more common findings. Lipping was relatively uncommon (16%-4%) and osteophyte formation (8%-0%) was the least frequently occurring change seen. These data confirm previous notions that normal physiological wear of the joint may result in some osseous changes of the condyles in middle to older age group patients having asymptomatic joints. Some of these may be associated with osteoarthritis such as erosions, lipping subchondral cyst and osteophyte formation (Figures 2, 3, 4). Erosion of the condyle is the earliest manifestation of degenerative changes.

CONCLUSION
Osseous changes of the condyles were found in both the study and control groups. Almost every characteristic, except lipping, showed a higher prevalence amongst the study group. A prolonged clicking of the TMJ warrants a clinical examination and an adequate radiographic examination preferably with CBCT, if available.

References
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Help patients **BEAT SENSITIVITY PAIN FAST**

As many as 1 in 3 people suffer from dentine hypersensitivity*. New Sensodyne Rapid Relief is clinically proven to deliver fast relief in just 60 seconds**,*** and long-lasting protection**** from dentine hypersensitivity*, helping to bring everyday improvements to your patients’ lives.*****

No.1 **DENTIST RECOMMENDED BRAND FOR SENSITIVE TEETH******

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Maxillofacial radiology case 160.

Below are two cases of a lesion that is not commonly seen in the jaws but has been found in most bones of the skeleton; however the majority occur in the long bones and in the spine. Discuss the radiological features and what is your diagnosis?

INTERPRETATION

Case 1 is a sixteen year old male (Fig.A) who presented with a history of a rapidly growing painful swelling in the lower left jaw causing displacement of the 37,38 (Fig.B) and ballooning expansion (red arrow) of the cortex (Fig.C). Case 2 is a fifteen year old female complaining of a fast growing swelling displacing and loosening of teeth in the lower right jaw. The cropped panormograph show a multicellular lesion (Fig.D). An Axial GT view of the lesion show an expansive ballooned-out appearance with a thin cortex outline and presence of internal trabeculation (Fig.E). Figure F is an Axial MR T2 image showing a hyper-intense lesion with septae and buccal and lingual expansion. A histological diagnosis of an aneurysmal bone cyst was made. The aneurysmal bone cyst is an uncommon lesion and is a very rare finding in the jaws. The true nature of the lesion remains uncertain, although most pathologists regard it as probably reactive. Although the lesion is characteristically cystic and blood filled, the term “aneurysmal bone cyst” was suggested by Jaffe and Lichtenstein (1942) who described the characteristic “blown out” contour of the bone seen in radiographs of the lesion. The aneurysmal bone cyst has a characteristic “ballooning” growth pattern which results in a radiolucent area with elevation of the periosteum to produce an oval or fusiform expansion of bone with the typical cortical expansion (Fig.G). The cyst constitutes only 1% of all non-odontogenic, non-epithelial cysts of the jaws. They most commonly occur in the long bones and the spine. Almost all lesions affecting the jaws present in the mandible, especially the posterior body and vertical ramus. They are found predominantly in young patients, rarely manifesting after the third decade of life with no gender predilection. Perforation of the cortex, pain and tenderness to palpation has been reported. Treatment of choice consists of enucleation with thorough curettage.

References:

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An alternative extra-oral digital technique for bitewing radiography.

SADJ May 2013, Vol 73 no 4 p265 - p267

Crombie K.1 Shaikh A.2 Harnekar SY.3

ABSTRACT

Introduction
The extra-oral technique, currently the standard method of taking bitewing radiographs, is challenging, especially in children, and in patients with limited mouth opening.

Objectives
To assess an alternative, extra-oral, digital technique for bitewing radiographs.

Methods
26 patients requiring bitewing radiographs were selected seriatim. A split mouth technique was used, taking an analogue intraoral bitewing radiograph on one side, and a modified, digital, posterior, segmental panoramic of the contralateral side. Two calibrated observers evaluated the bitewing images, using a viewing box, and assessed the digital modified posterior segmental panoramic images, using a computer monitor.

Results
No statistically significant association was shown between the operators and the techniques used, i.e. it is not technique or operator sensitive.

The extra-oral technique recorded perfect agreement (k=1) between the two observers for the categories of overlapping of teeth and area of coverage. For clarity of the alveolar crest there was strong agreement (k=0.8).

There was perfect agreement (k=1) between the two observers for all three categories examined on the intraoral bitewing radiographs.

Conclusion
An alternative and diagnostically accurate bitewing radiograph can be produced by modifying the patient positioning when taking a digital posterior segmental panoramic.

INTRODUCTION

The bitewing radiographic film is the most widely used intraoral radiographic technique. It is currently the standard method of taking bitewing radiographs for oral and dental diagnostic evaluation. Bitewing radiographs typically show the contact surfaces from the distal of the canines to the most distal molars and are usually taken bilaterally. The indications for bitewing radiographs include diagnosis of proximal caries, assessment of the extent of the caries, identification of secondary caries under existing restorations and the assessment of the periodontium.5-11

This technique can be challenging especially in patients who are resistant to the placement of a radiographic film within the oral cavity due to problems related to discomfort, pain and stimulation of the gag reflex. Patients may displace the film, reject the Finn holder, or reposition the film after placement, resulting in the failure of, or an inadequate, radiographic image. Difficulties may be further compounded in paediatric patients, and those who are anxious and fearful, patients with special needs and those presenting with trismus.

The method is also technique sensitive and errors will occur if the principles of the technique are not applied. The most typical errors that can occur are in the placement of the film, the vertical and horizontal angulations and the centering of the central ray of the x-ray beam.

Various other alternatives to the conventional bitewing radiographs have been suggested in the literature, including, intraoral as well as extra-oral techniques. Modifications to the intraoral technique include: adjustments of the film packet (softening the corners, bending occlusal film in half), adaptation of the film holder (tongue depressor and rubber bands), various devices for film holder and patient jaw (mouth props, helmet with chin strap, Velcro strips). Modifications of the films (reverse bitewing i.e. placed in buccal vestibule). The extra-oral techniques that have been recommended are the lateral oblique technique and the conventional panoramic. However, these techniques prove to be inadequate as they show poor detail, excessive superimposition and distortion.5-7

Scardie (1994)6 and his associates compared the diagnostic accuracy of orthogonally projected panoramic image with conventional panoramic radiograph for the detection of interproximal caries, using the conventional intraoral bitewing radiograph as a benchmark. They concluded that the orthogonal projection did not improve the diagnostic accuracy as had been suggested.

Newman and Friedman (2003)3 devised an aiming procedure for an extra-oral radiographic technique using a modified locating device which proved to be well tolerated by patients. One of the major shortcomings of this procedure is that it still requires patient cooperation. Another shortcoming was the repeated cone cutting that was obtained when the device was tested subsequently by Chen et al (2007).14

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As a result of these challenges, an alternative extra-oral digital technique was devised and tested.

The purpose of this study was to assess that technique for taking bitewing radiographs.

MATERIALS AND METHODS
The Kodak 8000 Digital Panoramic System allows for sectional imaging of the panoramic view, of the two posterior segments extending from the condyle to the molars, and of an anterior segment extending from the canine to the canine (Fig 1).

![Figure 1: Standard posterior sectional images](image1)

The posterior sectional function offered the potential for some modifications to be effected to optimize the view so as to obtain a view similar to that of a bitewing radiograph (Fig 2).

![Figure 2: Modified sectional images](image2)

To obtain the modified sectional extra-oral digital bitewing radiograph the patient is repositioned more posteriorly so that the corner of the mouth laser beam coincides with that of the mid-sagittal laser beam (Fig 4).

This modified technique was first tested on a phantom head.

Modification to the Sectional technique
The patient position for the standard panoramic view is obtained with the aid of three reference laser beams: ala-tragus line, mid-sagittal plane and the corner of the mouth (Fig 3).

![Figure 3: Standard positioning for pantomogram](image3)

Patients presenting for bitewing radiographs were considered for the study sample. Adult patients with no overlapping, displaced or crowded teeth in the buccal segments were invited to participate in the study. The purpose of the study was explained to the patient. Each was reassured that the procedure involved no additional exposure or cost. Patients willing to participate were given written information and subsequently signed a consent form.

Participants were given the option to withdraw from the study at any stage without any consequences or compromise to further management.

A total of 26 patients were selected.

Materials and Methods
A split mouth technique was used, taking a standard intraoral bitewing radiograph on one side, and the modified extra-oral radiograph of the contralateral side.

A size 3 Kodak Ultra-speed film was placed in a bitewing Rinn holder which was positioned in the mouth, and the film exposed by a GE 1000 intraoral machine, with exposure factors of 70kV 10mA 0.8s. The accompanying radiograph of the contralateral side of the same patient was taken on a Kodak 8000 Digital Panoramic System, using the modified, extra-oral technique with exposure...
factors of 70kV x 10mA 13s. All the radiographs were captured by the same operator.

The techniques were alternated between the left and right sides of each consecutive patient. The images obtained were numbered and randomized prior to evaluation. Two calibrated observers viewed and assessed the images.

A total of 26 pairs of radiographs (intraoral and extra-oral) were evaluated. The extra-oral (digital images) were viewed in a darkened room on a 39cm monitor with a resolution of 1024 x 768 pixels. The intraoral bitewing (analogue) radiographs were all viewed on the same viewing light box in a darkened room. These images were independently assessed in random sequence. The variables assessed included crown overlap, clarity of the alveolar crest and area of coverage from the 1st premolar to the 3rd molar area using the following criteria:

1. Overlap of crowns (yes/no).
2. Clarity of alveolar crest (clear/unclear).
3. Area of coverage to include the 1st premolar to the most distal molar (yes/no).

The data were captured and analysed using the Microsoft Excel and the SPSS packages respectively.

Inter-examiner correlations were determined by means of the kappa test. A non-parametric test (Fisher exact test) was used to compare the data between the two techniques.

The following criteria were used to interpret the K value:

<table>
<thead>
<tr>
<th>Value of Kappa</th>
<th>Level of Agreement</th>
<th>% of Data that are Reliable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>None</td>
<td>0-4%</td>
</tr>
<tr>
<td>.21-39</td>
<td>Minimal</td>
<td>4-15%</td>
</tr>
<tr>
<td>.40-59</td>
<td>Weak</td>
<td>15-35%</td>
</tr>
<tr>
<td>.60-79</td>
<td>Moderate</td>
<td>35-63%</td>
</tr>
<tr>
<td>.80-90</td>
<td>Strong</td>
<td>64-81%</td>
</tr>
<tr>
<td>Above .90</td>
<td>Almost Perfect</td>
<td>82-100%</td>
</tr>
</tbody>
</table>

RESULTS

There was perfect agreement (κ=1) between the two observers for all three categories examined on the intraoral bitewing radiographs (Table 1).

Table 1: Level of agreement between the two observers for the intraoral bitewing radiograph

<table>
<thead>
<tr>
<th>Level of agreement (Kappa)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlapping of teeth</td>
<td>1 (Perfect)</td>
</tr>
<tr>
<td>Clarity of alveolar crest</td>
<td>1 (Perfect)</td>
</tr>
<tr>
<td>Area of coverage</td>
<td>1 (Perfect)</td>
</tr>
</tbody>
</table>

Table 2: Level of agreement between the two observers for the extra-oral radiograph

<table>
<thead>
<tr>
<th>Level of agreement (Kappa)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlapping of teeth</td>
<td>1 (Perfect)</td>
</tr>
<tr>
<td>Clarity of alveolar crest</td>
<td>0.8 (strong)</td>
</tr>
<tr>
<td>Area of coverage</td>
<td>1 (Perfect)</td>
</tr>
</tbody>
</table>

For the extra-oral technique there was perfect agreement (κ=1) between the two observers for two of the categories examined, i.e., overlapping of teeth and area of coverage. For the clarity of the alveolar crest there was strong agreement (κ=0.8) (table2).

When a comparison was made between the two techniques with respect to the three criteria used, there was no association between the operators and the techniques used, i.e. it is not technique or operator sensitive (Table 3).

<table>
<thead>
<tr>
<th>Observer</th>
<th>Overlapping of teeth (p)</th>
<th>Clarity of alveolar crest (p)</th>
<th>Area of coverage (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.407</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>B</td>
<td>0.402</td>
<td>1.0</td>
<td>0.6</td>
</tr>
</tbody>
</table>

This confirms that the proposed extra-oral technique can be considered to be an acceptable substitute for the traditional intraoral bitewing radiograph.

DISCUSSION

The modified technique was able to repeatedly produce diagnostically satisfactory digital bitewing radiographs. As observed, the use of the intraoral bitewing film and the film holder can be uncomfortable, overwhelming, painful, and is even rejected by some patients, particularly patients with very small mouths as well as children. None of the patients showed any objection or hesitation in the taking of the extra-oral radiographs with the panoramic system.

CONCLUSION

This supports the hypothesis that an alternative, extra-oral, digital technique for taking bitewing radiographs may be clinically relevant among patients for whom the intraoral bitewing technique is particularly difficult to obtain, namely paediatric and other special needs patients.

Using the option of the posterior segmental program in the digital panoramic system, with modification of patient positioning produces an image comparable to the traditional intraoral bitewing radiograph.

Permission to reproduce the photographs was granted.

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Antibiotic release from leukocyte- and platelet-rich fibrin (L-PRF) – an observational study.

Peck MT,1 His D,1 Stephen L,1 Maboza E.4

ABSTRACT
Introduction
Leukocyte- and platelet-rich fibrin (L-PRF), an autologous derived platelet and leukocyte concentrate, was first introduced by Choukroun et al. in 2001 and is currently used in a wide range of medical procedures. Although various biological properties have been attributed to L-PRF, nevertheless, when tested for inherent antimicrobial activity, the biomaterial fails to demonstrate a clear and significant effect against a range of oral microbiota. Aims and objectives: To determine whether L-PRF prepared after a single oral dose of antibiotic had any significant antimicrobial effect over a 48 hour period. Methods: An in-vitro laboratory study for which L-PRF was prepared from a single healthy volunteer who had previously ingested oral antibiotics. The resultant prepared L-PRF was tested for antimicrobial activity against Streptococcus mutans (ATCC 35668) using standard laboratory methods. Results: For all samples tested, measurable zones of inhibition were clearly visible after 24 hours, but were absent after 48 hours. Conclusions: L-PRF prepared after a single dose of oral antibiotic results in a measurable antimicrobial effect that is sustainable for 24 hours. Although L-PRF will remain structurally intact for a few days, it does not appear to influence the duration of the antimicrobial activity.

Introduction
Leukocyte- and platelet-rich fibrin (L-PRF), an autologous blood-derived biomaterial, was first introduced by Choukroun et al. in 2001 as a simple method of introducing autogenous growth factors to a wound site.1 Since then, L-PRF has been utilized for a number of medical procedures, including the management of diabetic wounds, soft and hard tissue augmentation and dermatological lesions.2–4 L-PRF is prepared using a single spin protocol that results in an easily manipulated biomaterial that can be applied directly to the site of a surgery.1 The structure of this biomatrix, which consists of a platelet and leukocyte concentrate interwoven within a fibrin mesh, is claimed to be one of the major factors that contribute to its clinical success. Previous studies indicate that the unique characteristic of fibrin make it an ideal drug delivery system that allows the distribution of an active agent directly to the site required.4 The fact that fibrin undergoes fibrinolysis over a period of time, has the potential of prolonging the drug release and may therefore influence the clinical outcome. Previous studies have combined antibiotics with fibrin (mostly fibrin sealants) for the management of various conditions such as osteomyelitis, endocarditis, and other “difficult to treat” infections.5–11

Although various biological properties have been attributed to L-PRF, nevertheless, when tested for inherent antimicrobial activity, the biomaterial failed to demonstrate a clear and significant antimicrobial effect against a range of oral microbiota.12 We hypothesize that incorporating antibiotics into L-PRF may enhance its antimicrobial profile and that the structure of the L-PRF would allow for a prolonged release of the drug. The aim of this in-vitro pilot study was to determine whether L-PRF prepared after a single oral dose of antibiotic had any significant antimicrobial effect over a 48 hour period.

MATERIALS AND METHODS
The study was conducted at The University of the Western Cape, Cape Town, South Africa, in 2017. Ethical clearance was obtained from the University Research Ethics Committee (reference number: BM 16/3/31). Informed consent was obtained from the blood donor.

Preparation of the L-PRF
Thirty six milliliters of blood were obtained from a 24 year old healthy female volunteer who had undergone dental implant surgery. She had ingested a single dose of antibiotics, as surgical prophylaxis (Amoxicillin, 2 g orally), one hour prior to the surgical procedure. One hour after antibiotic ingestion, blood samples were collected in blood collecting tubes that contained clot activator, i.e., Vacuette® 9ml serum tubes with Z Serum Clot Activator (Greiner BioOne International AG, Germany). These were then immediately centrifuged at 400 × g for 12 minutes in a standard benchtop centrifuge (PLC-03, HiCare International, Taiwan) as previously described.12 Some of the resultant L-PRF clots were then used during the surgical procedure, whilst the remaining clots were used for the current study. These L-PRF clots were then compressed using the PRF Box™ (Process for PRF, Nice, France) to obtain uniform thickness of the sample specimens, two of which were selected and designated as Sample and Sample Two respectively.

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ACRONYMS
L-PRF : Leukocyte- and platelet-rich fibrin
Microbial Culture
The Oral and Dental Research Laboratory (Faculty of Dentistry, University of the Western Cape) sponsored samples of Streptococcus mutans (ATCC 35668, Quantum Biotechnologies, South Africa) for the study. The authenticity of the bacteria was confirmed via Gram stain, growth morphology on blood agar and API STREP 20 system (bioMérieux). Cultures were grown for 24 hours at 37°C. Two colonies were adjusted to 0.5 McFarland's standard (DensiCHEK PLUS, bioMérieux) in sterile physiological saline. One milliliter (1 ml) of the adjusted colonies was then spread plated on CASO agar (Merk Life Science GmbH, Germany).

Antimicrobial activity
The samples of prepared L-PRF were of comparable size and thickness due to the standardized protocol utilized in preparation. Each sample was placed in the centre of a bacteria-streaked agar plate and then incubated for 37°C in a standard laboratory incubation chamber for 24 hours. At that stage the plates were removed and the clear zones surrounding each L-PRF sample (zones of microbial inhibition), were repeatedly measured using a digital vernier caliper (Mastercraft, South Africa). In order to test the antimicrobial efficacy over the subsequent 24 hours, the samples were removed and placed in a fresh bacteria-impregnated agar plate. The plate was incubated for 24 hours as before and the inhibition zones again measured.

DATA ANALYSIS
Data from the test samples were captured using Microsoft Excel 2010 (Microsoft Corporation, Washington, USA) and statistically analyzed using one-way ANOVA and Tukey’s test.

Table 1: Zones of inhibition measured in millimeters

<table>
<thead>
<tr>
<th></th>
<th>24 Hours (Sample 1)</th>
<th>24 Hours (Sample 2)</th>
<th>48 Hours (Sample 1)</th>
<th>48 Hours (Sample 1)</th>
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<tr>
<td>33.97</td>
<td>29.41</td>
<td>0</td>
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<tr>
<td>41.57</td>
<td>42.70</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>32.20</td>
<td>31.22</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>29.53</td>
<td>44.03</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>32.90</td>
<td>31.99</td>
<td>0</td>
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</tr>
<tr>
<td>32.91</td>
<td>47.15</td>
<td>0</td>
<td>0</td>
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<tr>
<td>39.65</td>
<td>47.06</td>
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<tr>
<td>40.75</td>
<td>31.82</td>
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</tr>
<tr>
<td>35.11</td>
<td>42.82</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>41.33</td>
<td>31.60</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS
The 24 and 48 hour results were recorded as the observable zones of inhibition in millimeters and are represented in Table 1. Zones of inhibition were noted for both L-PRF samples after 24 hours. According to statistical analysis using one-way ANOVA and Tukey’s HSD Test, no significant differences were noted for the sizes of inhibition zones when the two samples were compared after 24 and 48 hours, i.e., similar results were recorded at both 24 and 48 hours. No measurable inhibition zones were seen for either sample after 48 hours (Table 2), indicating that all antimicrobial activity had been lost at that time. A statistically significant difference was seen in the data between the two time points.

DISCUSSION AND CONCLUSIONS
Repeated systemic use of antibiotics to treat or minimize localized infection has its limitations, especially in areas with constrained blood supply. Furthermore, localized drug delivery systems often require specialized carriers to allow for the delivery of therapeutically sustainable doses of the active agent. In the present study we attempted to determine whether using an antibiotic-laden autologous blood-derived concentrate had any significant antimicrobial effect over a period of time. The results from the current study indicates that L-PRF prepared after a single dose of antibiotics provides measurable antimicrobial activity for at least 24 hours against specific oral microbiota. After 48 hours, the antimicrobial effect is markedly reduced, with no statistically relevant antimicrobial effect seen. This may suggest that although L-PRF has a unique structure, its ability to concentrate antibiotics and release them over time, may be limited. This has been seen in previous studies in which fibrin sealants directly supplemented with antibiotics showed a rapid antibiotic release over a short period of time (85% over 72 hours).24,25 Woolverton et al. (2001) attributed this to rapid diffusion as a result of the antimicrobial molecules being small, ionically charged, and designed for oral and parenteral delivery.6 However, antibiotics having a less soluble nature, unlike the current study, have been shown to exhibit a much longer sustained release from fibrin sealants.11 Another reason for the rapid diffusion of antibiotics from L-PRF may be the limited binding capacity of the antibiotic used in the present study. Amoxicillin, when orally ingested, is 20% protein bound in the blood and about 60% of the drug is excreted in the urine within 6-8 hours.14 The protein binding is mostly to albumin (the most abundant plasma protein) which has a specific binding site but a relatively low affinity for the antibiotic.13 The drug has no known affinity to fibrin and this may explain the limited antimicrobial effect observed in the present study. It is therefore assumed that the drug was concentrated in the plasma component of the L-PRF and not directly bound to the fibrin or cells associated with the L-PRF matrix.

Unlike previous studies that have directly combined the antibiotic with the fibrin matrix, we attempted to incorporate antibiotics that were already in the blood (at peak plasma concentration) during the process of preparing the L-PRF matrix. This has the advantage of not requiring any additional materials or steps in incorporating the antibiotic into the L-PRF. Interestingly, certain clinical studies involving the use of L-PRF for dental surgical procedures have made use of oral antibiotic surgical prophylaxis prior to preparing L-PRF.23 In these studies, no mention was made of the influence of antibiotic ingestion in the healing outcomes of the site treated with the L-PRF. The present study indicates that antibiotics are presumably incorporated into L-PRF after a single oral dose and may be active for at least 24 hours. We can therefore presume that the clinical studies that have administered antibiotics prior to surgery, have indeed incorporated antibiotics into the L-PRF, if the L-PRF was prepared at least one hour after antibiotic prophylaxis. A further investigation into the influence of pre-operative antibiotics as a factor influencing the clinical behaviour of L-PRF is therefore required.

CONCLUSION
L-PRF has restricted intrinsic antimicrobial activity. Within the limitations of the present study, we have shown that L-PRF prepared after a single dose of oral antibiotic, results in a measurable antimicrobial effect that is sustainable for 24 hours. Although L-PRF will remain structurally intact for a few days, this does not appear to influence the duration of the antimicrobial activity.
activity. We therefore assume that the antibiotic is mostly concentrated in the plasma and is not directly bound to the structural components of the I-PRF matrix. Further research is required to determine the significance of these preliminary findings.

Conflict of interest.
The authors declare no conflict of interest regarding the publication of this paper. This paper forms part of the requirements for partial fulfillment of the degree PhD.

References
Genetics in Oral Health: The Need for Human Genetics in the Dentistry Curriculum.

SADJ May 2018, Vol 73 no 4 p271 - p273

Roberts T,1 Yip WK,2 Mofokeng LN,1 Hijarunguru N,1 Ngaxa K,1 Mathura T,1 Moosa A,1 Mandoma N,1 Tsotso T,1 Magageni Y,1 Shivambu V,11 Aborass M,11 Chetty M.11

ABSTRACT

Introduction
Genetic and genomic research has improved understanding of the genetic origins of growth, development and disease. Dentists may encounter genetic disorders or oral manifestations of a genetic-based systemic disease, and need to have a sound understanding of genetics if accurate information is to be given to patients. No known studies that have evaluated the option of an undergraduate course in genetics.

Aim
To establish this need at the University of the Western Cape, South Africa.

Methodology
A cross-sectional, observational survey was conducted in 2017.

Results
Ninety-seven dental students and 21 staff members participated. All knew that genetics was not included in the undergraduate dental programme; 13% knew that there had been no course in the past; 34% felt confident in their knowledge; 29% were ill-equipped to communicate with other medical clinicians about genetic disorders; 77% of all participants expressed the need for genetics education in dentistry.

Conclusion
There is a significant lack of knowledge and confidence of both staff and students to treat patients with genetic conditions. A formalized course in human genetics should be incorporated into the dental curriculum at the Dental Schools in South Africa.

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5. Ngaxa K,1
6. Mathura T,1
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INTRODUCTION
Genes are what constitute the human genome. They determine the characteristics of individuals and are transferred from one generation to the next. The human genome project, published in 2001, is considered the most important scientific accomplishment in history.1 The information emanating from this project led to an understanding of the role of genetics in the aetiology of several diseases and disorders. Mutations in the genome results in genetic conditions, many of which are heritable. Phenotypic expression of genetic aberrations can affect any tissue or organ including those in the head and neck. There are approximately 5,500 known inherited diseases in humans and more than 700 involve craniofacial malformations (www.nidcr.nih.gov, 2017). According to Smith’s Recognizable Patterns of Human Malformation, 12 of the 26 categories of malformations used for diagnostic purposes involve features of the head or neck and several are limited to oral structures.2 The influence of genes in the development of oral disorders, including dental caries, periodontal disease and malignancies of the oral cavity is becoming apparent. Likewise, the effects of genetic diseases on oral structures are becoming evident.

In order to discuss the genetic factors and the impact of genetic disorders in oral health care and to manage and treat patients appropriately, it is important for dental clinicians to have a comprehensive knowledge of genetics. A sound understanding of genetic susceptibility, lifestyle, and oral health risk factors allows the dentist to offer effective preventive and treatment strategies for oral diseases. An understanding of the molecular biology of bone, periodontal structures, salivary gland, and tooth development could lead to innovative treatment approaches that may differ from dentistry’s current surgically based techniques. Tissue engineering in terms of cell manipulation such as the development tissue such as skin, bones, and cartilage has already been explored. Advances in drug delivery, gene therapy, and biopharmaceuticals are creating new therapeutic methods that vastly differ from those currently in practice.3

The foundations of academic and clinical dental practices are embedded into the undergraduate dental curriculum. The introduction of genetics education during the formative phases of training will have a significant influence on the incorporation of this field into oral health care. Consequently, dental graduates will be equipped with a basic knowledge of genetics and skills for understanding and applying this to clinical practice. Foundational compulsory skills in genetics for all health care professions have been established in the United States of America.4 In South Africa, however, the core knowledge in this field remains underdeveloped for dental professionals.

In view of the expanding interest in genetics and its application in oral health and disease, the authors conducted a questionnaire-based survey of senior undergraduate and postgraduate dental students and staff members at the Faculty of Dentistry, the University of the Western Cape, South Africa. The main purpose
of the investigation was to assess the need for human genetics and genomics in the dental curriculum at the University of the Western Cape. The objectives were to determine:

- Whether there is an established genetics course for undergraduate and postgraduate students,
- The current status of human genetics and genomics in the dental curriculum at the University of the Western Cape,
- The manner in which genetic concepts are integrated into various courses at the Faculty of Dentistry,
- The perceived need for genetic education into the dental curriculum.

**METHODOLOGY**

**Study Design**

The study was a cross-sectional, observational study in the form of a survey and was conducted between July and October 2017. It enabled the researchers to analyze various factors simultaneously and was conducted for health planning and curricula purposes. Ten undergraduate dental students interviewed the participants on separate occasions.

**Study Population**

The research population included the part-time and full-time academic staff, 4th and 5th-year undergraduate dental students and postgraduate dental students at the Faculty of Dentistry, the University of the Western Cape, Tygerberg Oral Health Care Centre.

**Generalizability**

This study is applicable, but not limited to, the UWC Faculty of Dentistry. The results of this study would be practical and relevant to all dental schools in South Africa.

**Sample Size**

A total of 118 individuals participated. The following tools were used:

- A questionnaire
- Excel spreadsheet for the capture of data
- Epi-info to analyse the data

The survey form contained 14 individual questions specifically constructed to determine the participants’ awareness of the dental curriculum and the clinical relevance of genetics in dentistry. None of the questions was open-ended.

**Validity**

Validity was obtained to eliminate bias.

**Logistics**

Each group member presented the questionnaire to participants. The data were collected and collated and into an Excel spreadsheet and made suitable for statistical analysis.

**Ethical consideration**

Ethical clearance was obtained from the University of the Western Cape’s ethical committee. This study was conducted in accordance with the guidelines of the Declaration of Helsinki. There was no conflict of interest. Informed consent was obtained from all participants and full disclosure of the purpose, methods, alternatives, associated risks and benefits were verbally conveyed to each participant prior to conducting the questionnaire. The consent form was read in one of three of the predominant official languages spoken in the region. Participant confidentiality was maintained throughout the study. Participation was voluntary and could be withdrawn during any phase of the investigation. All participants will be informed of the outcome of the study post completion.

**RESULTS**

The total number of participants was 118 of whom 97 were students and 21 were academic staff from the UWC Dental School.

All participants knew that a formal background of genetics was not a prerequisite to enter the dental school.

Figure 1 shows the percentages for the various answers for different categories of participants (i.e. ‘staff’, ‘students’ and ‘staff-student’) pertaining to the genetics course. About 61% of all participants (‘staff-student’) did not know whether there had been a genetics course in the past at the Faculty of Dentistry. Twenty-three percent (23%) were unable to answer the question while 13% said there was not a course and only 2% affirmed there was a genetics course in the past.

Figure 2 shows the percentages of different genetic disorders reported by participants as being common at the Dental Faculty for different categories of participants. Cleft palate and Down’s syndrome were documented as the most common disorders (68% and 33% respectively). The frequency of these genetic disorders was followed by Amelogenesis imperfecta (17%). Dentinogenesis imperfecta (9%) and Ectodermal dysplasia (2%) in that order. Thirty-nine percent of academic staff suggested Cleft palate as the most common disorder, while the frequency of Down’s syndrome and Amelogenesis imperfecta were equally suggested by 26% of the staff. Conversely, 46% of students suggested Down’s syndrome was the most common disorder followed by Cleft palate (33%), Amelogenesis imperfecta (9%) and Dentinogenesis imperfecta (8%).

Figure 3 shows the percentages of the answers for the different categories of participants with reference to the ability of dental clinicians to treat patients with genetic abnormalities on their own. Thirty-nine percent of all the participants could not provide an answer to this question. Of the remaining 61%, only 34% of the participants felt confident to treat patients with genetic abnormalities compared with 27% who did not. This percentage ranking for all participants is further supported by the staff and student categories. Overall, approximately 63% of all participants acknowledged that dental clinicians are able to treat patients with genetic abnormalities on their own while 70% felt otherwise.

Figure 4 shows the percentages of the various answers pertaining to the different categories of participants concerning their ability to communicate with other medical clinicians about genetic abnormalities. The histograms revealed that an overall of 60% of all participants was confident that they could communicate with other clinicians. However, there was a disparity between the percentages of staff and students (71% and 49% staff and students respectively). Moreover, 29% of students felt ill-equipped to communicate with other medical clinicians and 22% of students did not answer the questions.

Figure 5 shows the percentages for the various answers for different category of participants pertaining to their knowledge in recognizing genetic abnormalities in dentistry. The data show that 32% of all participants felt that they had the necessary knowledge, 35% stated they did not have the necessary knowledge and 33% did not know whether they had knowledge adequate to recognize genetic abnormalities in dentistry.

Figure 6 shows the percentages for different categories of participants to assess the standard of knowledge in genetic disorders in dentistry. Only 10% of all the participants feel that their level of knowledge is good which suggests that there is insufficient knowledge in genetic disorders. This is also an indication of the need for such a course at the Dental school.

Eighty percent of all participants rated the specified conditions as important in dentistry.

The percentages of different participant categories rating the importance of individual dental condition are shown in Figures 8 to 10. More than 90% of all participants regarded Osteogenesis imperfecta Type 3 and Cleft palate as important dental conditions (Figures 8 and 9). Greater than 70% of all participants rated periodontal disease as an important dental condition compared with 22% of students who considered it as unimportant (Figure 10). Fifty-four percent of all participants rated Dental caries to be important in dentistry compared with 46% who considered it unimportant.
Genetics in Oral Health: The Need for Human Genetics in the Dentistry Curriculum.

Figure 1: A Bar graph showing awareness of whether there was a genetics course in the past.

Figure 4: A Bar graph showing whether participants could communicate with other medical clinicians regarding genetic abnormalities.

Figure 2: A Bar graph showing genetic disorders perceived to be the most commonly seen at the Dental Faculty.

Figure 5: A Bar graph showing whether participants thought that they had sufficient knowledge to recognize genetic abnormalities in dentistry.

Figure 3: A Bar graph showing the perception of whether participants were able to treat patients with genetic abnormalities on their own.

Figure 6: A Bar graph showing the perception of the participants’ knowledge pertaining to genetic disorders in dentistry.
Figure 7: A Bar graph showing the importance of certain dental conditions (e.g. Cleft palate, Osteogenesis imperfecta Type 3, Dental caries and Periodontal disease) in dentistry.

Figure 8: A Bar graph showing the level of importance of Osteogenesis imperfecta Type 3 as a dental condition.

Figure 9: A Bar graph showing the importance of Cleft palate in dentistry.

Figure 10: A Bar graph showing the importance of Periodontal disease in dentistry.

Figure 11: A Bar graph showing the importance of Dental caries in dentistry.

Figure 12: A Bar graph showing the need for genetics in dentistry.
Figure 12 shows the percentages for the various answers for different categories of participants with regard to the need for genetics in dentistry. The results show that 77% of all participants agree there is a need for genetics education in dentistry.

**DISCUSSION**

The main purpose of the investigation was to assess the need for human genetics and genomics in the dental curriculum at the University of the Western Cape.

All participants were aware that a genetics course was not an entrance requirement to dental school. The status quo at this faculty is similar to dental faculties in the United States of America (USA). A survey conducted in the USA in 2004, reported that only one out of 53 dental schools required formal training as a prerequisite. However, the dental students in the remaining schools had genetics topics integrated into various subjects during their undergraduate training. The importance of genetics is highlighted by the influence of hereditary factors in the development of common oral conditions including periodontal disease, caries, and oral cancer. For this reason, dental clinicians require to be confident to discuss issues including the genetic basis for common oral health problems and various genetic susceptibility tests with their patients and offer effective preventive and treatment strategies for oral diseases.

Eighth-five percent of the participants were unaware of any designated genetics course in the dental curriculum at the University of the Western Cape in the past (Fig. 1). The high figure suggests that the participants either showed minimal interest in genetics or genetics may not have been a priority at the Dental Faculty. The absence of a formal genetics course in dentistry at the Dental Faculty, UWC, is not unique. Dudicke (2004) stated that 8 of 53 schools in the US had a designated genetics course in the undergraduate curriculum. In many instances, however, and as observed above, genetics was integrated into other courses including the basic sciences and clinical disciplines.

Interestingly, Cleft palate and Down’s syndrome were perceived to be more common (overall 38%) than other genetic abnormalities at the Dental Faculty. Both conditions have distinct clinical features and are easily recognizable. However, more than 60% of all participants were unsure of their ability to recognize genetic abnormalities in dentistry (Fig. 5). This figure supports the previous concept that genetic disorders with distinct clinical features are easier to identify than those with inconspicuous changes.

Participants who indicated that they were unable to recognize genetic abnormalities in a clinical setting were asked to select reasons from a list. The most common cause reported was limited exposure to genetic abnormalities in a clinical setting, followed by inadequate knowledge of genetic disorders. The most alarming response from a minority of dental students was a lack of interest in genetic abnormalities in dentistry. The students’ lack of knowledge may have impacted on their attitude and confidence toward genetic conditions in dentistry.

Seventy percent of all participants perceived that the majority of dental clinicians lacked the essential knowledge to treat patients on their own (Fig. 3). These results are contradictory to a survey conducted at the University of Texas School of Dentistry, Houston in 2014 that included 393 participants comprising 240 being dental students, 64 oral hygiene students and 89 dental residents. Several participants in the Houston study completed one or more formal courses in genetics. Of these, 49% agreed or strongly agreed that they were knowledgeable in basic genetics concepts and 68% agreed or strongly agreed that genetics is relevant to oral health care.

A poor knowledge of genetic disorders has the potential to hinder the ability of the clinician to recognize, treat and manage patients with genetic abnormalities. It has been suggested that the most effective approach for teaching decision-making skills to health care providers are case studies. Moreover, the authors suggested that these strategies could be structured and personalized to meet specific educational need. Furthermore, case-based studies also allow students to master required skills in less time and with fewer “live” patient sessions.

Only 8% of the participants felt confident to treat patients with genetic abnormalities (Fig. 8). The perception of lack of knowledge pertaining to genetic conditions may be the result of the absence of formal training in the field and may have had a significant impact on the confidence of the clinicians to treat these patients and to communicate with other medical staff about genetic conditions (Fig. 4).

More than 90% of all participants regarded Osteogenesis imperfecta Type 3 and Cleft palate as important genetic conditions in dentistry (Figs. 8 and 9). Greater than 70% of all participants rated periodontal disease as an important dental condition compared with 22% of students who considered it as unimportant (Fig. 10). Fifty-four percent of all participants rated dental caries to be important in dentistry compared with 48% who considered it unimportant (Fig. 11). The majority of the participants regarded Osteogenesis imperfecta type III and Cleft palates as more important than more common oral conditions and dental caries. The reasons could include a deficient knowledge regarding the genetic contribution toward the more common dental disorders.

**CONCLUSION**

The results of this survey indicate that students and clinicians have limited training and experience pertaining to genetics in dentistry. The absence of formal training and lack of clinical exposure to patients with genetic disorders may compromise their ability to identify these and impact on their options of managing these patients more holistically. New undergraduate and postgraduate programs could assist training and educating the faculty to appreciate the relevance of genetics in health care.

**References**

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Diabetic status of patients presenting for dental treatment.

SADJ May 2018, Vol 73 no 4 p274 - p277
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ABSTRACT

Introduction

Untreated Diabetes mellitus (DM) has severe long-term complications. In 2008, DM affected 4.6% of the South African population.4 Glycemic status is an indicator of the blood glucose levels.

Aim and objectives

To assess the glycemic status and presence of intra-oral soft tissue lesions in a sample of patients presenting at UWC Maxillofacial outpatient clinic.

Design and Methods

A cross-sectional observational study was carried out on 400 adult patients, 18 years or older. Pregnant patients were excluded. Random blood glucose levels (RBG) were measured in mmol/L on samples of peripheral blood (finger prick) using a glucometer.

Results

Of the 400 patients, 51 (12.7%) were either known diabetic patients or newly diagnosed (prediabetic and diabetic) and 15 (29.4%) of these 51 patients were unaware of their status (undiagnosed). Of the diabetic patients (n=40), 17 (42.5%) had soft tissue lesions, which occurred in 137 of the 349 patients having normal blood glucose levels (39.2%). Oral candidiasis was seen in 25% (n=10) of diabetic patients, compared with the prevalence of 18.3% amongst those with normal blood glucose levels (n=64 out of 349).

Conclusion

The study supports the need for general screening of all patients to facilitate early diagnosis of this disease.

INTRODUCTION AND LITERATURE REVIEW

Diabetes Mellitus (DM) is the most prevalent endocrine disorder, affecting approximately 6% of the population worldwide.5 In 2010, the global prevalence amongst adults aged 20-79 years was 6.4%, and is projected to be 7.7% by 2030.

In developed countries, the increase between 2010 and 2030 is expected to be approximately 20% and may be as high as 69% in developing countries.5 Similarly, the prevalence of type 2 DM in children and adolescents is on the increase and appears to be related to obesity, DM, commonly referred to as diabetes.

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ACRONYMS

DM : Diabetes Mellitus
RBG : Random Blood Glucose

is becoming more common in younger persons, highlighting the need for prevention and early diagnostic strategies, to reduce treatment demand and morbidity of diabetic related complications.6

A substantial proportion of any population remains undiagnosed (undiagnosed) because diabetes has an asymptomatic, latent period during which the disease is not clinically detected. Diabetes is referred to as a “silent killer” because, if not diagnosed early, it results in acute and/or chronic complications. Acute complications include hyperglycemia, hypoglycemia and ketoacidosis. Chronic complications comprise retinopathy, neuropathy, nephropathy, cardiovascular complications, delayed wound healing and death, especially in poorly controlled and pregnant diabetics.7

Diabetes is a metabolic disorder caused by an absolute or relative deficiency of insulin. This can be due to low insulin production by the pancreatic beta cells, or insulin resistance in the peripheral tissues.8 When insulin is lacking or its action is stopped, glucose cannot enter cells and this results in loss of energy and weakness. In addition, glucose accumulates in the blood (hyperglycemia) and overflows into the urine (glycosuria) with subsequent increased urine volume (polyuria).

Prediabetes (intermediate hyperglycemia) is defined by a blood sugar level that is higher than normal but not high enough to be diabetic. The glycemic variables are higher than normal, but lower than diabetes thresholds. Without lifestyle changes, prediabetics are at risk of progressing to type 2 diabetes.3

Haemoglobin A1C test (HbA1c) is the gold standard confirmatory test for diabetes and captures chronic glucose exposure for a period of three months. It is more likely to be confirmatory in establishing a diagnosis of diabetes than any single measure of glucose.3 All other investigations (fasting plasma glucose FPG, 75-g oral glucose tolerance test OGTT, random plasma glucose RPG) require a repeat test (either FPG or 75-g OGTT) to confirm a diagnosis of diabetes.3

The diagnosis of diabetes (Table 1) is established by a fasting plasma glucose level of ≥ 126 mg/dL (7.0 mmol/L) on two separate occasions; a plasma glucose ≥ 200 mg/dL (11.1 mmol/L) after 2-h OGTT, HbA1c ≥ 6.5% (48 mmol/L) or random plasma glucose ≥ 200 mg/dL (11.1 mmol/L), along with symptoms of hyperglycemia.3
Table 1: Criteria for the Diagnosis of Diabetes<sup>11,12</sup>

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPG</td>
<td>&gt;126 mg/dL (7.0 mmol/L)</td>
<td>Two separate occasions</td>
</tr>
<tr>
<td>OGTT</td>
<td>&gt;200 mg/dL (11.1 mmol/L)</td>
<td>Two or more after 75g glucose loading</td>
</tr>
<tr>
<td>HbA1c</td>
<td>&gt;6.5%</td>
<td>One measurement</td>
</tr>
<tr>
<td>RBP</td>
<td>&gt;200 mg/dL (11.1 mmol/L)</td>
<td>One measurement with symptoms of hyperglycemia</td>
</tr>
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</table>

The disadvantage of the fasting plasma glucose test includes the need to abstain from food and drink for 8 hours prior to phlebotomy procedure and that there is a 12-15% day-to-day variance in fasting blood glucose values.<sup>11</sup>

The OGTT is considered a first-line diagnostic test. Limitations of this test include poor reproducibility and the need for patient compliance as an eight-hour fast is needed before the 75-g glucose load, followed by drawing blood two hours later.<sup>12</sup> The total prevalence of pathologic glucose metabolism was substantially higher based on HbA1c values than from OGTT.<sup>11</sup>

RBG levels of 200 mg/dL (11.1 mmol/L) or higher associated with classic symptoms of diabetes such as polyuria, polydipsia, weight loss, blurred vision and fatigue, are diagnostic. Lower RBG values as 140 - 180 mg/dL (7.8 - 10.0 mmol/L) have a fairly high specificity of 92-98%; thus patients with such values should undergo more definitive testing. A low sensitivity of 39-55% limits the use of RBG testing.<sup>12</sup>

HbA1c values have currently been permitted by the American Diabetes Association ADA as a screening and diagnostic measurement for DM. One advantage of using this test is that it does not require fasting. However, it must be performed in a clinical laboratory because of the lack of standardization of point-of-care testing. Limitations of HbA1c test includes low sensitivity and possible racial disparities. Interferences are also possible by medications such as high-dose salicylates; vitamins C, E and conditions such as severe iron deficiency anemia.<sup>13</sup>

There is a strong relationship between oral health and diabetic status. Poorly controlled diabetics are susceptible to dental problems such as gingivitis, periodontitis, recurrent periodontal abscess, delayed healing after extraction, dry socket, oral infections like candidiasis, xerostomia, neurosensory disorders which result in glossodynia, stomatopyrosis or burning mouth syndrome, hypogeusia and other oral dysesthesias.<sup>14</sup>

The rising prevalence of Type 2 DM, especially in the younger population, the delay in diagnosis and the morbidity associated with complications of undiagnosed diabetes emphasize the need for screening, prevention and early diagnostic strategies. The purpose of this study was to investigate the utility of random blood glucose collection as a screening tool to facilitate early referral and definitive diagnosis of diabetes mellitus amongst outpatients attending the Maxillofacial Clinic at the UWC Dental Faculty. The term diabetes will be used for patients with a RBG value > 111 mmol/L or fasting blood glucose (FBB) value > 7.0 mmol/L.

**AIM AND OBJECTIVES**

To assess the glycemic status, as an indicator for diabetes, of patients presenting for dental treatment at the Maxillofacial Outpatient Department at Tygerberg Hospital. To assess the incidence of undiagnosed diabetes mellitus. To determine the prevalence of diabetes mellitus in patients presenting for dental treatment and to describe associated intraoral soft tissue lesions.

**DESIGN AND METHODS**

A cross-sectional observational study was done on n=400 patients who presented for treatment at the Maxillofacial Outpatient Department at Tygerberg Hospital. They were adults > 18 years of age. Children and adolescents <18 years of age, patients who are unable to open their mouth for any reason, those with sepsis and pregnant women were excluded.

A blood drop was collected from consenting patients who met the inclusion criteria. Participants were advised to rinse their hands with water and antiseptic solution, whereas the side of a fingerprint was lanced, a blood drop applied to the Accu-Chek® test strip which was inserted into the Accu-Chek® blood glucose monitor, to measure the glycemic status.

The data collected was recorded on a collection form, transferred to an Excel® spreadsheet and analyzed by a statistician using the same program.

**THE RESULTS**

Of the 400 study participants, 38.5% were male and 61.5% were female. Their age range was 18 to 81 years with a mean of 39.8 years. The respondents below the age of 40 comprised 56.2%, 31% were between 41 and 60 years and 12.7% were above the age of 60 years.

Patients were categorized into three groups based on blood glucose level: normal (n=349), pre-diabetic (n=11) and diabetic (n=40).

**Table 2: Sample age and sex distribution**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Female N (%)</th>
<th>Male N (%)</th>
<th>Total N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 years</td>
<td>137 (34.2%)</td>
<td>88 (22%)</td>
<td>225 (56.3%)</td>
</tr>
<tr>
<td>41-60 years</td>
<td>81 (20.2%)</td>
<td>43 (10.7%)</td>
<td>124 (31%)</td>
</tr>
<tr>
<td>&gt; 61 years</td>
<td>31 (7.8%)</td>
<td>20 (5%)</td>
<td>51 (12.7%)</td>
</tr>
<tr>
<td>Total</td>
<td>249 (62.2%)</td>
<td>161 (37.7%)</td>
<td>400 (100.0%)</td>
</tr>
</tbody>
</table>

Of the subjects aged below 40 years, 7 (1.8%) were pre-diabetic and 7 (1.7%) were diabetic. Among participants aged between 41-60 years, 3 (0.8%) were pre-diabetic and 21 (5.2%) were diabetic, whereas only one (0.2%) pre-diabetic and 12 (3%) diabetic subjects were above 60 years of age.

Blood glucose measurements were obtained from 309 and 91 patients using the Random blood glucose method and fasting blood glucose method respectively, summarized in Table 4. Of the 400 patients included in the study:

- The prevalence of diabetes was 10% (n=40);
- The incidence was 1% (n=4);
- Prediabetic patients accounted for 2.7% (n=11).

In total 51 (12.7%) out of 400 were either known diabetic patients or newly diagnosed (prediabetic and diabetic) and 15 (39.4%) out of these 51 patients are unaware of their status (undiagnosed).

**Table 3: Distribution of diabetes and prediabetes among sampled population by Age**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Normal</th>
<th>Pre-diabetic</th>
<th>Diabetic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 years</td>
<td>34 (8.5%)</td>
<td>7 (1.7%)</td>
<td>7 (1.8%)</td>
<td>48 (12%)</td>
</tr>
<tr>
<td>41-60 years</td>
<td>98 (24.5%)</td>
<td>3 (0.8%)</td>
<td>21 (5.2%)</td>
<td>122 (30.5%)</td>
</tr>
<tr>
<td>&gt; 61 years</td>
<td>217 (54.2%)</td>
<td>1 (0.2%)</td>
<td>12 (3%)</td>
<td>230 (57.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>349 (87.2%)</td>
<td>11 (2.7%)</td>
<td>40 (10%)</td>
<td>400 (100.0%)</td>
</tr>
</tbody>
</table>

Table 5 shows the blood glucose levels (normal, prediabetic and diabetic) for the fasting group. Seven (7.8%) out of 91 patients were referred for diabetes testing.
In these patients the time between food intake and blood glucose measurement was a minimum of 8 hours and their blood glucose measurements were categorized as FPG. Five patients (5.4%) had FBG measurements between 5.6 and 6.9 mmol/dl and 6 (6.5%) had FPG measurements of > 6.9 mmol/L. Four (4.3%) of known diabetic patients had a FBG of > 6.9 mmol/L.

<table>
<thead>
<tr>
<th>Table 4: Number of patients identified by blood glucose readings as normal, prediabetic and diabetic (n=400 patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Random</td>
</tr>
<tr>
<td>269</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

In the RBG group, clinically evident soft tissue lesions were recorded in n=30/91 (32.9%) patients, 50% of whom had blood glucose levels > 7 mmol/L (40% were in the prediabetic range and 31% had normal blood glucose levels). Oral candidiasis accounted for 33.3%, 40% and 17.5% of these soft tissue lesions in the diabetic, prediabetic and normal group respectively.

In the RBG group, clinically evident soft tissue lesions were recorded in n=140/309 (45%)

patients, of whom 41% had blood glucose levels > 11 mmol/L (86.6% were in the prediabetic range and 41.6% had normal blood glucose levels). Oral candidiasis accounted for 23.5%, 33% and 18% of these soft tissue lesions in the diabetic, prediabetic and normal group respectively.

Soft tissue lesions were recorded in 42.5% (n=17) of all diabetic patients (n=40), compared with non-diabetic individuals 39.2% (n=137 out of 349). Of the 17 patients who had soft tissue lesions, 13 (76%) had blood glucose levels >15 mmol/L. Oral candidiasis was recorded in 25% (n=10) of diabetic compared with non-diabetic patients 18.3% (n=84 out of 349).

Of the 51 hyperglycemic patients, 45% (n=23) had soft tissue lesions; 23.5% (n=12) had oral candidiasis, compared with the 18.3% of patients with normal blood glucose levels.

Data analysis showed that 103 (25.7%) of 400 patients wore dentures. Oral candidiasis was evident in 12.6% of diabetics who wore dentures.

Other soft tissue lesions recorded included fissured tongue (17.5%), geographic tongue (4%), irritation fibroma (4%) and traumatic ulcers (4%).

**DISCUSSION**

The purpose of the study was to evaluate the glycemic status (as an indicator) of undiagnosed diabetes mellitus, to determine the prevalence of diabetes mellitus in patients presenting for dental treatment and to describe associated intraoral soft tissue lesions.

The sample comprised n=400 participants, whose ages ranged between 18 - 81 years, with a mean of 39.8 years. Most respondents were female aged between 18-40 years. The age range and gender profile of this study was comparable to one in rural India17 in which 59.2% of participants were below the age of 40 years, 32.2% were between 41 - 60 years and 8.6% above 60 years of age.

Previous studies have mainly only screened people 40 years and older, but recent studies15,18 have included and subsequently diagnosed patients below 40 years with Type II diabetes mellitus. In the present study, the percentage of prediabetic patients was highest in the age group below 40 years of age. Prediabetic states have been shown to progress to diabetes mellitus in 2-10 years when no intervention is put in place.20 This supports the inclusion of screening a broader age range for investigation in the current study. This would facilitate early diagnosis and thereby intercept undiagnosed chronic exposure to hyperglycemia and its long-term cumulative effects.

In the present study, the greatest proportion of diabetic patients was seen in participants older than 40 years of age. This was expected and comparable to other studies,17 which revealed a higher rate of diabetes between ages 40 to 60 years.

This study revealed that the incidence of undiagnosed DM was 1.0%. This is comparable to other studies in which incidence estimates of 1.2% and 1% were reported in the Western Cape and in Zambia respectively,18 despite the study’s smaller sample size. A study in rural India17 reported an incidence of diabetes of 2.9%. This higher percentage of newly diagnosed patients could be related to the previous exclusion of patients younger than 40 years of age from diabetes screening programs. It is known that persons of Indian descent reportedly have the highest proportion

<table>
<thead>
<tr>
<th>Table 5: Blood glucose values for the fasting group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic status</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Normal &lt;5.6</td>
</tr>
<tr>
<td>Prediabetic 5.6-6.9</td>
</tr>
<tr>
<td>Diabetic &gt;6.9</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 6 shows the blood glucose levels (normal, prediabetic and diabetic) obtained from the RBG group. Eight (2.5%) patients were referred for diabetes testing. In the RBG group, 15 (4.8%) patients had blood glucose measurements between 7.8 and 11.1 mmol/L and 13 (4.2%) had blood glucose readings of >11.1 mmol/L.

Thirty-two (10.3%) patients were known diabetics and 8 (2.5%) out of 309 patients were referred for confirmation of their diabetes status (6 prediabetic, 2 diabetic). Soft tissue lesions, candida and smoking

Soft tissue lesions (candidiasis, fissured tongue, geographic tongue, irritation fibroma and traumatic ulcer) were recorded in 160 patients, 23(18%) of whom had above normal blood glucose levels. The prevalence of soft tissue lesions seen is summarized in Table 7. Clinically evident oral candidiasis was seen in 84/137 patients with normal blood glucose levels and in 14/23 patients with elevated blood glucose levels. Forty-five participants with blood glucose levels above normal (prediabetic and diabetic) had soft tissue lesions, 27.4% of which were oral candidiasis. In comparison, of the participants whose blood glucose readings were within the normal range, 39% had soft tissue lesions, 18% of which was oral candidiasis.

<table>
<thead>
<tr>
<th>Table 6: Blood glucose values for the random group</th>
</tr>
</thead>
<tbody>
<tr>
<td>mmo/L</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Normal &lt;7.8</td>
</tr>
<tr>
<td>Prediabetic 7.8-11.1</td>
</tr>
<tr>
<td>Diabetic 11.1-&gt;</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

In the FBG group, clinically evident soft tissue lesions were recorded in n=30/91 (32.9%) patients, 50% of whom had blood glucose levels > 7 mmol/L (40% were in the prediabetic range and 31% had normal blood glucose levels). Oral candidiasis accounted for 33.3%, 40% and 17.5% of these soft tissue lesions in the diabetic, prediabetic and normal group respectively.

<table>
<thead>
<tr>
<th>Table 7: Overview of the soft tissue lesions in the normal, prediabetic and diabetic groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Random</td>
</tr>
<tr>
<td>Soft lesions</td>
</tr>
<tr>
<td>Candida</td>
</tr>
</tbody>
</table>

In the RBG group, clinically evident soft tissue lesions were recorded in n=140/309 (45%)

In the RBG group, clinically evident soft tissue lesions were recorded in n=140/309 (45%)}
of diabetes, and the exclusion of possible prediabetic patients therefore precluded them from early intervention strategies. Notably, the proportion of prediabetic participants in the Indian study was very high (10.6%) compared with our study findings. In the present study, ethnicity was not taken into account.

The prevalence of DM in this study was 10%. This is higher than prevalence values in a previous Western Cape and Zambian study, which were 7.2% and 3.5% respectively. That study was large and included eight communities within the Western Cape and 16 communities in Zambia. In our study, the sample size was considerably smaller and the geographical area was limited, thus the high prevalence values may be reflective of the lack of awareness of high blood glucose levels in general.

In healthy individuals, blood glucose levels do not vary widely throughout the day because the relevant hormones (insulin and glucagon) work synergistically to prevent plasma glucose levels from shifting too high or low. Blood glucose levels higher than 11 mmol/L may indicate a problem when measuring RBG. In this study two different tests were used to measure glycemic status namely, FBG and RBG. Both measured a single episode of glucose exposure and can be used for screening purposes. These findings were used to facilitate the referral of at-risk patients for the measurement of HbA1C levels or to provide dietary counseling. (The HbA1C level provides information for the average of three months plasma glucose exposure).

In total 51 (12.7%) of the 400 patients were either known diabetic patients or newly diagnosed (prediabetic and diabetic) and 15 (39.4%) of these 51 patients had been unaware of their status (undiagnosed). All the screened patients whose blood glucose readings were above normal were referred for confirmatory tests to measure their HbA1C. Previously known diabetic patients with elevated above normal glycemic readings were also referred to their doctors for further evaluation.

The range of soft tissue lesions seen in prediabetic and diabetic patients were candida 27.4%, fissured tongue 17.5%, geographic tongue 4%, irritation fibroma 4%, traumatic ulcer 4%. Other soft tissue lesions were too few for any inferences to be made with regard to their presence and diabetic status. The study revealed that 42.9% (n=17) of diabetic patients (n=40) had a soft tissue lesion, which was higher than in those with normal blood glucose levels 29.2% (n=37 out of 349) and 28% (n=10) of patients who were diabetic had oral candidiasis, compared with those with normal blood glucose levels 18.3% (n=64 out of 349).

In total, 45% of prediabetic and diabetic patients (n=23 of 51 patients) had soft tissue lesions, 27.4% (n=14 of 51 patients) of whom had candidiasis. This was greater than in participants with normal blood glucose levels. Dental caries, smoking, and inadequate oral hygiene could be additional predisposing factors. Similarly, a Malaysian study found the prevalence of oral mucosal lesions to be higher in diabetic patients (45.6%). It has been reported that poor glycemic control predispose to oral candida infection oral, which occurs with increased frequency in patients with DM.

Early diagnosis would allow management to prevent or delay development of diabetes and its complications and thereby reduce associated diabetic related costs. Chatterjee et al. in 2010 revealed that screening seems to be cost saving compared with not screening from a health system perspective, and potentially cost-neutral from a social assessment. Our study findings recommend that attention should be paid to early screening for DM.

CONCLUSION

In conclusion, diabetes is one of the most widespread diseases and its prevalence is increasing significantly. Furthermore, it has a definite relationship with oral health.

Screening enables early diagnosis of individuals who are unaware of their glycemic status and also identifies persons at risk for possible future development of the condition. Screening thereby facilitates early management for both at-risk and diabetic persons and is likely to be less than the cost of the subsequent treatment. RBG testing method is easier, more rapid, is cost-effective and less invasive than laboratory measurement of plasma glucose concentration.

RECOMMENDATION

This study co-incidentally demonstrates the potential of public health facilities, such as dental clinics, for the screening of various conditions of public health concern such as Diabetes Mellitus, HIV and Tuberculosis.

RBG is a useful method to screen for prediabetes and diabetes to facilitate referral of patients to measure HbA1C.

References

Correlation between the expectations of patients and their new complete removable dentures, constructed by undergraduate students.

ABSTRACT
Most edentulous patients have expectations regarding complete dentures which may impact on their levels of satisfaction.

Aim
To determine whether their expectations influence the satisfaction of patients with new complete dentures constructed by undergraduate dental students.

Objectives
1. To determine the expectations of patients prior to their receiving new complete dentures.
2. To determine whether those expectations influence satisfaction with the new dentures.

Methodology
This observational study used data collected using two questionnaires: Patient Expectation and Oral Health Impact Profile-20. The codings of the questionnaires were aligned to facilitate correlation between the feedback obtained from patients.

Results
The sample comprised 100 patients, whose ages ranged between 56-65 years with a majority of females (72%); 85% were of coloured ethnicity. Reliability testing of the Patient Expectation Questionnaire was completed. Oral Health Impact Profile-20 results showed high levels of satisfaction in most domains. Statistical correlation between patients’ expectations and satisfaction with new complete dentures was not proven. However, comparison between patient expectations and satisfaction showed positive results.

Conclusion
Patients’ high expectations were met or even exceeded in certain domains. A statistical relationship between patient expectations and satisfaction was not demonstrated, but analysis yielded positive results without any association between the two variables.

INTRODUCTION
The increase in life expectancy of the population combined with a modernized lifestyle and dietary habits such as an increase in sugar intake, contribute to the prevalence of edentulism amongst older citizens in developed countries.¹ The treatment of choice in most of these countries for complete edentulism is an implant-supported denture, which decreases the requests for complete removable dentures (CRD). The prevalence of complete edentulism in developing countries such as the Republic of South Africa (RSA) is also high but the local demand for rehabilitation is most often for the more cost effective CRD.² Overall health services provided at the public health clinics in RSA predominantly comprise dental extractions together with a limited range of preventative and restorative procedures.²⁴,²⁵ Consequently, an increase in both partial and complete edentulism is evident among those attending public health facilities.²⁶

Within the RSA context, CRDs are considered to be the cheap treatment option and are available to those of the population who are able to seek treatment from private practitioners. For the underprivileged majority who attend public health clinics, however, this option or service has not been available, especially in the Western Cape Province of RSA where the demand is greatest.⁷ CRD treatment for this cohort, comprising mostly pensioners and the unemployed, is available only at the academic dental institution, and here they would be treated largely by undergraduate dental students.

Whilst edentulism is not life threatening, it has a tremendous impact on the functional and social aspects of the oral health and quality of life of the individual. Therefore every effort should be pursued to understanding the complexities around this phenomenon. The consequences of tooth loss and complete edentulism are well documented and important aspects which have been reported are poor self-image, nutritional deficiencies and psychological effects.²⁷,²⁸ Naturally, then, patients have certain expectations as regards these problems when treatment is in the offering.

Patient expectations regarding treatment with CRDs are not only dependent on their own past experiences but also on the information they have received from others, that is, both denture and non-denture wearers.¹⁰,¹⁴ These expectations would likely influence the level of satisfaction experienced by patients with newly acquired CRDs, affecting the success of prosthetic treatment outcomes. In this regard, Suresh et al. conducted a study using a validated questionnaire which investigated four specific categories of expectation, namely mastication, aesthetics, phonetics and comfort.¹² Using an investigator-administered approach, the study concluded that pre-treatment expectations which were satisfied
contributed to successful outcomes but that the treatment failed if and when these expectations were disappointed. Another study indicated that patients had high expectations regarding denture stability and fit, and that this was evident mostly amongst first time denture wearers. Smith and McCord specified that the expectations of edentulous patients were high regarding mastication, speech and aesthetics. The importance of meeting expectations to ensure satisfaction with the completed treatment cannot be overemphasized; it thus forms a major part of treatment planning and execution and must be considered at all times.

Patient satisfaction with CRD treatment incorporates a series of aspects related to the denture, to the patient and to the procedures involved:

a. Patient factors may include age, demographic features and denture-bearing anatomical areas, more specifically the residual ridge form.6-10

b. On the other hand, factors associated with the dentist or the dental student comprise the accuracy of clinical procedures such as jaw relations, the quality of the denture produced, and, very importantly, the experience of the clinician and the relationship established between dentist and patient.6-10

Extensive reference has been made to the latter, where disparities in satisfaction as perceived by patients were reported when treated by students, either junior or senior.6-10

c. Specific factors that influence the levels of satisfaction with dentures have been reported in the literature and include psychosomatic characteristics of the patient, quality of the denture, comfort, speech, aesthetics, mastication, retention, fit/stability and occurrence of pain.6-10, 10-11

However, the link between patient satisfaction and quality of life is tenuous, for any complication or dissatisfaction can exert an influence. Thus, it is important that there is a clear understanding of what these concepts imply. Oral health-related quality of life (OHRQol) is based on the influence the treatment has on the patient’s perception of oral health, but more importantly on the impact of his/her daily life.12-13 The concept of OHRQol introduced by Gilt and Redford was to ensure the inclusion of the social and psychological impacts of oral disease which determine the degree to which oral health influences the patient’s life and social functioning.12-16 In line with this idea, specific patient satisfaction and OHRQol instruments were developed to determine the impact of treatment procedures, such as the CRDs, on the daily life of the patient.12-16 The use has become widespread of validated instruments in the clinical environment and for research, such as the oral health impact profile (OHIP), to investigate the influence of CRDs and other treatments on patient satisfaction and on OHRQol.12-16, 17-18 The OHIP is a subjective, validated and reliable tool and is consistent and sensitive to changes as regards the social impacts of oral conditions, even in its shortened version.12-13

Conducting studies focusing on patient-based outcomes have increased in Dentistry as these offer patients an opportunity to share opinions regarding the treatment rendered.19 Patient satisfaction implies treatment success, and that expectations have indeed been met. Hence, using a patient-based approach to determine the factors which influence this important outcome may assist in improving the treatment.

<table>
<thead>
<tr>
<th>Table 1: Patient Expectations Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FL</strong> 1. Do you expect to have difficulty chewing because of problems with your dentures?</td>
</tr>
<tr>
<td><strong>FL</strong> 2. Do you expect to have food catching underneath your dentures?</td>
</tr>
<tr>
<td><strong>PD2</strong> 3. Do you expect to avoid eating some foods because of problems with your new dentures?</td>
</tr>
<tr>
<td><strong>PD2</strong> 4. Do you expect your diet to change/ be unsatisfactory because of problems with your new dentures?</td>
</tr>
<tr>
<td><strong>PD2</strong> 5. Do you expect that you will be unable to eat with your new dentures?</td>
</tr>
<tr>
<td><strong>PD2</strong> 6. Do you expect to interrupt your meals because of problems with your new dentures?</td>
</tr>
<tr>
<td><strong>PP</strong> 7. Do you expect pain in your mouth as a result of your new dentures?</td>
</tr>
<tr>
<td><strong>PP</strong> 8. Do you expect to have sore spots/ ulcers in your mouth because of your dentures?</td>
</tr>
<tr>
<td><strong>PP</strong> 9. Do you expect your new dentures to be uncomfortable? (If not applicable, please mark Never)</td>
</tr>
<tr>
<td><strong>PD1</strong> 10. Do you expect to be self-conscious because of problems with your dentures?</td>
</tr>
<tr>
<td><strong>FL</strong> 11. Do you expect your dentures to fit relatively/ properly?</td>
</tr>
<tr>
<td><strong>H</strong> 12. Do you expect your dentures to affect your Quality of Life?</td>
</tr>
<tr>
<td><strong>H</strong> 13. Do you expect you will be satisfied with your new dentures?</td>
</tr>
</tbody>
</table>

**KEY:**
- FL: Functional Limitation
- PD2: Physical Disability
- PP: Physical Pain
- PD1: Psychological Discomfort
- H: Handicap
Table 2: Factor analysis

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Do you expect to have difficulty chewing because of problems with your dentures</td>
<td>.668</td>
</tr>
<tr>
<td>Q2. Do you expect to have food catching underneath your dentures</td>
<td>.732</td>
</tr>
<tr>
<td>Q3. Do you expect to avoid eating some foods because of problems with your new dentures</td>
<td>.789</td>
</tr>
<tr>
<td>Q4. Do you expect your diet to change/be unsatisfactory because of problems with your new dentures</td>
<td>.811</td>
</tr>
<tr>
<td>Q5. Do you expect that you will be unable to eat with your new dentures</td>
<td>.755</td>
</tr>
<tr>
<td>Q6. Do you expect to interrupt your meals because of problems with your new dentures</td>
<td>.750</td>
</tr>
<tr>
<td>Q7. Do you expect to have pain in your mouth as a result of your new dentures</td>
<td>.902</td>
</tr>
<tr>
<td>Q8. Do you expect to have sore spots/ulcers in your mouth because of your dentures</td>
<td>.855</td>
</tr>
<tr>
<td>Q9. Do you expect your new dentures to be uncomfortable</td>
<td>.309</td>
</tr>
<tr>
<td>Q10. Do you expect to be self-conscious because of problems with your dentures</td>
<td>.776</td>
</tr>
<tr>
<td>Q11. Do you expect your dentures to NOT fit retainently/ properly</td>
<td>.454, .434</td>
</tr>
<tr>
<td>Q12. Do you expect your dentures to NOT affect your Quality of Life</td>
<td>.811</td>
</tr>
<tr>
<td>Q13. Do you expect you will be NOT satisfied with your new dentures</td>
<td>.810</td>
</tr>
</tbody>
</table>

Factor One: Mastication
Factor Two: Pain
Factor Three: Adaptation
Factor Four: Discomfort

(bold numbers indicate a conceptual strength between the two factors)

The aim of this study was to determine whether patients’ expectations influence their satisfaction with new complete dentures prepared by undergraduate students. The following objectives were addressed:

1. Determining patient expectations prior to their receiving new complete dentures and
2. Evaluating whether the expectations of patients influence their satisfaction with new complete dentures.

METHODS

For this observational study, a readily available group of 100 patients (a convenience sample) treated by undergraduate dental students was used. The patients were sourced from the existing waiting list created by staff of the Department of Prosthodontics at the University of the Western Cape (UWC). Patients were initially screened by staff members for suitability to be treated by students. The screening process included a brief medical history, an oral examination including ridge assessment and a preliminary diagnosis to assess suitability for treatment by a student. Once patients were scheduled to be treated, a file with important demographic particulars (age, address and income category) was recorded. The principal researcher approached the edentulous patients to inform them of the study and to obtain their consent to participate. Students in their clinical years of study constructed the dentures under the supervision of qualified dentists.

Inclusion criteria specified that the patients required new dentures, had healthy mucosa and that they had had previous denture experience. Patients with any mucosal pathology, temporomandibular disease, psychological problems and first time denture-wearers were excluded.

Data collection included completion of two questionnaires which were marked with corresponding case numbers for easy correlation: the Patient Expectation Questionnaire (PEQ) (Table 1) and Oral Health Impact Profile-20 (OHIP-20) questionnaires. The PEQ was completed at the start of the first clinical visit, and the OHIP-20 three months after delivery of the CRDs. Responses to the questions were recorded using a 5-category Likert scale: 1) never, 2) hardly ever, 3) occasionally, 4) fairly often and 5) very often, with a low score representing a better OHQoL.

The PEQ was a new tool formulated by the principal researcher. The questions on this document were grouped according to the categories of questions on the OHIP-20 (Table 1). A series of statistical tests was completed to assess the validity and reliability of the PEQ. Reliability tests analyze the scale's internal consistency, which tests the degree to which this PEQ tool produced stable and consistent results. For this stage, the Cronbach's alpha was determined, where a result between 0.7-0.8 indicates an acceptable value. A factor analysis was also completed as a data reduction technique to summarize the items being loaded, which also removed redundancy or duplication from a set of correlated variables. The OHIP-20 is a previously validated questionnaire, not requiring reliability and validity tests.

Data analysis included frequency calculations of demographic details and of the responses on the two questionnaires; the information was grouped to ascertain the distribution of variables amongst specified intervals and in order to make meaningful deductions. A Pearson correlation coefficient was computed to assess the linear relationship and the strength of this relationship between patient expectation and satisfaction with CRDs. Data collection and analysis were completed using Excel and SPSS software.
Table 3: Reliability Tests of PEQ questions on Mastication

<table>
<thead>
<tr>
<th>Factor 1 - Mastication</th>
<th>Corrected Item-Total Correlation</th>
<th>Cronbach’s Alpha if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Do you expect to have difficulty chewing because of problems with your dentures? (FL)</td>
<td>.616</td>
<td>.840</td>
</tr>
<tr>
<td>Q2. Do you expect to have food catching underneath your dentures? (FL)</td>
<td>.655</td>
<td>.830</td>
</tr>
<tr>
<td>Q3. Do you expect to avoid eating some foods because of problems with your new dentures? (PD2)</td>
<td>.708</td>
<td>.820</td>
</tr>
<tr>
<td>Q4. Do you expect your diet to change be unsatisfactory because of problems with your new dentures? (PD2)</td>
<td>.710</td>
<td>.820</td>
</tr>
<tr>
<td>Q5. Do you expect that you will be unable to eat with your new dentures? (PD2)</td>
<td>.610</td>
<td>.838</td>
</tr>
<tr>
<td>Q6. Do you expect to interrupt your meals because of problems with your new dentures? (PD2)</td>
<td>.578</td>
<td>.844</td>
</tr>
</tbody>
</table>

KEY:
FL: Functional Limitation
PD2: Physical Disability

Table 4: Reliability Tests of PEQ question on Pain

<table>
<thead>
<tr>
<th>Factor 2 - PAIN</th>
<th>Corrected Item-Total Correlation</th>
<th>Cronbach’s Alpha if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q7. Do you expect to have pain in your mouth as a result of your new dentures? (PP)</td>
<td>.684</td>
<td>.315</td>
</tr>
<tr>
<td>Q8. Do you expect to have sore spots/ulcers in your mouth because of your dentures? (PP)</td>
<td>.658</td>
<td>.349</td>
</tr>
<tr>
<td>Q11. Do you expect your dentures to NOT fit retentively/properly? (FL)</td>
<td>.213</td>
<td>.887</td>
</tr>
</tbody>
</table>

KEY:
FL: Functional Limitation
PP: Physical Pain

RESULTS

Ethical clearance was obtained from the UWC Ethics Committee (Registration Number: 13/716). All participants signed a consent form according to the Declaration of Helsinki.

The majority of the sample was in the age category 56-65 years with 32% in the 65 years and older group, forming the second largest category. Females made up 72% of the sample. Eighty five percentage of the sample was Coloured, with Blacks, Whites and Indians completing the sample.

Testing the PEQ questions for reliability and validity produced a Cronbach’s alpha of .773. This is an acceptable alpha value, confirming that the scale is very reliable.

1. A factor analysis, conducted as a data reduction technique, is presented in Table 2. The four factors were: mastication, pain, adaptation and discomfort. For this process of validation, the analysis yielded a four factor solution with Eigen values (Table 2). Factors which have a high Eigen value should be included, while those with a low Eigen value should be removed. The common method is to include factors with Eigen value > 1 and eliminate factors < 1. The total variance of the four factors was 64.4%.

2. Reliability of the identified factors (mastication and pain) was conceptually stronger (bold numbers in Table 2) than the other two factors (adaptation and discomfort) which were thus disregarded in the subsequent analysis (Tables 3, 4).

3. Reliability tests were conducted on the two factors (mastication and pain) identified from the factor analysis. As evidenced by the internal consistency of the estimates of reliability, the scale was shown to be very reliable (Tables 3, 4).

It was determined that the reliability would also increase if the following questions were dropped:

Q10. Do you expect to be self-conscious because of problems with your dentures?
Q12. Do you expect your dentures to NOT affect your Quality of Life?

The reasons for inconsistency in answers to these questions could be a lack of understanding and interpretation of the statements.

Results for the PEQ indicated that patients’ expectations were greatest in the following domains:

a. Questions relating to Functional Limitations (FL). The majority of the sample indicated that they did not expect to encounter difficulty with chewing or to have food catching under the new CRDs (Figure 1). Most patients (87%) also expected well-fitting CRDs (Figure 2).

b. Questions relating to Physical Pain (PP). About half of the sample expected to experience pain as a result of the new CRDs (PEQ results) but this was not evident in relation to the satisfaction scores (OHIP-20 results) for this factor (Figure 3). More than two thirds (64%) of the sample felt that their new CRDs would never be uncomfortable.

c. Questions relating to Physical Disability (PD). Sixty-six percent of patients indicated that they would never avoid certain foods nor feel that their diet would be unsatisfactory because of the CRDs. Patients indicated an expectation of not experiencing problems with eating or having their meals interrupted due to problems with the new CRDs.

Similarly, OHIP-20 results indicated that patients were mostly satisfied with their newly acquired CRDs:

a. Questions related to Functional Limitations (FL)
b. Thirty seven percent of patients never encountered difficulty chewing, whereas 32.2% experienced food catching underneath their new CRDs (Figure 1). Almost half of the sample (43.4%) felt their CRDs were not fitting properly (Figure 2). Forty percent of patients had pain due to the new CRDs whilst 38% did not find it uncomfortable to eat certain foods (Figure 3). However, 35.6% had sore spots in their mouth and 33.3% indicated some discomfort with their new CRDs.

c. Questions related to Physical Disability (PD2)
Approximately equal numbers of patients (51.1%) said they never avoided eating some foods or felt their diet was unsatisfactory because of problems with the CRDs. A third of the participants (31.1%) felt they were unable to eat with their CRD’s whilst 28.9% had to interrupt meals because of problems with their CRDs.

d. Questions related to Psychological Disability (PD3)
Two thirds of the sample felt they were never upset or embarrassed because of problems with their CRDs.

e. Questions related to Social Disability (SD)
A majority of the sample (82.2%) never avoided going out because of problems with their CRDs and 83.3% were never intolerant with their spouse and family. A very small percentage (8%) of the sample felt irritable because of problems with their CRDs.

![Expectation (PEQ) vs Experience (OHIP-20)](image1)

**Figure 1**

**Poorly fitting Dentures: Expectation (PEQ) vs Experience (OHIP-20)**

![Pain in mouth: Expectation (PEQ) vs Experience (OHIP-20)](image2)

**Figure 2**

**Pain in mouth: Expectation (PEQ) vs Experience (OHIP-20)**

Correlation between responses of the PEQ and OHIP-20

A Pearson correlation coefficient was computed to assess the relationship between patient expectation and satisfaction with the newly acquired CRDs. A Pearson correlation of r=+7.0 indicates a positive relationship between variables. However, for this study, the correlation was calculated to be r=+1.1. This indicates that there was in fact no statistically significant correlation between the two variables of Patient Expectation and Patient Satisfaction with new CRDs.

Patients expected not to encounter any difficulties whilst eating with their new CRDs or with food catching underneath their new CRDs (Figure 1). However, many were not satisfied with functional performance for a third complained of food lodging beneath their dentures. The majority had not had any expectation of improper denture fit, yet almost half felt that their new CRDs were not sitting properly over the denture-bearing areas (Figure 2).

More than half of the patients expected to experience some pain with the new CRDs and surprisingly, only a third recorded they had actually felt pain (Figure 3). Also, more than two-thirds of the patients never expected the CRDs to sit comfortably, yet only a third had complaints related to uncomfortable fit and reported that discomfort was experienced only whilst eating certain foods. Patients’ expectations regarding having problems with eating or having their meals interrupted due to problems with the new CRDs were mostly positive. The satisfaction scores were mostly aligned to this expectation as less than a third complained of inability to eat or having their meals interrupted due to problems with the new CRDs.

**DISCUSSION**

The null hypothesis of this study was that the expectations of patients do not influence their overall satisfaction with their complete dentures, which had been constructed by undergraduate dental students. This hypothesis was accepted following the interpretation of the Pearson correlation analysis that showed there was no significant statistical correlation between the two variables namely expectation and satisfaction. The analysis of the frequency distributions of both questionnaires supported this finding with high levels of expectation and satisfaction noted in all domains.

The majority of the sample were aged 56 years and older with a third being over 65 years, similar to the reports of comparable surveys found in the literature. Females made up the largest gender component in the study. This follows the trend that females lose their teeth earlier and hence can become edentulous before their male counterparts. Patients of coloured ethnicity formed the largest part of the sample. This is supported by studies that found the coloured community has a higher prevalence of edentulism amongst population groups in the Western Cape Province of RSA. This disparity in edentulism amongst ethnicity can be attributed to factors specific to the coloured community. Secondary education was achieved by most of the participants. Studies have shown that levels of education play a fundamental role in the rate individuals become edentulous.

Reliability tests for the PEQ using Cronbach’s Alpha were required in order to validate the questionnaire. Once the reliability was ascertained, factor analysis was completed on the results of the questionnaire. These factors were related to mastication and pain and covered the functional limitations and physical disability domains. This result resonates with the study conducted by Smith et al. (2004) which concluded that edentulous patients have expectations regarding aesthetics, comfort, speech and mastication. When analyzing the OHIP-20, high levels of satisfaction were recorded in most of the domains of the questionnaire. The most important factors reported by other studies that influence satisfaction are perceived pain, retention of the CDs, aesthetics, function and speech. These were also identified for this current study.

**Conclusion**

Analysis of the questionnaires indicated that the high initial levels of expectations were met in most domains, so that even though a statistical relationship between patient expectations and satisfaction was not proven, analysis of the questionnaires produced positive results.

**Implications for Practice**

Due to the high prevalence of complete edentulism amongst the underprivileged community of the Western Cape Province of SA, there is still a great demand for CRDs in this part of the world. Unfortunately, the service is obtainable only at dental teaching institutions because the public health clinics do not provide such treatment options. As the expectations of the patients did not negatively influence denture satisfaction, the effort on improvement should focus on the continual upgrading of teaching as well as on the effective delivery of CRDs.
Comparing patient-based outcomes related to neutral zone and conventional mandibular dentures: a systematic review.

SADJ May 2017, Vol 72 no 4 p284 - p289
Geerts G, Khan S

SUMMARY
Introduction: neutral zone mandibular dentures are considered to be superior to conventional complete dentures.

Aim
To synthesize evidence regarding patient-based outcomes of treatment with complete mandibular dentures following static or dynamic methods of establishing denture shape.

Objective
To answer the question: “In edentulous patients, what is the effect of neutral zone dentures on oral health-related quality of life and preference as compared with conventional dentures?”

Methods
Medline, Wiley, Cochrane Central Register of Controlled Trials, Proquest, Elsevier, Trip and Science Direct databases were searched for clinical studies, using a specific search strategy.

Results
From a total of 103 records, 9 studies (participants n=270) were included in the review, based on specific selection criteria. Reports on oral health-related quality of life and preference produced conflicting results. Most patients reported improvement in retention, stability, comfort, chewing, speech with fewer recall visits for neutral zone dentures. High level of heterogeneity in study design, patient-based outcomes, instruments and statistical analysis was encountered, preventing meta-analysis. Quality of most studies was low, with small sample sizes (range: n=5-128), short follow-up periods (5 days-2 months), and high level of selection, performance and detection bias.

ACRONYMS:
CD: complete dentures
NZ: neutral zone method
OH-RQoL: oral health-related quality of life
PBOs: patient-based outcomes
RoSiM: risk of bias

Conclusion
Results should be interpreted within the context of little and low-level scientific evidence.

INTRODUCTION
Conventional complete dentures (CD) have been the most common and only treatment modality for rehabilitation of edentulousness until the introduction of dental implants. Implant-retained or implant-supported prostheses have been proven to be superior to conventional CDs in terms of patient-based outcomes (PBOs). However, implant therapy may be out of reach of patients due to a variety of reasons. This group of patients is and will continue to be dependent on traditional CDs to restore form and function. It is assumed that these patients would benefit if dentures were made to be as stable and comfortable as possible.

The neutral zone (NZ) concept has been defined as “the potential space between lips and cheeks on the one side, and tongue on the other side; that area or position where forces between tongue and cheeks and lips are equal.” As early as 1746, Fauchard advocated that the inside and outside form and shape of dentures should be considered carefully in order to avoid conflict with lips, cheeks and tongue (in: Lott and Levine, 1966). Today, there is a high level of international consensus that teeth should be arranged in a neutral position and that arch form should assist stability during function.

While experts may agree, there appears limited scientific evidence based on patient feedback on the clinical benefits of CDs made according to a dynamic NZ method (NZD) over a biometric, static method of determining arch form and shapes of dentures. To date, no systematic review of clinical studies comparing PBOs of the mandibular NZD versus a conventional mandibular CD has been done. Therefore, the efficacy of NZDs compared with CDs has yet to be established.

The aim of this systematic review was to synthesize scientific data related to PBOs of mandibular CDs fabricated according to the NZ concept as compared with conventional methods.

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Contributions
1. Greta Geerts: Conceptualization 100%, Researcher 50%, Writing 50%
2. Saadika Khan: Researcher 60%, Writing 50%

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The objectives of this systematic review were:

1. To identify clinical studies comparing PBOs of mandibular NZDs versus conventional CDs.
2. To extract and compare data based on PBOs of both types of dentures from studies included in the review.
3. To perform a meta-analysis should the nature of the data identified from the clinical studies allow this to be done.

Search and Selection Strategy

Online searches were conducted for primary and ongoing studies to identify literature on the topic of NZ as a treatment strategy for edentulous adult patients. Two reviewers (GS and SK) independently and systematically searched for studies using the databases Medline, Wiley, Cochrane Central Register of Controlled Trials, Proquest, Elsevier, Trip and Science Direct. Medical subject headings (MeSH terms) were applied in databases which allowed this function. Key terms were combined using Boolean operators and search strategies were developed for each database using database specific functions. For PubMed, the search terms were: Neutral zone AND complete dentures and the following article types were selected: Case Reports, Clinical Study, Clinical Trial, Clinical Trial Phase I, Clinical Trial Phase II, Clinical Trial Phase III, Clinical Trial Phase IV, Comparative Study, Controlled Clinical Trial, Multicenter Study, Observational Study, Pragmatic Clinical Trial, Randomized Controlled Trial. A similar search strategy was developed and modified according to the requirements of each database to ensure inclusion of all relevant studies. If databases allowed it, the following filters were applied: publication dates (1980-2017), species (human), ages (18+ years). No language filters were activated. Similar articles listed for each reference were also searched for possible inclusion. Based on titles and abstracts, a first selection of articles was done. Full texts of these selected articles were retrieved. Eligibility of these articles was determined using the customized eligibility tool. Reference lists of included studies were searched for additional records. Where full texts were unavailable, authors were contacted. Efforts were also made to obtain English versions of studies reported in other languages either by requesting them from the authors or using language experts to translate key findings. At every level of selection, consensus was reached between the two reviewers, adopting a lenient approach towards inclusion of records.

Data extraction

The two reviewers independently reviewed all included full-articles extracting the following data using the standardized data extraction sheet: authors, title, date, country, publication type, study method, estimate of bias, sample (number, age, sex), interventions, outcomes, statistical analyses, results, conclusions, funding sources, ethics clearance, comments and correspondence required. Extraction sheets were compared. Differences were discussed until consensus was reached. Where more than one article reported different aspects of the same study, these were combined as a single study. Data from the included and excluded studies were summarized in tables of included and excluded studies respectively.

Qualitative analysis

The two reviewers independently evaluated the included studies for RoB using the Cochrane's "Risk-of-bias assessment tool". Risk of bias was assessed across the following components: Sequence generation and allocation concealment to prevent selection bias; Blinding of participants, personnel and outcomes assessors to reduce performance bias; Incomplete outcome data to eliminate attrition bias; Selective outcome reporting to reduce selective outcome reporting bias; and other sources of bias, such as those related to specific study designs, early stoppage, fraudulent or extreme baseline imbalances. Risk of bias for each component was scored as 'high', 'low' or 'unclear'. Bias was summarized in RoB graphs for each study in the Review Manager Software program.

Data synthesis and management

Results from the included studies were reported separately according to the interventions, controls, and reported outcomes. No imputation of missing data was carried out and as all outcomes were reported, authors were not contacted for these. Although a meta-analysis of outcomes across studies was anticipated, the included studies had different designs and reported outcomes differently. Hence, individual study results could not be pooled in a meta-analysis.
**Table 1: Selection criteria for study eligibility**

<table>
<thead>
<tr>
<th>Inclusion criteria (all criteria had to be present)</th>
<th>Exclusion criteria (any of the criteria present resulted in exclusion)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of study</strong></td>
<td>Clinical study (n=8)</td>
</tr>
<tr>
<td><strong>Type of participants</strong></td>
<td>Clinical study (n&lt;5)</td>
</tr>
<tr>
<td>Human</td>
<td>Narrative reviews</td>
</tr>
<tr>
<td>Male and female</td>
<td>Systematic reviews</td>
</tr>
<tr>
<td>≥18 years of age</td>
<td>Animal</td>
</tr>
<tr>
<td>Requesting replacement CD</td>
<td>&lt;18yrs of age</td>
</tr>
<tr>
<td><strong>Type of interventions</strong></td>
<td>No NZD</td>
</tr>
<tr>
<td>NZD with or without piezographically shaped flanges</td>
<td>No comparison between interventions</td>
</tr>
<tr>
<td><strong>Type of comparisons</strong></td>
<td>No PBOs</td>
</tr>
<tr>
<td>PBOs from NZD and conventional CD, including patients’ existing dentures</td>
<td></td>
</tr>
<tr>
<td><strong>Type of PBOs</strong></td>
<td></td>
</tr>
<tr>
<td>Primary outcomes: OHRQoL, preference, patient satisfaction</td>
<td></td>
</tr>
<tr>
<td>Secondary outcomes: stability, retention, comfort, speech, chewing, need of recalls as reported by patients</td>
<td></td>
</tr>
</tbody>
</table>

CD = conventional mandibular denture  
NZD = neutral zone mandibular denture  
PBOs = patient-based outcomes  
OHRQoL = oral health-related quality of life

**RESULTS**

Results of the search are indicated in the PRISMA flow chart (Figure 1). One hundred and fifty nine records were generated. 157 records from online search engines and two records found later on reference lists from included full-texts. A total of 56 duplicate records were removed, leaving 103 records which were assessed for eligibility. After reading titles and abstracts, a further 79 records were excluded. Full texts of the remaining 24 records were retrieved. A total of 10 articles, reporting results of 8 studies, were used for this review. There were no deviations from the protocol during the search.

The nine studies were placed in three different groups according to NZ methodology. In Group 1, NZDs were made using a NZ impression including piezographically shaping of flanges. In Group 2, NZDs were made without piezographically shaping of flanges. Group 3 included methods of Groups 1 and 2. Because of the different NZ techniques followed for these studies, it was decided not to combine results from studies in different groups.

There were seven studies in Group 1, reporting on a total of 137 patients. Their follow-up periods were 1, 2, 4, 8 (x2) weeks. Two studies did not report a follow-up period. Two studies reported on OHRQoL using two different versions of the OHIP, with conflicting results.10-14 Geerits (2017) (OHIP-20; n=37) reported no significant

**Table 2: Characteristics of included studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Methods</th>
<th>Statistics</th>
<th>Participants</th>
<th>Intervention</th>
<th>PBOs</th>
<th>Results</th>
<th>Instrument</th>
</tr>
</thead>
</table>
| Fahmy & Kharat (1990) Saudi Arabia Clinical study | Cross-over Follow-up 2 weeks post-insertion | No stats for preference | Total:10  
Gender: not reported  
Age: not reported | 1. new conventional CD  
2. new NZD (Group 1) | Preference  | 10/10 preferred NZ denture (better comfort and speech, none mentioned mastication as reason for preference) | No instrument given for preference |
| Geerits (2017) South Africa Clinical study | Cross-over Sequence randomized Follow-up 2 months post-insertion | Power analysis, Paired t-test, Fisher exact test, GLM, treatment effect size | Total:37  
Gender: 22 female  
Age: 62.8 (47-85) | 1. new conventional CD  
2. new NZD (Group 1) | OHRQoL Preference | Preference: 15/35 NZ, 8/39 CD and 14/26 none. Statistically no difference in preference or OHRQoL. Treatment effect size = small | OHRQoL-20  
Preference: NZD, CD None. Treatment ES |
| Ladh et al. (2014) India Clinical study | Cross-over Follow-up: 2 months for each denture | Kruskal-Wallis with non-parametric Mann-Whitney tests, (p<0.05) | Total: 10  
Gender: 1 Female  
Age group: 60-80 yrs.  
Advanced ridge resorption | 1. old denture (A)  
2. swallowing (SNZ) & phonetic (PNZ) NZ (Group 1) | Satisfaction: Aesthetics  
Stability  
Retention  
Comfort  
Speech  
Soreness  
Food entrainment | For mandibular denture: Satisfaction, retention, stability, speech, comfort, chewing, statistically better for SNZ and PNZ as compared to A. No difference between SNZ and PNZ  
No difference for soreness among 3 groups. Statistically difference in food entrainment between A and SNZ: Preference: higher for SNZ | 16-item questionnaire with VAS scale answers (5-point Likert scale 0-4) |
| Rehmann et al. (2016) Germany Clinical study | 1 cohort Follow-up: 4 weeks of wearing denture | Sign test | Total: 21  
Gender: 10 females  
Age: mean 71 (+- 19yrs) | 1.unsatisfactory “new” CD  
2. NZD (Group 1) | Satisfaction: Denture function  
Mastication  
Stability | Stat sign improvement in OHRQoL for NZ  
Masticatory test: no sign, change.  
18/21 patients reported improved general stability and stability with chewing.  
14/21 patients reported improved stability during speech. | OHRQoL-14  
Scale: stability clearly improved, improved, unchanged, deteriorated |
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Follow-up</th>
<th>Patients</th>
<th>Gender</th>
<th>Age</th>
<th>Dental Condition</th>
<th>Improvement</th>
<th>Stability</th>
<th>Pressure Sores</th>
<th>Recalls</th>
<th>Satisfaction</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehmann et al (2012) Germany Clinical study</td>
<td>1 cohort Follow-up not reported.</td>
<td>no</td>
<td>1 cohort</td>
<td>no</td>
<td>5</td>
<td>Unsatisfactory Old Dentures 2 N/ZD (Group 1)</td>
<td>4 patients: improvement in general, while chewing and speaking, 1 patient unchanged. Perceived sores: similar improvement</td>
<td>Scale: clearly improved, improved, unchanged, deterioration.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walsh and Walsh (1976) South Africa Clinical study</td>
<td>1 cohort Prospective Randomization not reported. Follow-up 1 week.</td>
<td>no</td>
<td>1 cohort</td>
<td>no</td>
<td>50</td>
<td>Old CD unacceptable by patients but technically acceptable 2 new N/ZD dentures (Group 1)</td>
<td>Stability 28/30: improvement in stability, 1/30 no improvement. 1/30 impossible to adapt. 9/30 needed recall (no control)</td>
<td>Scale: Improvement. No improvement. Impossible to adapt. Number of patients needing recall.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ziaigham (2006) Pakistan Clinical study</td>
<td>2 Cohorts (12 x 2) Comparative Duration: not reported</td>
<td>Student t-test</td>
<td>24</td>
<td>no</td>
<td>5</td>
<td>Selective impression technique denture 2 N/ZD (Group 1)</td>
<td>Secondary outcome: Preference In discussion: All patients preferred N/ZD no data in results.</td>
<td>No scale/category given</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raja and Salem (2009) Pakistan Clinical study</td>
<td>4 Cohorts Follow-up 40 days after insertion Randomized sampling</td>
<td>t-test, chi-square, Fisher's Exact Test (p&lt;0.05)</td>
<td>128</td>
<td>no</td>
<td>50</td>
<td>CD 2 N/ZD dentures Duration of edentulousness: 2 groups (Group 2)</td>
<td>Satisfaction Statistically less recalls for N/ZD dentures for patients who were edentulous for&gt;2yrs.</td>
<td>Patient satisfaction expressed by number of post-insertion visits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stromberg and Hickey (1965) USA Clinical study</td>
<td>Cross-over Follow-up: 5 days (3 measurements: day 1, day 3, day 5)</td>
<td>no</td>
<td>9</td>
<td>no</td>
<td>5</td>
<td>NZ = manually formed flanges 2 N/ZD 1 piezoelectrically formed flanges (Group 3)</td>
<td>Preference 100% preference for manually formed dentures</td>
<td>No scoring details for “preference” given</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study characteristics of all included studies are summarized in Table 2. It must be noted that, regarding outcomes, only PBOs were extracted. Some studies also reported on clinician-based outcomes, but these outcomes are not reported since they fell outside the scope of the review. Excluded studies are recorded in Table 3, together with reasons for exclusion.

For each included study, RoB was assessed as being ‘low’, ‘high’ or ‘unclear’ following Cochrane guidelines. Results are shown in a RoB graph and RoB summary (Figures 2 and 3). A detailed explanation of the results is as follows:

### ALLOCATION (SELECTION BIAS)

Three of the nine studies were reported as randomized. For sequence generation: Three out of nine studies used some sequence to include patients into the study (Figures 2 and 3). One study used lot, one used random tables and another used computer generated numbers. Where patients were asked to join the study or were included on the basis of their experiencing problems with old dentures, these were recorded as studies with a high risk of bias. Three of the studies used an allocation technique (directing the patient to a specific treatment group) eliminating selection bias. In two of the studies, allocation was unclear.

### BLINDING (PERFORMANCE BIAS AND DETECTION BIAS)

Blinding of either participants and/ or personnel was ensured in three of the nine studies (Figures 2, 3). Blinding of participants only may thus be considered as in a single-blinded cross-over clinical trial. But this process was unclear in one of the studies. For all the included studies, the outcomes assessors were not blinded and these were at judged as having a high risk of bias.

### INCOMPLETE OUTCOME DATA (ATTRITION BIAS)

All studies did not report the analysis to be completed by the “intention-to-treat” principle, nor did any of the studies lose any patients, thus results were not negatively affected. Moreover, all pre-specified outcomes (even though these were not pre-specified as primary or secondary outcomes) were reported, thus all the studies were judged to have a low risk of bias as there was no missing data (Figures 2 and 3).
### Table 3: Characteristics of excluded studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason/s for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Afroz et al. (2012)</td>
<td>Patients had oral submucous fibrosis</td>
</tr>
<tr>
<td>2. Astorga et al. (2013)</td>
<td>Participants’ characteristics suggested this study be excluded</td>
</tr>
<tr>
<td>4. Comul and Semohano (2015)</td>
<td>Case report, which initially formed part of inclusion criteria, but this later changed</td>
</tr>
<tr>
<td>5. Darwish et al. (2015)</td>
<td>The study did not include the NZ as intervention or control, and patients had implants</td>
</tr>
<tr>
<td>6. Kursoglu et al. (2007)</td>
<td>The study was excluded on the basis of the NZ not being the intervention or control and the study type or design also not meeting the inclusion criteria</td>
</tr>
<tr>
<td>7. Liu et al. (2015)</td>
<td>The study had the specific design but the NZ not the intervention or control</td>
</tr>
<tr>
<td>8. Macquaire (2004)</td>
<td>The conventional denture was not the control</td>
</tr>
<tr>
<td>10. Mustafa (2015)</td>
<td>No NZs or patient-based outcomes</td>
</tr>
<tr>
<td>11. Patel (2010)</td>
<td>The study was excluded on the basis of the NZ, the intervention or control and the participants not meeting the inclusion criteria</td>
</tr>
<tr>
<td>12. Pillon et al. (1985)</td>
<td>The study did not meet the type or design criteria</td>
</tr>
<tr>
<td>13. Perwal et al. (2016)</td>
<td>The study met the design criteria but not having the neutral zone denture as the intervention or control suggests exclusion</td>
</tr>
<tr>
<td>14. Tambe et al. (2014)</td>
<td>The NZ and characteristics of participants ensured exclusion of this study.</td>
</tr>
</tbody>
</table>

**NZ = neutral zone mandibular denture**

### SELECTIVE REPORTING (REPORTING BIAS)

All included studies pre-specified and reported all outcomes, but only the Geers (2017) study pre-specified these as primary and secondary outcomes. Most of the studies were not registered or approved by a review board, but because these studies reported all the outcomes as specified in the protocol, these were still judged as having a low risk of bias.

### OTHER POTENTIAL SOURCES OF BIAS

Studies were judged as having a low risk of bias if there were no reason to suggest any other potential sources of bias. Four other studies were judged as having a high risk of bias due to the poor design, small sample sizes, no blinding and/or no randomization and because no ethical approval was obtained.

### DISCUSSION

This SR was developed to answer the question: “In edentulous adult patients, what is the effect of NZDs on OHRQoL, patient satisfaction, and preference as compared with that of conventional mandibular CDs?” Following the search strategy, nine studies were included in an effort to answer the question. The nine studies showed high levels of heterogeneity in terms of study design, sample size, gender, type of PBGs, instruments used to measure PBGs and RoB. Therefore, the answer to the question is: There exists no strong evidence on the beneficial effects of NZDs over conventional CDs when analyzing PBGs.

The nine selected studies were placed in one of three groups according to NZ technique used. In Group 1, four of the seven studies reported frequencies and/or ratios which were not statistically analyzed. Only three studies did a statistical analysis of some PBGs but used different instruments to measure these. Only two studies used validated instruments for measuring OHRQoL, but reached conflicting results, with Geers (2017) reporting no difference in OHRQoL between NZDs and CDs, while Rehmann et al. (2016) did identify differences. The reason might be that the study design differed, with Geers (2017) being a prospective cross-over study, while the Rehmann et al. (2016) study was a cohort study with the new NZD being compared with the patients’ existing dentures, made outside trial conditions. In the Ladh et al. (2014) study, the main focus was comparing PBGs using a 16-item questionnaire using a 5-point Likert scale. This questionnaire was not provided. Hence, validity and reliability of the data could not be determined. Two different methods of making NZDs (swallowing and phonetics) performed statistically better than the CDS in satisfaction, retention, stability, comfort, speech and chewing hard food. However, they were compared with the patients existing dentures that were made outside the confines of the trial. Hence, for both the Ladh et al. (2014) and Rehmann et al. (2016) studies, the fact that existing dentures were used as control may have caused bias towards a positive outcome for the NZDs. It has been reported that simply making new dentures already improves OHRQoL, regardless of technique used. Another prospective single cohort study in Group 1 using the existing denture was by Walsh and Walsh (1976). The same argument can be used here to explain bias towards the positive results for NZDs as compared with CDs.

One study in Group 1 was prospective, using two cohorts, one receiving new CDs and one receiving new NZDs, but there was no other information on PBGs other than that all patients who received the NZDs preferred it (to the old dentures).

Groups 2 and 3 each had one study. The study in Group 2 was a prospective cohort with all patients receiving both a CD and NZD. However, the only PBG reported on was the number of recalls as a measure for satisfaction. The study in Group 3 was a cross-over study, but compared functionally shaped with manually shaped flanges. No literature could be found confirming a positive cause-effect relationship between number of recalls and patient satisfaction. The authors did not have a conventional denture as control – both dentures were NZ dentures. However, it was decided to include this study in the review for the following reason: Piezographically contoured flanges is one of the variables of the other two groups. This study showed that piezographically developed flanges did not influence retention as compared with manually shaped flanges, while all patients preferred the manually shaped flanges. This could be clinically relevant and should be investigated further because not having to dynamically shape flanges as part of the NZ procedures reduces clinical chair time.

Quality of the evidence of the research is dependent on several factors. By completing a RoB assessment, quality is evaluated and addressed. The quality of the evidence is an indication of the integrity of the study. The ethics in conducting a clinical study encompasses several aspects too, but the details of design and conducting the study and obtaining the expected data is equally important. It has been reported that developing a protocol and registering it with an Ethics review board or in trial registries and even publishing it, ensures rigor. The quality of the study is determined by the study design; and details must be such that
results may be generalizable to larger populations. Randomized controlled trials and cross-over trials are of higher quality than cross-sectional and cohort studies. But if an RCT does not have all the steps such as ‘sequence generation,’ ‘blinding’ or ‘allocation concealment’ these maybe downgraded and considered of poorer quality. The results may not be considered reliable and valid. Most of the included studies followed some guidelines to protect against bias even though all the details were not reported. These were judged by using the Cochrane’s RoB tool. For example, completing power calculation to estimate sample size would reduce RoB. Sample sizes of the included studies ranged from five to 128, but only one study reported a power calculation.114

The use of different study designs, methodologies, validated and unvalidated instruments and “results” not supported by data, prevented comparisons and the completion of meta-analysis among the studies. For example, Raja (2009) and Zaigham (2006) used subjective grading systems, also lacking calibration and reliability.15

CONCLUSION

The nine studies incorporated in this SR showed a high level of heterogeneity in terms of study design, types of PBOs and instruments used to measure these PBOs.

The quality of the majority of clinical studies was low, with small sample sizes, short follow-up periods and presence of high level of selection, performance and detection bias.

Little high-level scientific evidence exists on the benefit of dynamic over static methods to determine mandibular CO form and shape.

Declaration

The authors received no funding for this research. The authors declare no conflict of interest.

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INTRODUCTION
The genome project has provided opportunities to understand the genetic characteristics of disease and to create novel approaches to prevent, diagnose, and manage medical and dental disorders. There is growing evidence of the part of the dentist in recognizing not only dental and oral disorders but also systemic markers of genetic disorders. In this way, the dentist has a role in the overall health and well-being of patients. The contribution of hereditary factors to canes, periodontal disease, oral cancer, and malformed or absent teeth, is increasingly evident in dentistry, as are the implications of systemic genetic disorders in oral and dental health care.

This article highlights some of the opportunities that collaboration between higher education institutions bring to the development of sustainable community-university partnerships. In particular, it explores the potential for universities to collaborate on building effective engagement mechanisms that support an ongoing flow of new projects and partnerships over time. It draws on evidence gathered over the years in terms of research and scientific publications, conference attendance and community engagement.

THE BEGINNING
The collaborative relationship between the Division of Human Genetics at UCT and the Dental Faculty at UWC began in the 1990’s when Prof LXG Stephen of UWC, Faculty of Dentistry, undertook a PhD in Department of Human Genetics at UCT. During the project, it became increasingly evident that access to dental health care for persons with genetic disorders was suboptimal. For these reasons and in view of the growing interest and importance of genetic disorders, a collaborative UWC-UCT Dental Genetic Clinic was established at the Red Cross Children’s Hospital in 2000. The accomplishment of this clinic solidified the prior informal association.

ACRONYMS:
OSD : Occupation Specific Dispensation
between Paediatrics, Human Genetics and Dentistry. This initiative resulted in the development of a facility that was unique in South Africa.

ACADEMIC SIGNIFICANCE
In 2002, the UWC-UCT Dental Genetic Clinic was upgraded and whilst there was a full-time dentist employed, special emphasis was placed on facilitating optimal specialized dental care for patients with heritable disorders. Over the years several MSc students of UWC, Faculty of Dentistry, both local and foreign, particularly from other African countries, have rotated through this clinic. During this period, these postgraduate students were mentored with regard to the dental management of children with genetic disorders and congenital abnormalities. In this way, the interface between Medical Genetics and Dentistry was bridged and knowledge and interest in this field developed. Some of these Masters students went on to specialize in various fields of dentistry and a two completed PhDs in Human Genetics. Their project titles were ‘Dental Implications of Inherited Connective Tissue Disorders in South Africa’ and ‘Dental Implications of Genetic and Congenital Intellectual Disabilities in Cape Town’. The UWC-UCT Dental Genetic collaborative initiative has resulted in frequent congress participation and 29 publications in peer reviewed medical and dental literature. These are listed below.

OUTREACH AND COMMUNITY ENGAGEMENT
When appropriate, the dental team were members of the multidisciplinary medical team that went to community centres for the disabled, schools for the disabled and various outreach clinics, including hospitals within and beyond Cape Town. This approach enabled dentists to interact with the larger health care team and in this way, provide affected individuals with necessary dental care. An important facet of several genetic disorders is the psychosocial attributes which cannot be overlooked. Given the cosmetic aspect of dentistry, these individuals were provided with suitable care.

CURRENT SITUATION
At the Faculty of Dentistry, UWC, a Dental – Genetics Clinic has been formalized which serves as a referral centre for patients with genetic disorders from throughout the Western Cape. When necessary, these patients are managed by a multidisciplinary team of specialists. Over the last few years, several local and foreign postgraduate students have expressed interest in the field.
genetics and currently there are three registered MSc students and two PhD students with projects in the field of Human Genetics and Dentistry. The emerging interest in interdisciplinary research has facilitated the involvement of academics from the Dental Faculty in becoming members of the South African Human Genetics Society and the African Society for Human Genetics and subsequently to attend and participate in congresses. In this way, the awareness of the importance of Genetics in Dentistry has been strengthened and several African collaborative opportunities have been identified.

**INTRA- AND INTER FACULTY COLLABORATION AT UWC**

Patients presenting with a genetic disorder require a comprehensive multidisciplinary approach to their oral and dental management and collaborative intra-faculty relationships between the Departments of Prosthodontics, Orthodontics, Oral Medicine and Periodontics, Paediatric Dentistry, and Maxillofacial Surgery, are essential. Inter-faculty collaborations have also been established at the University of the Western Cape between Dental Genetics, Faculty of Science and Bioinformatics in particular SANBI.

**CONCLUSION**

The collaborative relationship between the Division of Human Genetics at UCT and the Dental Faculty at UWC has enabled and provided opportunities for members of the dental fraternity at UWC to speak the language, understand concepts and recognize the clinical implications in order to work as meaningful members of a healthcare team.

**Bibliography**

Insights into the “Stemness” of Cultured Adult Human Dental Pulp Fibroblast-like cells

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Basson NJ, Moodley DS, Olivier A, Hiss D

INTRODUCTION
Fibroblasts are the most numerous cells occurring in the dental pulp. Although distributed throughout the tissue, they are particularly abundant in the coronal portion of the pulp in the cell-rich zone. The function of pulpal fibroblasts is to produce and maintain the proteins of the extracellular matrix of the pulp.

Other fibroblast-like cells also occurring throughout the cell-rich zone and the pulp core, and often related to blood vessels, are undifferentiated mesenchymal cells. These cells represent the pool of cells from which the connective tissue cells of the pulp, such as odontoblasts and fibroblasts, are formed. In recent times, a more modern term for undifferentiated mesenchymal cells has emerged: “adult mesenchymal stem cells” (MSCs). They appear to be tissue-specific cells capable of giving rise to cells that are committed to differentiation once given the proper signal.

Adult MSC’s have a appearance similar to small young fibroblasts, and are distinguishable from fibroblasts morphologically and share the same expression of surface antigens as fibroblasts. They are however far more multipotent in terms of differentiation into cell types. Defined as undifferentiated cells that can continuously produce unaltered daughter cells, they also have the ability under specific growth conditions to differentiate into multiple lineages of mesenchymal tissues such as osteogenic, adipogenic and myogenic cells. Given these properties, there is an enormous potential for the application of MSC’s for cell therapy in regenerative medicine and tissue engineering in the craniofacial region. The capacity to stimulate stem cells in culture is indispensable in regenerative medicine. Therefore the isolation of adult MSC’s from dental tissue has drawn a lot of interest amongst scientists over the last number of years. The cells have been isolated from a number of different types of human dental tissue, including human exfoliated deciduous teeth, periodontal ligament, dental follicle, apical papilla, and the adult dental pulp.

Although significant information has been gained about MSC’s over the last number of years, important questions remain unanswered regarding the identity of these cells, such as their relation to fibroblasts. Both fibroblasts and MSC’s are plastic adherent cells that may be isolated from adult dental pulp using tissue culture techniques. In our laboratory we found it easy to isolate and culture “fibroblasts” from human dental pulp by using the explant method whereby cells grow out of a piece of tissue placed in a suitable growth medium. However, since adult MSC’s have an appearance similar to small young fibroblasts and indeed are indistinguishable from fibroblasts morphologically, the question arose as to their true identity. Therefore we investigated the “stemness” of these cultured fibroblast-like cells and the ease of establishing specific tissue lines from them.

MATERIALS AND METHODS
Isolation of fibroblast-like cells
This research project was registered with the Ethical Committee of the University of the Western Cape. Ethical clearance for the collection and use of extracted teeth was obtained from each individual donor. Impacted third molars and premolars removed for orthodontic purposes were used in the isolation of fibroblasts. Twenty-one freshly extracted teeth, from 21 individuals, were used. The teeth were collected in a container medium comprising Dulbecco’s modified Eagle medium (DMEM), 10% foetal bovine serum, 1% penicillin, 1% streptomycin, 0.2% fungizone and 0.2% gentamycin. Within 24 hours after removal, the teeth were placed in gauze, cracked open with a vice and the pulps removed (Figure 1). The pulps were rinsed several times in phosphate buffered saline (PBS) and the middle-third of the pulp removed, cut into small pieces and placed in petri dishes. Each piece of tissue was covered with a drop of foetal bovine serum (FBS) to facilitate attachment to the petri dish and allowed to dry for one hour after which DMEM (without fungizone and gentamycin) was added.

The specimens were incubated at 37°C in an atmosphere of 5% CO2 at a humidity of 95%. After 14 days, the outgrowths of cells (Figure 2) were dissociated using trypsin-verse for five minutes and then the cells were stored in liquid nitrogen. In due course, and as was required, frozen cells from each cell line were gently thawed and grown, using standard procedures.

Morphological characteristics
The general morphology of the fibroblast cells was observed microscopically using an Olympus CK2 inverted microscope at 400X magnification. Cells were grown to confluence and at the first passage the cell lines were allowed to grow for 24 hours in

ACRONYMS
MSC’s: adult mesenchymal stem cells
PBS: phosphate buffered saline
DMEM: Dulbecco’s modified Eagle medium,
FBS: foetal bovine serum

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4. D Hiss, Department of Medical Biosciences, University of the Western Cape Cape Town.
5ml petri dishes containing glass coverslips to which the cells would attach. After washing in PBS, the attached cells were fixed with cold acetone for 20 minutes, washed again in PBS and then stained with 1% crystal violet for 10 minutes. The stained cells were then washed, dehydrated in alcohol and xylene and mounted on glass slides. The remaining sub-lines were allowed to continue growing to confluence, and at the second and third passages, were treated as above.

**Growth parameters**

Cells grown in DMEM were dissociated with trypsin-verse and plated in 24-well plates at a seeding density of 1.2 x 10^4 cells/mL. The cells were grown with a medium change every third day until confluence was obtained after eight days. Every 24 hours the cells from three randomly selected wells were dissociated to obtain cell suspensions and the cells were counted in duplicate with a Neubauer haemocytometer. Logarithms of the average counts against times were used to plot growth curves.

**Flow cytometry**

To test for MSC properties, fibroblast cells from each cell line were subjected to flow cytometry analysis for expression of positive (CD90, CD105 and CD166) and negative (CD34, CD11b, CD19, CD45 and HLA-DR) MSC markers. The cells, harvested by trypsin-verse for 5 min, were washed in cold PBS supplemented with 0.5% Rovine Serum Albumin and aliquots of 2 x 10^5 cells were labelled for 30 min in the dark at 4°C with a StemFlow Human Mesenchymal Stem Cell Analysis Kit. The analysis was performed on a Canto II flow cytometer using an isotope control cocktail (BD Biosciences).

**Differentiation Assays**

In vitro differentiation of the isolated cells into osteoblasts, adipocytes and chondroblasts were performed using StemPro® Differentiation kits (GIBCO, LTC Tech SA, Johannesburg) for each respective differentiation.

All differentiation protocols were performed at the third passage. For each differentiation, cells were seeded into a 5ml petri dish and grown to confluence of about 60%. The conventional complete culture medium was then replaced with the induction medium from the StemPro® kit. Medium changes were performed twice a week for two weeks. The cell monolayer was rinsed once with PBS and fixed with 4% formalin for 30 minutes at room temperature. The formalin was removed and the cells rinsed twice with deionized water.

Osteogenesis was shown by staining the monolayer of cells with 2% Alizarin Red S solution for three minutes. The stain was removed and the cells washed three times with deionized water. The red stained calcium-rich extracellular matrix was then observed visually under a light microscope.

Chondrogenesis was shown by staining the monolayer of cells with 1% Alcian Blue solution (prepared in 0.1 N HCl) for 30 minutes. The cells were washed three times with 0.1 N HCl and once with deionized water. The blue stained proteoglycans synthesised by the chondrocytes were then observed visually under a light microscope.

Adipogenesis was shown by staining the monolayer of cells with Oil Red O solution for 30 minutes. The cells were washed three times with deionized water. The presence of intracellular lipid droplets was observed microscopically.

**Colony-forming potential**

To test for colony-forming ability, cells were grown to 70–80% confluence in DMEM, dissociated with trypsin-verse and plated at about 100 cells per 100-mm tissue culture dish. The cells were cultured for 10–14 days at 37°C in 5% humidified CO₂, washed with PBS and stained with 0.5% Crystal Violet in methanol for 5–10 min at room temperature. The plates were washed twice with PBS and inspected for visible colonies.

**RESULTS**

**Isolation of fibroblast-like cells**

The ages of the donors varied from 14 to 36 years with an average of 27.5 years. Only thirteen of the pulp specimens obtained from the 21 individuals produced outgrowth. The rate of outgrowth of cells differed between the various specimens. Some produced a substantial outgrowth of cells that allowed dissociation at 14 days, while others produced no outgrowth. Six pulp cell lines were established. All were able to actively proliferate after freezing and storing under liquid nitrogen.

**General morphology**

Two different types were observed, a slender spindle shaped cell (Figure 2a), and an epithelioid cell (Figure 2b). When the cells were sparsely distributed in the early stages of the passage, all the pulp cell lines displayed the typical spindle shaped microscopic features of cultured fibroblasts. However, as soon as the cultures were allowed to grow to confluence they tended to become rounded with an epithelioid shape (Figure 2b).

**Growth parameters**

The recorded growth curves indicated that the cultured cells progressed through a characteristic growth pattern of a lag phase, exponential phase and a plateau phase (Figure 3). The lag phase, during which the cells adjusted to their new environment lasted approximately 22 hours, the phase of exponential growth 40 hours and the change in the growth curves which showed that confluence was approached was seen at approximately five days. Full confluence was reached at eight days and no significantly higher counts were obtained thereafter.

**Flow cytometry**

The graph in figure 4 represents the overlay of cells stained with the isotype control (red) and cells stained with the negative antibody mix (blue). The fibroblast cell lines were all negative for CD34, CD11b, CD19, CD45 and HLA-DR.

The graphs in figure 5 represent the overlay of cells stained with the isotype control (red) and cells stained with the positive antibody mix (blue) containing CD90, CD73 and CD105. There was a clear shift in CD90 and CD73, but CD105 showed only a slight shift and only 53.4% of the cells were positive for CD105. On the other hand, 99.6% of the cells were positive for CD90 and 99.9% of the cells were positive for CD73.
Figure 3: A typical growth curve of the cultured pulp fibroblast cells over a period of 8 days depicting the different growth phases.

Figure 4: Cells stained with the negative antibody mix

Differentiation Assays
Osteogenic, chondrogenic, and adipogenic differentiation was observed two weeks after onset of the differentiation protocol. Osteogenic differentiation was shown by the presence of red stained mineralized extracellular matrix deposition (Figure 6b), adipogenic differentiation by the presence of red stained intracellular lipid droplets (Figure 6c) and chondrogenic differentiation by the blue staining of proteoglycans (Figure 6d).

Colony-forming potential
All the cell lines expressed colony forming ability (Figure 7).

DISCUSSION
According to the Mesenchymal and Tissue Stem Cell Committee of the International Society for Cellular Therapy, MSC's should be plastic-adherent when maintained in standard culture conditions, should express surface markers CD105, CD73, and CD90, but should lack expression of hematopoietic markers CD45, CD34, CD14, or CD11b, CD79 alpha. Furthermore, MSC’s should be multipotent with an ability to differentiate at least into osteoblasts, adipocytes, and chondroblasts.

The cells we isolated from human dental pulps had typical fibroblast morphology. On testing the above mentioned properties we found that these cells complied with all the criteria for MSC’s and can therefore be regarded as such.

The low success rate of establishing cell lines (28%) could be ascribed to poor pulp cell growth and the limited survival rate of the cells. This highlights the difficulty in establishing reliable human pulp MSC lines. No difference was observed between the different
Although fibroblasts and MSC's have been well studied, the differences are not fully understood as is also the identity of MSC's in relation to fibroblasts. For example, it has been found that conventional stem cell properties such as plastic adherence and the expression of CD44, CD90 and CD105 are not specific for stem cells. Furthermore, the differentiation potential into osteoblasts, adipocytes, and chondrocytes, properties that are generally believed to be specific for stem cells and that can be used to discriminate MSC's from fibroblasts, have also been shown to be properties of fibroblasts.

Fibroblasts differ in different parts of the body and also differ from each other in the same region. Many fibroblasts of the pulp, for example, are characterized by being relatively undifferentiated ("immature fibroblasts") and remain in a relatively undifferentiated state. These cells have a similar appearance to small, young fibroblasts, but are far more multipotent in terms of the cell types into which they may turn. "Mature" fibroblasts with a diminished capacity for transformation, may also exist that can develop into a variety of mature cell types.

Although fibroblasts share mesenchymal phenotypes with stem cells, have differentiation potential and adhere to plastic, they lack the colony-forming potential of MSC's. That is a feature which could be used as an additional test to distinguish between stem cells and fibroblasts.

Currently scientists are looking for markers that are more specific for MSC's and Halton et al. have already identified several markers on gene and protein level that have robust differences of expression in MSC's and fibroblasts.

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Ethics and the Children’s Act: What the Dental Practitioner needs to know.

When it comes to providing a health service to children, health professionals are faced with many challenges, the most important of these being issues of consent and guardianship and how these impact on the treatment that can be provided. According to the Constitution, a child is defined as a person under the age of 18 years. Excluding cases of mental impairments, it is accepted that individuals at 18 years of age are able to make their own decisions and are therefore able to consent to issues involving their health and any treatment they may require. For healthcare professionals in particular, the patients that pose the biggest challenges where ethics are concerned are those that fall below this age of majority.

The Children’s Act is administered by the Department of Social Development and provides a framework and guide for all individuals dealing with children. When it comes to the provision of healthcare, the main objectives of the Children’s Act are as follows:

- Children should be protected from maltreatment, neglect and abuse.
- The child’s best interests are always the primary concern.
- The general health and well-being of every child should be promoted.
- The special needs of children with disabilities (including learning disabilities) should be recognized. The child should be provided with appropriate care and the caregiver must be provided with the necessary support. These special needs children should not be subjected to any practices (medical, social, cultural or religious) that would negatively impact on their health, well-being or dignity.
- Children should have access to health care services. Accessibility means that services should be provided without discrimination and services should be affordable and physically and ‘environmentally’ accessible i.e. it should be within easy reach.
- In cases where these services are not affordable, the government has to step in. Children will be provided with the basic health care services in cases where their parents or caregivers cannot afford treatment.

The Constitutional rights of the child also include:

- The right to be treated equally
- The right to privacy
- The right to confidentiality regarding their health status (except where maintaining such confidentiality is not in the best interest of the child). Children also have the right to keep the health status of their parent or caregiver confidential so as to avoid discrimination against them e.g. children may be stigmatized if their parent’s HIV status becomes known.

The Committee on the Rights of the Child is particularly concerned about the issue of HIV and children’s rights as well as the health rights of adolescents who have reached puberty. Regarding health care needs, the Act states that children are entitled to be informed about their health status. Information should be provided in such a manner that the child is able to understand and comprehend the situation. “Child-friendly” language should be used. Children have to be informed about any decisions that are made regarding their health care needs and they have the right to participate in these decisions. Their wishes should always be considered before any decisions are made regarding their well-being.

ISSUES OF CONSENT

Consent is the agreement to medical treatment where a person can indicate his or her will. Informed consent is when a person agrees to treatment after being fully informed about the risks, benefits and possible negative consequences of a particular procedure as well as what might happen if consent is not given and treatment not delivered.

If consent is not obtained, and treatment intervention nevertheless proceeds, the health care worker’s actions could be considered “assault” as any actions that are administered without consent would be considered “unlawful” actions.

Consent for medical treatment should be sought from the child’s biological or adoptive parents or other caregivers. A caregiver is someone other than the parent who is taking care of the child and can be any of the following:

- A foster parent. Foster parents can be appointed by a court or the Department of Social Development.
- A person who cares for a child with the blessing or consent of the biological parent.
- A person who cares for a child in temporary safe care.
- The head of a child youth centre in which the child has been placed.
- The head of a shelter.
- Superintendent of a hospital.
- A child or youth care worker who cares for a child who does not have family in the community.
- A child at the head of a child-headed household.

Biological parents are considered the natural guardians. Even if a child has been conceived through artificial insemination using the gametes of another person, this child born to a married couple is considered to be the couple’s biological child. The donor of the gamete cannot claim paternity or guardianship. A child who is adopted may be regarded as the natural child of the adoptive

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parents. Biological and adoptive parents are considered legal guardians and have full parental rights. A legal guardian can also be someone who is appointed to be a guardian either in a will or by a court and has the proper documentation. The High Court is the supreme guardian of all children and only that body can grant permission to someone to become a guardian or limit or stop parental responsibilities.²

Even if caregivers do not have parental responsibilities over the child, they should still protect the child and safeguard the child’s health, well-being and development. It should however be noted that there are limitations for the types of procedures to which these caregivers can consent on behalf of a child.

CONSENT FOR MEDICAL TREATMENT

Medical treatment has not been defined by the courts but it includes medical or pharmaceutical remedies but not surgical procedures.⁵ Counseling can also be considered a form of treatment.

The minimum age for independent consent is 12 years. The Children’s Act⁶ allows a child of 12 years or older to give consent to medical treatment or procedures provided that the child is “sufficiently mature” and has the mental capacity to comprehend the benefits, risks and other implications of the procedure in question. If sufficient maturity is displayed, the child’s consent is adequate and additional parental consent is not required.⁸

The nature of the treatment varies according to the level of invasiveness of the procedure and the degree of complication. The type of procedure therefore also has to be taken into consideration.⁸

Children mature at different rates.⁷ It is therefore imperative that the health care worker first determines the child’s level of maturity by asking appropriate questions which test the child’s level of comprehension. The stage of schooling and age-appropriate language skills could be used as a means of gauging the child’s level of maturity. The child should understand the relevant information, the consequences of the treatment and be able to reason around issues concerning the treatment required.⁸ Further, the child should be able to articulate that he or she is aware of the risks and consequences if consent is given or not. Care needs to be exercised when assessing whether the child can provide independent consent.

Caregivers may consent to medical treatment even though he/she may not be the child’s legal guardian. By allowing a person caring for a child to provide consent to medical treatment, the administrative processes for health care providers are simplified. In the absence of a legal guardian, the Children’s Act⁷ makes provision for these caregivers to provide consent in cases where emergency pain relief is required. If a caregiver refuses to consent to treatment and there are no other resources available, the Minister of Social Development, court or superintendent of the facility may be approached for consent.⁸

The HIV status of a minor may not be disclosed without the consent of his or her legal guardian. If the child is old enough to decide on whether or not to disclose his or her status, the child’s freedom of choice must be respected.

Testing a child for HIV can only be done if it is in the best interest of the child or if it is necessary to establish whether a health care worker or any other person may be at risk of contracting HIV. Consent for HIV testing must be obtained from either the child if he or she is old enough to understand the situation (including the risks and benefits) or the parent if the child is not of sufficient maturity. The provincial head of social development, a designated child protection organization, superintendent of the hospital or children’s court may be contacted in the absence of the parent. A court order may also be sought if necessary in cases of refusal on the part of the parent or child.⁸

CONSENT FOR SURGICAL TREATMENT

Knowing which caregivers are able to grant consent is essential when planning for surgical procedures like treatment under general anaesthesia or sedation. Only the following caregivers can consent to surgical treatment:²

- Married biological mother and father.
- Divorced mother and/or father (depending on the court’s decision).
- Adoptive parents.
- Unmarried biological mother.

Unless the courts grant the father full parental rights, unmarried biological fathers are only expected to provide maintenance and are allowed to have contact with the child. Guardianship and care are usually the responsibility of the unmarried mother.⁷

The Children’s Act⁶ does however now make provision for unmarried fathers to claim parental responsibility⁹ if they:

- were living with the child’s mother in a serious long-term relationship at the time of the child’s birth.
- want to claim paternity of the child even if he and the child’s mother do not have a relationship.
- contribute to the child’s upbringing.
- contribute or try to contribute to the maintenance of the child.

The unmarried father can also claim parental rights (by applying to the High Court) if the mother is an unfit parent, has passed away or if it is in the best interests of the child.¹² Paternity cannot be claimed if the child has been conceived due to rape or incest or the person is biologically related to the child because of artificial insemination.²

The mother of an unmarried parent may also be considered the guardian of her grandchildren² but unless stipulated by the court, she would not be considered a legal guardian. Caregivers who are not the child’s legal guardian may not consent to surgical treatment.² Even though foster parents have rights similar to parents, they cannot consent to surgical procedures including treatment under general anaesthesia and sedation. In such cases, or in cases where consent cannot be obtained from the biological parents or legal guardian for whatever reason, consent from the Minister of Social Development must be sought.¹² If the medical condition is of such an urgent nature that consent from the Minister needs to be granted as soon as possible, it is perhaps better to request consent from the High Court or local children’s court.¹³ There is a children’s court in every magisterial district.¹³ In emergency situations where there is no time to approach the minister or the court, the superintendent of a facility can grant consent for surgical procedures.¹³ The superintendent cannot however delegate his or her powers of consent to anyone else unless that person is acting as a “person in charge of the hospital”.¹³

Children of 12 years of age can give consent to a surgical operation provided he or she is “duly assisted (in writing) by a parent or guardian”.¹⁴ The meaning of the words “duly assisted” has not been clarified by the courts but involves certification by the parent that the child understands the nature of the operation and is sufficiently mature to comprehend the risks and benefits of the procedure.¹⁵ A contradiction is also noted in the Children’s Act which states that children between the ages of 12 and 18 can consent to surgery without the permission of their parents.⁶ Discretion on the part of the health care worker is therefore important.

In cases where the child refuses treatment, surgical procedures can be carried out against the child’s will provided that it is in the best interests of the child.¹⁷ The parent or Minister of Social Development will then have to grant consent on behalf of the child.
YOUNG PARENTS UNDER 18 YEARS: CONSENT FOR TREATMENT FOR THEIR CHILDREN

Individuals who are younger than 18 years but who have children of their own, can consent to medical and/or surgical treatment for their children provided they are of sufficient maturity and can understand the implications of the procedure. If these teenage parents are not mature enough to comprehend the situation, this responsibility rests upon the shoulders of their parents. These grandparents then have to “duly assist” their children and provide consent in writing.6

WITH HOLDING OF CONSENT

Both parents have equal guardianship over children that have been born within a marriage. In cases where one parent refuses, the other parent may grant consent if the procedure is in the best interests of the child. Parents should consult each other and their views should be given due consideration. However, legally, one parent’s consent is sufficient. If a parent wants to overturn consent granted by the other parent, a court order will need to be sought.5

If parents are no longer together, the holder of parental responsibility should consult with the other parent regarding decisions which affect the child’s health. Even though parents have a duty to consult each other, it is not the place of the health service provider to check that this has been done.5

According to the Children’s Act,4 no parent can withhold consent for religious or other similar reasons. If they refuse the recommended treatment, they will be required to provide proof that a medically acceptable alternative exists. If they are unable to show that such an alternative exists, the parent can be overruled by the Minister of Social Development.5 This ensures that strongly held religious beliefs will not stand in the way of a child receiving lifesaving treatment.

SUSPICION OF CASES OF ABUSE

A healthcare worker is required by law to report cases of suspected abuse or neglect.6 The Children’s Act states that “failure to report a reasonable conclusion that a child has been abused or deliberately neglected would make the health professional liable to be found guilty of an offence and liable upon conviction”. This will be dealt with in more detail in another article.

CONCLUSION

As health professionals, the basic tenets of the Children’s Act should always inform our treatment practices and the best interests of the child should always be considered. All healthcare professionals should therefore be familiar with the laws that govern the health issues of children.

References

5. Stolz-Nielsen, J. (2010). The Children’s Act and the health care worker. Faculty of Law, University of the Western Cape.
South African statutory regulations for dental practices.

INTRODUCTION
The Constitution of the Republic of South Africa dictates that: "every person has the right to a working environment that is not harmful to their health or well-being" 1,2 The practitioner and/or health care facility as the employer should ensure a safe working environment as far as reasonably possible for all employees, as well as individuals attending the facility.3,9

The Centres for Disease Control in the United States of America has a comprehensive document that outlines every aspect of infection prevention in the dental setting.4,8

Oral Health Care Workers (OHCW) refers to any individual in the dental practice that is directly or indirectly involved in the processing and use of instrumentation and medical waste (Table 1).5 All OHCW should comply with HPCSA booklet 16. Guidelines for the Management of Health Care Waste.6 The integration of infection prevention strategies requires the OHCW to understand and apply the basic principles of infection control and to comply with the standard infection control precautions. All OHCW carry the responsibility to ensure the correct segregation, handling and disposal of hazardous waste in the dental practice setting.

WASTE MANAGEMENT
The Health Professions Council of South Africa (HPCSA) guidelines on waste management is set out in the booklet 16 section 6. This section states that: "It is the responsibility of all health care practitioners to have a health care waste management system in place or to have access to such a system. Such a system should be provided by an accredited waste service provider and be conducted in accordance with the relevant SABS code". The relevant SABS codes that serve as the basis for the HPCSA booklet 16 can be obtained from the SABS.7,9

The HPCSA and the SABS regulations state that it is the responsibility of the practitioner to ensure that an accredited health care waste management company is utilised by their practice. Every practice need to provide evidence of compliance in terms of an acceptable waste management protocol and of effective record keeping thereof.10

ACRONYMS:
- CDC: The Centres for Disease Control in the United States of America
- OHCW: Oral Health Care Workers
- HPCSA: Health Professions Council of South Africa
- SABS: South African Bureau of Standards

Designated departments in each province monitor the production of health care waste. Registration is required by each practice with this regulatory department. The registered health care waste service provider can assist you with the local or national government regulations applicable to your practice.11,12

All bio-hazard containers should be in use for a maximum of 14 days and the contents should not exceed the prescribed weight of the container. Sharps containers may be filled to below the marked fill line and retained for a maximum of 90 days before removal by the registered medical waste service provider.

The collection records of all bio-hazard and the sharps containers should be retained for at least five years. These records should also reflect the weight of the monthly mass of the total health care risk waste generated and/or disposed of by the practice.

CONCLUSION
The production and management of health care waste is monitored by local provincial governments. The HPCSA expects compliance with the published SABS guidelines from all OHCW.

It is the responsibility of every OHCW to ensure a safe environment for staff, clients and the general public, by disposing of health care medical waste in accordance with the prescribed regulations.

**Table 1: OHCW involved in the processing and use of instrumentation and medical waste.**

<table>
<thead>
<tr>
<th></th>
<th>Dentist</th>
<th>Dental hygienist</th>
<th>Dental assistant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dental laboratory technician (on-site and commercial)</td>
</tr>
<tr>
<td>Students and trainee staff members</td>
<td></td>
<td></td>
<td>Locum personnel / contract workers</td>
</tr>
<tr>
<td>Other persons not directly involved in patient care but potentially exposed to infectious agents (e.g., administrative, clerical, housekeeping, maintenance, or volunteer personnel).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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References


CASE SCENARIO
Enquiry from a dental clinician
As a general dental practitioner, I have been reading about the advent of dental lasers. From the advertisements it seems that purchasing a dental laser would place my practice in an "ideal position" to be on the "forefront of dentistry". After reading the safety regulations for Class 3b and 4 lasers set out by the Department of Health, Directorate Radiation Control, I completed the necessary training to safely operate this dental laser. I have now purchased a unit and wish to announce the availability of this "new service" at my practice with a series of advertisements in the local newspaper and on social media, using some of the following statements:

"Pain-free dentistry without injections guaranteed, come and experience it with lasers."

"Get treated by the best laser dentist in town."

"Dr X offers dentistry with lasers. With Dr X you can step into the future of dentistry."

Please advise me of any ethical issues that might arise from this course of action and the proposed advertising.

COMMENTARY
The adoption of any new technology in health care brings several ethical and technical challenges. It has been suggested that the ethical issues are divided into five major groups: (1) Media, marketing and advertising; (2) economic outcomes; (3) user training; (4) user-patient relationship and (5) other issues. In addressing the issues posed by this ethical case scenario, the evidence for the efficacy and safety of the laser must be critically evaluated together with a consideration of the precise clinical circumstances in which it can be used. Further factors to be assessed include the process of communicating, marketing and delivering this technology to potential recipients.

EVIDENCE BASE
The attraction to adopt "new" technology may supersede the collateral release of good evidence that the laser does in fact deliver on the promises made by manufacturer and retailer. It can take years for trials adequate to confirm the efficacy of new technology. Lasers have been integrated into general and specialist dental practice for a wide variety of procedures. Systematic reviews published in reputable journals and testing the evidence of tangible health gain or superior treatment efficacy of dental lasers over conventional techniques are still quite limited. Evidence on the safety of dental lasers in the short to medium term has not revealed any major patient risk, when the instrument is used according to stated instructions. The practitioner should carefully consider whether the laser is imperative to the success of the planned procedure.

PERVERSE INCENTIVES
Literature on other health technologies such as the CAT scan, CBCT and MRI, has shown that their wider availability can induce the very real risk of over-treatment. It has been suggested that in the introduction of new technologies, the surgeon could follow continuous evidence-based decision-making and that there should be discussion with the patient, prior to the use of the equipment. While some of this may reflect legitimate use that adds value to existing diagnostic and treatment regimes, it is nevertheless hard to ignore the possibility of over-use driven by an economic imperative. There is a real temptation to increase the use of a technology to more quickly recover the massive capital cost incurred in its purchase.

This is referred to in the Introduction to Booklet 5 of the Health Professions Council of South Africa (HPCSA) which states: "The ownership and use of high technology equipment creates a special problem, not only because of its inappropriate use by health care practitioners who are not properly qualified, but also due to over-servicing by appropriately qualified health care professionals". A practitioner may be offered a tempting attractive scheme to use or buy high technology equipment. The definition of perverse incentives (2,9, page 5, HPCSA Booklet 5) indicates that "improper financial gain or other valuable consideration" i.e. money or any other form of compensation, payment, reward or benefit could be viewed by the HPCSA as a perverse incentive. The practitioner who accepts such an incentive could face additional legal action under the Corruption Act (Act No. 94 of 1998). The introduction of new and innovative technologies like lasers will be facilitated if companies take into consideration the perspective of how ethics could become an integral component of the discourse about technological and organisational progress.

Patient information and advertising
Central to Patient Rights and the Ethical Principles of Care is the imperative to provide patients and potential clients with enough information for them to make an informed decision regarding the treatment to which they may consent. Dental lasers are still "new" technologies, and users may be unable (at this stage) to provide good evidence of the longer term implications of their use. In addition, realistic treatment predictions may differ from patient expectations which have been elevated by inflated promises in product advertising.

HPCSA Booklet 5 (page 5, rule 3.3) states that advertising "shall not advertise or endorse or encourage the use of any medical device in a manner that unfairly promotes the practice of a particular health care practitioner or a health care facility for the purpose of financial gain or other valuable consideration".

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Advertising services should not be misleading to the public and make them believe that a superior service will be rendered with the use of high technology equipment.

Another pitfall addressed in HPCSA Booklet 2 (page 9 no. 3) warns practitioners not to allow canvassing or touting for patients to be done on the practitioners’ behalf. When purchasing a dental laser there might be a contract of sale in which the practitioner is approached to register on the company website to increase visibility for the laser services offered. The professional must be careful not to overstep the canvassing or touting rule by allowing the laser company to “advertise” on their behalf. The practitioner might find that he or she is presented on the company website as having superior knowledge or skill over another non-laser practitioner.

There seems to be a very thin line between good product information and persuasive medical product marketing. The statements suggested above are our encircling practitioner clearly stray into the realm of persuasion and marketing, rather than providing sound evidence-based information to patients.

CONCLUSIONS

To ensure adherence to best practice guidelines in both clinical and ethical terms, practitioners need to constantly review the evidence base of any new technologies they adopt and to consider the ethical requirements of providing this background to patients.

It remains the responsibility of the practitioner to ensure that all aspects of patient care, safety and practice administration are addressed. Familiarity with the guidelines of the HPCSA and of the Directorate Radiation Control, Department of Health, is strongly encouraged.

Good evidence on the risks and benefits of laser dentistry must be communicated to patients so they are able to make an autonomous, informed decision to consent or not to its use. Informed consent must always be obtained from the patient when the use of a laser is considered as an adjunct to conventional treatment or in lieu of conventional treatment.

References


Dental clinical teachers’ perceptions of their teaching role.

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Maart R., Gordon N.

SUMMARY

Introduction
Clinicians often occupy a clinical teaching role without being adequately prepared for or orientated to the associated demands.

Aim
Explore perceptions of clinical teachers at the Faculty of Dentistry (UWC).

Method
A cross-sectional research design was used. Full and part-time clinical teachers (n=66) employed in 2014 were included. Data was gathered using a questionnaire administered via the online Survey Monkey® system. Results: The response rate was 47% (n=31). The top five qualities of a clinical teacher were understanding of students, patience, subject knowledge, good communication, and teacher role model. All respondents selected “availability throughout a clinical session, punctuality at a clinical session and identifying gaps in procedural/clinical aspects in the patient care” as important roles of a good clinical teacher. Differences in perceptions of clinical roles were seen between full and part-time clinical teachers.

Conclusion
Clinical teachers’ perceptions of their teaching role was to a great extent in line with best practice as indicated in the literature. Faculty teaching and learning initiatives should highlight the clinical teacher role, harness the unique perspectives of full and part-time clinical teachers and address barriers that may hinder this process.

INTRODUCTION

A core dimension of the lecturer role at dental schools is that of a clinical teacher, also referred to as a clinical supervisor. Clinical supervision is defined as ‘monitoring, guidance and feedback on matters of personal, professional and educational development in the context of patient care’.

Best practice in clinical teaching has been identified within the domains of positive role modelling; competent and compassionate health care provision; effective supervision and mentoring; use of varied teaching approaches and being supportive. Considering that a role model demonstrates a standard of excellence which should be imitated, it is vital for trainees and trainers to be aware of positive and negative role modelling so that trainees demonstrate and trainees imitate the appropriate professional behaviour. Dental student opinions of inconsistent and sometimes insensitive feedback highlights that students could identify negative teaching and personal qualities modelled to them.

The clinical environment is an authentic learning platform for students as they treat patients under supervision of qualified dental professionals. This one-to-one interaction is a key element in student learning. To support learning, clinical teachers should provide specific feedback on student performance, show an interest in teaching, motivate students, be able to translate didactic information into patient care situations, show compassion and approach patient treatment in a proactive manner. Feedback should facilitate learning, include appropriate cognitive feedback to the student, be contextual, be part of any assessment to improve the students’ clinical skills and reinforce good practice.

Students reportedly valued supervisor feedback, regarding immediate and constructive feedback as most helpful. The one-minute Preceptor model as a framework for clinical teaching, identifies five micro-skills to guide the teacher. These are securing a commitment from the student on actions they intend taking, probing for supporting evidence to explore the ‘mindmap’ of the student, teaching general rules, reinforcing what is done correctly and correcting mistakes. An additional factor in the teaching and learning process is that dental educators may be at different stages of didactic competence, ranging from a novice that is new to teaching to the expert where teaching has become instinctive and intuitive.

The background and professional status of staff and concerns regarding curriculum and students appear to influence clinical teaching. Sweet et al reported that practitioners viewed their role as supervision rather than teaching; that senior academics tended to be resistant to change particularly when such change challenged the authority of their discipline; that intuitive teachers tend to emphasise practical learning; and that trained academics focussed on education theory and critical thinking. Furthermore, supervisors reported a lack of clear objectives and expectations, considered that teaching was pitched at the wrong level and that there was a lack of active participation with a focus on recall rather than problem solving by learners.

AIMS AND OBJECTIVES

The purpose of this descriptive study was to explore the perceptions of clinical teachers at Faculty of Dentistry (UWC) regarding their roles in the clinical environment in order to inform faculty teaching and learning initiatives. The objectives were to determine their demographics, perceptions of their role as clinical teachers, barriers experienced in fulfilling their role as...
DENTAL EDUCATION < 305

clinical teachers and suggestions to promote excellence in clinical teaching at the faculty.

METHOD

The Faculty of Dentistry (UWC) routinely offers teaching and learning initiatives for part-time and full-time staff. One such initiative includes a monthly Faculty Journal club on Teaching and Learning, with a strong emphasis on clinical teaching. A core group of 10-15 staff attend these discussions although the topic and logistics are contributing factors to attendance.

Clinical teachers at the Faculty are generally drawn from full-time academic staff across clinical departments and part-time staff from private practice. Part-time staff is a feature of dental education for the clinical expertise they provide and the fact that dental student numbers are increasing without a concomitant increase in full-time staff. Full and part-time clinical teachers were included in this study as they may have different perceptions on their role within the clinical environment, which could influence their actions as clinical teachers.

This was a quantitative, cross sectional study of all clinical teachers (n=68) employed in the Faculty of Dentistry in 2014.

Data was collected by means of a questionnaire using open-ended and closed questions.

The questionnaire focused on the perceptions of clinical teachers on their role in teaching within the clinical environment and the barriers they experienced in executing this role. Included were: 1) teacher demographics, 2) open-ended questions about perceptions of qualities and competencies of the clinical teacher, 3) details of barriers to fulfilling the role of a clinical teacher and 4) suggestions to promote excellence in clinical teaching. A set of 26 statements were prepared, structured around the role of the clinical teacher before, during and after a clinical session, to enquire about perceptions on the process of clinical teaching (Table I). Respondents were asked to rate these statements on a five-point scale namely; ‘critical’ (5), ‘important’ (4), ‘useful’ (3), ‘not important’ (2) and ‘not critical’ (1). The questionnaire was administered using the online SurveyMonkey system (Palo Alto, CA, USA).

Face and content validity of the questionnaire were addressed by the critical scrutiny of colleagues in the Dental Faculty who have done research in the field of clinical teaching. A pilot study was conducted and format changes were made for more user friendly online application.

Open-ended data were summarised using descriptive frequency tables. The Chi-square test was used to test for significant relationships between categorical demographic information. Where the assumptions of the Chi square test were not met the alternative output of likelihood ratio was used. The non-parametric Independent Samples Kruskal-Wallis test was used to compare the distribution of responses for the different demographic features of the clinical teacher. An importance index (II) was calculated for each question on the importance of the role of the clinical teacher by subtracting the total number of responses in the ‘critical’ and ‘important’ categories from the total of responses for the ‘not important’ and ‘not critical’ (Table II).

<table>
<thead>
<tr>
<th>Table 1: Perceptions of the role of the clinical teacher in the clinical environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical teachers should, for the students they supervise</strong></td>
</tr>
<tr>
<td>i. Know the level of clinical competence expected in view of the student programme.</td>
</tr>
<tr>
<td>ii. Discuss within disciplines, expectations of students prior to a clinical placement.</td>
</tr>
<tr>
<td>iii. Review within disciplines, student performance at milestones in their clinical training, (based on discipline specific outcomes).</td>
</tr>
<tr>
<td>iv. Provide within disciplines, feedback to students of their performance as noted in (3) i.e. feedback to students at milestones of their training.</td>
</tr>
<tr>
<td><strong>During the clinical session</strong></td>
</tr>
<tr>
<td>v. Be punctual for every clinical session.</td>
</tr>
<tr>
<td>vi. Be assigned to specific students for the session.</td>
</tr>
<tr>
<td>vii. Enquire at the start of the session whether students know what is required of them for the specific patient being treated.</td>
</tr>
<tr>
<td>viii. Be available to students that are responsible for throughout the session.</td>
</tr>
<tr>
<td>ix. Observe students working throughout the session.</td>
</tr>
<tr>
<td>x. Interact with students to find out their understanding of the theoretical aspects of their patient care.</td>
</tr>
<tr>
<td>xi. Identify gaps in theoretical aspects of student knowledge regarding patients being treated.</td>
</tr>
<tr>
<td>xii. Briefly teach theoretical concepts of gaps noted in xi.</td>
</tr>
<tr>
<td>xiii. Interact with students to find out their understanding of the procedural/clinical aspects of their patient treatment.</td>
</tr>
<tr>
<td>xiv. Identify gaps in procedural/clinical aspects in the patient care.</td>
</tr>
<tr>
<td>xv. Demonstrate procedures/clinical aspects students struggle with during patient care.</td>
</tr>
<tr>
<td>xvi. Refer students to appropriate sources to address gaps noted in the clinical session.</td>
</tr>
<tr>
<td>xvii. Inform and demonstrate to students that they are willing to teach.</td>
</tr>
<tr>
<td><strong>At the end of the clinical session</strong></td>
</tr>
<tr>
<td>xix. Inform students of their grade/mark attained for the session.</td>
</tr>
<tr>
<td>xx. Emphasise to students positive behaviour/actions that students performed.</td>
</tr>
<tr>
<td>xxi. Suggest to students ways to improve student behaviour/actions found lacking.</td>
</tr>
<tr>
<td>xxii. Offer assistance to students to improve their competence in patient care.</td>
</tr>
<tr>
<td>xxiii. Direct students to sources to improve their competence in patient care.</td>
</tr>
<tr>
<td>xxiv. Give feedback to peers in the discipline of student performance in the session.</td>
</tr>
<tr>
<td>xxv. Highlight in the discipline, general clinical concerns noted.</td>
</tr>
<tr>
<td>xxvi. Suggest in the discipline, means to address concerns noted in (25).</td>
</tr>
</tbody>
</table>

Each statement was rated on a scale of 1 ['not critical'] to 5 ['critical'].
Table 2: Clinical teacher ratings of the importance of roles in the clinical environment (Importance Index)

<table>
<thead>
<tr>
<th>Statements on the role of clinical teacher</th>
<th>Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Be available to students that they are responsible for throughout the session.</td>
<td>100.0%</td>
</tr>
<tr>
<td>2. Be punctual for every clinical session.</td>
<td>100.0%</td>
</tr>
<tr>
<td>3. Identify gaps in procedural/clinical aspects in the patient care.</td>
<td>100.0%</td>
</tr>
<tr>
<td>4. Interact with students to find out their understanding of the procedural/clinical aspects of their patient treatment.</td>
<td>100.0%</td>
</tr>
<tr>
<td>5. Interact with students to find out their understanding of the theoretical aspects of their patient care.</td>
<td>100.0%</td>
</tr>
<tr>
<td>6. Provide within disciplines, feedback to students of their performance (from student review within disciplines).</td>
<td>100.0%</td>
</tr>
<tr>
<td>7. Review within disciplines, student performance at milestones in clinical training (based on discipline specific outcomes).</td>
<td>100.0%</td>
</tr>
<tr>
<td>8. Identify gaps in theoretical aspects of student knowledge regarding patients being treated.</td>
<td>95.8%</td>
</tr>
<tr>
<td>9. Demonstrate procedures/clinical aspects students struggle with during patient care.</td>
<td>91.7%</td>
</tr>
<tr>
<td>10. Emphasise to students positive behaviour/actions that students performed</td>
<td>91.7%</td>
</tr>
<tr>
<td>11. Highlight in the discipline, general clinical concerns noted.</td>
<td>91.7%</td>
</tr>
<tr>
<td>12. Know the level of clinical competence expected in view of student programme.</td>
<td>91.7%</td>
</tr>
<tr>
<td>13. Observe students working throughout the session.</td>
<td>91.7%</td>
</tr>
<tr>
<td>14. Offer assistance to students to improve their competence in patient care.</td>
<td>91.7%</td>
</tr>
<tr>
<td>15. Refer students to appropriate sources to address gaps in their knowledge or skills noted in the clinical session.</td>
<td>91.7%</td>
</tr>
<tr>
<td>16. Direct students to sources to improve their competence in patient care.</td>
<td>91.7%</td>
</tr>
<tr>
<td>17. Enquire at the start of the session whether students know what is required of them for the specific patient being treated.</td>
<td>91.7%</td>
</tr>
<tr>
<td>18. Inform students of their grade/mark attained for the session.</td>
<td>91.7%</td>
</tr>
<tr>
<td>19. Inform and demonstrate to students that teachers are accessible for assistance.</td>
<td>91.3%</td>
</tr>
<tr>
<td>20. Discuss within disciplines, expectations of students prior to a clinical placement.</td>
<td>87.5%</td>
</tr>
<tr>
<td>21. Suggest in the clinical discipline/department of students being supervised, means to address concerns noted.</td>
<td>87.5%</td>
</tr>
<tr>
<td>22. Suggest to students ways to improve student behaviour/actions found lacking.</td>
<td>87.5%</td>
</tr>
<tr>
<td>23. Inform and demonstrate to students that they are willing to teach.</td>
<td>87.0%</td>
</tr>
<tr>
<td>24. Briefly teach theoretical concepts of gaps noted during the session.</td>
<td>76.2%</td>
</tr>
<tr>
<td>25. Be assigned to specific students for the session.</td>
<td>75.0%</td>
</tr>
<tr>
<td>26. Give feedback to peers in the discipline/department of student performance in the session.</td>
<td>66.7%</td>
</tr>
</tbody>
</table>

Data were entered into the Statistical Products and Solution Services (SPSS) version 22. Quantitative data were analysed using frequencies and percentages. Chi square test statistics was used to test for associations (p<0.05) between the profile of clinical teachers and their perceptions.

Ethical clearance was obtained by the University of the Western Cape Ethics Committee. Participants were invited to participate in the study using staff email addresses with a link to SurveyMonkey if they chose to partake. The research purpose was explained in the online survey and anonymity was assured by the online system.

RESULTS

The response rate was 47% (n=31). The 21 full-time and 10 part-time staff who responded were mostly female (75%) with the majority reporting a Bachelor of Dental Sciences (BDS) as one of their qualifications. The professional status of full-time staff was almost evenly spread in terms of lecturer (38.1%), senior lecturer (33.3%) and professor (28.6%), whereas part-time staff were primarily lecturers (85.7%) and professors (14.3%). Full-time teachers had overall higher professional status (p = .036) and significantly more years of experience in clinical teaching (p = .015). Sixty percent (60%) of part-time and 23% of full-time clinical teachers had less than 11 years of experience.

QUALITIES OF CLINICAL TEACHERS

The top five qualities identified were understanding students (n=18), patience (n=10), subject knowledge (n=8), passion/commitment (n=7) and communication (n=7). Part-time teachers perceived 'understanding students', 'communication' and 'subject knowledge' less important as a teacher quality than did the full-time teachers (p = .029, p = .027, p = .05 respectively).

Competencies of clinical teachers

The top five identified competencies of a clinical teacher were: clinical skills and experience (n=18), subject knowledge (n=16), good communication (n=7), good teacher (n=6) and role model (n=4). Part-time clinical teachers perceived clinical skills and experience more important as a competency than did the full-time teachers (p=.05, p = .038 respectively).

Perceptions on the role of the clinical teacher

The median values for all 26 items (Table 2) on the clinical teacher roles were between 4 and 5 for the combined responses of full and part-time clinical teachers, indicating that respondents regarded all roles as important. However, full-time clinical teachers perceived observing students working throughout the session as less important than did the part-time clinical teachers (p=.038).

Females perceived the following statements as more important than males (p<0.05):

- 'Suggest to students ways to improve student behaviour/actions found lacking',
- 'Give feedback to peers in the discipline of student performance in the session',
- 'Highlight in the discipline, general clinical concerns noted'.
Perceived barriers for clinical teachers

Barriers reported to fulfilling their roles as clinical teachers were categorised as:

- ‘The teacher’: too many students per teacher, too much administrative work, unmotivated staff, public pressure, clinical load.
- ‘The student’: unprepared/unmotivated students, poor student ethics towards patients, punctuality.
- ‘Curriculum issues’: lack of curriculum review, poorly planned assessments, lack of tutorial sessions, contradictory teaching in relation to evidence-base.
- ‘The clinical environment’: limited space, logistics around materials and patient files, and outdated technology.

Suggestions to promote excellence in clinical teaching

Suggestions for the Faculty to promote excellence in clinical teaching were categorised as:

- ‘The teacher’: acknowledge valuable input of all clinical teaching staff, collegially among staff around professionalism/rules/discipline, smaller student groups, employ young energetic hard working teachers, comparable salaries with other universities.
- ‘The curriculum’: compulsory student evaluation before they enter clinics, standardise concepts across disciplines, improve assessment tools, establish clear evidence base, cross-department seminars/discussions.
- ‘The clinical environment’: sufficient and available consumables/workng equipment and support staff, clinical protocols in place, more comfortable working environment such as air conditioning, improve logistics around files, introduce information technology systems.
- ‘Other’: collaborate with other dental faculties nationally.

DISCUSSION

The stronger academic status of full-time teachers is possibly a result of a more enabling environment that would allow them to pursue an educational trajectory to use resources such as journal club attendance to equip them for clinical teaching. If part-time clinical teachers are seen as integral to the teaching and learning process, higher education institutions must create opportunities for them to develop the necessary competencies, while recognising the skills they bring to this project. Training programmes should emphasise that being a dental educator is an ongoing journey where educators are expected to maintain and improve teaching practice throughout their careers.16

Excellence in clinical teaching requires ‘clinical knowledge of medicine, of specific patients, and of context plus an educational knowledge of learners, general principles of teaching, and case-based teaching scripts’.12 Effective supervisors need to have good interpersonal skills, good teaching skills, be clinically competent and knowledgeable in addition to supervisory skills.10,14,16,22 The manner in which these terms are defined integrates the traditional supervisory and teaching roles and supports their interchangeable use in the literature. However, the results of this study show that the perceptions of part-time staff do not fully encompass their teaching role in the clinical environment; these differences are in line with Sweet et al.,16 that the background of dental staff is also reflected in their understanding of teaching development needs.

Broad themes of teacher qualities identified in this study are also reported in the literature.17,20 Perceptions of ideal clinical teachers agreed between students and faculty were, “stimulating, encouraging, competent, communicates, and well-read”;17 suggesting that students can identify the teacher from whom they can learn. The notion of respect and role-modelling is inherent in the teacher qualities identified. Respect of students contributes to their professional development and shows them the correct attitude towards patients and colleagues.16 At the same time standards of excellence are modelled to students.8

Clinical competence, reported as among the most important attributes of an effective clinical teacher,21 was also noted in this study with reference to clinical skills, experience and subject knowledge. The fact that part-time clinical teachers perceived clinical skills and experience more important as a competency than did the full-time teachers further reflects differentials in practice background and highlights the contribution of part-time teachers to professional education and training. Full-time staff engage with students in a classroom and clinical environment, creating an opportunity for daily interaction21 which may broaden their understanding of the dimensions of the learning process within the clinical environment as noted in this study.

Participant response (Table 2) shows that clinical teachers are for the most part aware of the dimensions of positive feedback in terms of the need to observe students, offer assistance, emphasise positive behaviours, inform them of grade marks and direct them to appropriate learning resources. Positive feedback can reinforce effective behaviours, suggest new behaviours that may be helpful in the future and correct mistakes.23 The actions noted are in line with the One-Minute preceptor model,24 an indication of consistent feedback, and shows participant understanding that feedback facilitates learning.25 There was an apparent contradiction in the lower rating of the importance of engaging departments/disciplines before and after clinical sessions around student expectations and performance (Table 2) and suggestions to improve excellence in clinical teaching. This dissonance may require clarification of the roles and responsibilities of clinical teachers within the broader faculty structures.

Part-time clinical teachers rated ‘observing students working throughout the session’ higher than full-time clinical teachers. This may indicate an implicit understanding of their role in guiding the student to perform the correct procedure at the correct time and reflects their practice experience. Part-time practitioners saw their role as supervisors rather than teachers, indicating that they may have ‘interesting techniques’ to share.19 Conversely, full-time clinical teachers rated this activity less important and may still be rooted in a traditional clinical supervisory role where they see themselves as assessing the outcome of the procedure rather than guiding the process thereof.

Barriers identified were similar to challenges in clinical teaching reported in the literature,20,24,25 highlighting the fact that these barriers may need to be addressed at different levels within the Faculty. Medical teachers reported similar concerns with additional problems such as pressure from commitment to the multiple roles of the academic,14,18 having relationships with several agencies such as the University and the National Health System and a lack of incentives and rewards for teaching and patient-related factors.14 Recommendations made by respondents appear to address the barriers identified, indicating that staff know how their challenges in the clinical environment can be addressed. Of interest is that the notion of rewards and incentives26 to promote excellence in clinical teaching was not reported by any staff.

Teacher competence and the learner-educator relationship are significant contributors to the academic success of students and to the way in which future clinicians work as members of a team and as caring professionals.19 Forums where clinical teachers can explore issues of teaching and learning have the potential to create vibrant learning communities.21 The suggestions of respondents on ways to promote excellence in clinical teaching tends to the creation of a community of practice in clinical teaching which has been shown to contribute to a more collegial and positive work environment amongst dental hygiene educators.27 Journal club discussions at the Dental Faculty, as part of the broader Faculty processes to develop excellence in clinical teaching and learning, may be a niche for such a community of practice28 which can foster understanding the perceptions of clinical teachers may guide appropriate interventions that would promote best practice and excellence in clinical teaching.

The results of this study should be interpreted against the response rate as individuals who chose not to participate may have different perceptions. The small number of respondents in each of the professional status categories may explain the lack of significance between staff backgrounds and teaching perceptions as noted in the literature.
CONCLUSION
This study found that the perceptions of respondents regarding clinical teaching were to a great extent in line with best practice according to the literature. Faculty teaching and learning initiatives should highlight the clinical teacher role for all staff, harness the unique perspectives that full and part-time clinical teachers bring to the teaching platform to maximise clinical teaching and learning while simultaneously addressing barriers that may hinder this process.

Acknowledgement
We, the authors, owe a debt of gratitude to the late Professor Wendy McMillan for her inspiration and to pursue excellence in clinical teaching. Also acknowledgement for funding received from Deputy Vice-Chancellor for Teaching and Learning towards statistical support.

References
19. Reeves J. Why teachers adopt a controlling motivating style towards students and how they can become more autonomy supportive. Educational Psychologist 2009; 44(3):159-75.
Oral hygienists’ self-perceived competence on completion of a blended learning course in local anaesthesia at a South African university.

SUMMARY
Introduction
The expanding scope of practice of oral hygienists require universities to offer courses that would enhance their skills. Aim and objectives: To determine the self-perceived competence of oral hygienists to deliver local anaesthesia (LA) after completion of a blended-learning course.

Design
This was a descriptive, prospective study.

Methods
Data were collected at two stages, using self-administered questionnaires 1) immediately after the face-to-face component of the course and 2) after the final assessment when participants had had the opportunity to deliver LA in their practices. Results and conclusions: All participants (n=25) were female, aged 26–55 years (mean=44 years). The most positive aspects of the course were the engagement with lecturers (90%), accessibility of notes (90%) and video clips (96%). At the end of the face-to-face period, participants (n=25) reported as having the knowledge (100%), skill (76%) and confidence (84%) to administer LA. Results from the second questionnaire (n=19) however, indicated lower scores for the same parameters. This could be explained by limited opportunity to practise LA prior to completion of the second questionnaire. The self-perceived competence of the participants and the practice dynamics appear to be determining factors as to whether LA is employed in their working environments.

INTRODUCTION
In South Africa, the course leading to qualification in the profession of oral hygiene has evolved from a two year diploma, initiated in 1974, to a three year Bachelor’s Degree in Oral Health. Concomitantly, the clinical scope of practice was expanded in 20001 and 2013.2 Oral hygienists who wish to practise to the full in these revised scopes are required to attend the relevant courses at accredited universities. On successful completion, their registration is updated with the regulatory body, the Health Professions Council of South Africa (HPCSA), and they may then practice accordingly. In addition to these expanded scopes, independent private practice for oral hygienists was introduced in 2012.3 This allows for the transition of the oral hygienist from the current legislation of supervised practice, to the independent private practitioner. One requirement for independent private practice is the completion of the 2000 Scope of Practice which includes the administration of local anaesthesia.4 These changes are intended to capacitate the profession with greater autonomy in its role within the broader dental field.

The development of the profession of oral hygiene in South Africa over the past 20 years reflects the maturation of the profession globally.12 Continuing education, through short courses, is a feature of all professions in the health sciences.8 The purpose is for practitioners to keep abreast
of progress in their fields, and ultimately to provide quality care to patients.6,2,12.

These practitioners re-enter higher education as adult learners. They may have different motivations for returning, and may be at different levels of preparedness for academic study. Adult learners typically require direct connections between their studies and goals.19 However, they are capable of persistent application and independent learning if bolstered by the possibility that their anxiety about success may be addressed by their instructors.19 This challenges universities to use methodologies and technologies to meet the needs of adult learners as well as to satisfy the objectives of the extended education.14

Blended-learning, as a teaching and learning methodology, encompasses traditional face-to-face and e-learning by using the advantages of both methods.16 Traditional learning is considered vital in building a sense of community16 and e-learning has the potential to transcend time and space boundaries and to improve convenience and effectiveness for individual and collaborative learning.17 Interactive education, in addition, can enhance participant activity and provide an opportunity to practise skills which could improve professional practice to a greater extent than would didactic sessions.18,19 In supporting adult learning, Mattheos et al. (2010)20 suggest that “interactivity”, “flexibility”, “continuity” and “relevance to learners’ practice” are major characteristics of a successful continuing education programme.

Ultimately the learning programme should ensure that the practitioner is competent with respect to the knowledge, skills, attitudes and values that would enable him/her to improve health outcomes for the patient.20 In assessing competence, objective assessment tools are regarded as the gold standard. Self-perceived competence, however, does provide an indication of the levels of skill and knowledge, together with an assessment of the motivation to maintain and improve those skills.21, 6 For this study, self-perceived competence encompasses the dimensions of knowledge of, attitudes to, and skills to perform local anaesthesia.6,21

Including local anaesthesia in the scope of practice of oral hygienists aligns South Africa with international trends.6,8,10,22 The administration of local anaesthetic by oral hygienists was found to be associated with factors such as positive outcomes for their practice, as well as having a high value placed on the procedure6, together with enhanced respect.5,10,22 Hygienists showed confidence in their perceived competence to perform the procedure,6 and this contributed to the manner of delegating tasks in their practice environments.6

In South Africa, short continuing education courses have been offered on the 2000 Scope of Practice11 since 2001. There is, however, no published literature on the perceived competency of oral hygienists after completion of these continuing education courses.

The aim of this study, therefore, was to determine the self-perceived competence of oral hygienists in local anaesthesia after completion of a blended-learning course. The objectives were to determine participants’ profile, their concerns prior to starting the course, their experiences of the learning programme, their self-perceived competence to administer local anaesthetic, and the use of local anaesthesia in their practice environments. The results may be used to inform any review of the blended-learning course in local anaesthesia.

MATERIALS AND METHOD
The study was conducted at the Faculty of Dentistry, University of the Western Cape (UWC) between July and September 2016. The study population was a single cohort of oral hygienists attending a continuous education course on the 2000 Scope of Practice.1 A blended-learning approach was used. The course structure consisted of: pre-course reading; a one week face-to-face component, and assessments. The oral anaesthesia component was embedded within this course (see Table 1).

Table 1: LA course structure

<table>
<thead>
<tr>
<th>1. Preparation for the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Course material to revise basic anatomy and an online self-assessment was loaded onto the UWC e-learning platform (iKamva) two weeks prior to the face-to-face component.</td>
</tr>
<tr>
<td>• PowerPoint lectures, animated audio-visual files and links to other audio-visual material related to injection techniques were loaded to the iKamva site prior to the formal lectures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Face-to-face component of the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lectures, audio-visual presentations with explanations of techniques; practice on simulators, and demonstration on a simulated patient in a laboratory setting (8 hours); clinical application (11 hours).</td>
</tr>
<tr>
<td>• Formatative assessments included (immediate feedback was provided at the face-to-face sessions):</td>
</tr>
<tr>
<td>• A test on ‘Emergency Medicine’ prior to being allowed to do a number of LA procedures on patients in the oral surgery clinic.</td>
</tr>
<tr>
<td>• A clinical assessment on a patient on the last day of the face-to-face period. Participants who were unsuccessful attended an intervention and retook the assessment.</td>
</tr>
<tr>
<td>• An online theoretical assessment within one week of completing the face-to-face period.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Course completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>• After successfully completing the face-to-face component, participants were provided with a logbook to record LA procedures performed within their practice environment.</td>
</tr>
<tr>
<td>• A summative online assessment was done six weeks after the face-to-face period, after which successful participants could register their expanded functions with the HPCSA.</td>
</tr>
</tbody>
</table>

This was a descriptive, prospective study. The sample comprised participants registered for the course (n=25). Two questionnaires were used, one to evaluate perceptions of the process (Questionnaire 1), and the second, perceptions of the outcome (Questionnaire 2).

The questionnaires consisted of open-ended and closed questions. The first questionnaire was self-administered and was completed on the last day of the face-to-face component. Information related to participant demographics; their views on local anaesthesia being included in the scope of practice; their concerns prior to starting the course and their experiences of the learning programme. Their self-perceived competence to administer local anaesthetic was sought. Participants were asked to respond to statements regarding their
The second questionnaire using Google Forms was made available to participants two months after completion of the face-to-face component. At this time, participants had successfully completed the summative assessment and had had the opportunity to administer local anaesthetics in their practices. Questions enquired about the administering of local anaesthesia in their work environments, their perceived competence in the techniques, and their perception of the value of local anaesthesia in their practice environments. The same five point Likert type data was used in the closed questions.

Ethics approval was obtained (Humanities and Social Sciences Research Ethics Committee: reg. HS/18/8/14). At the introduction of the local anaesthesia component of the course, participants were informed of the related research project. They were informed of the purpose of the study and that their feedback would inform the review of the module. They were informed that participation was optional, and that their responses (should they participate) would be anonymous and confidential. They were also informed that they could withdraw from the study at any point, without being disadvantaged.

The First Questionnaire was completed on the last day of the local anaesthesia contact session. Study information and consent letters were attached to the questionnaires and distributed to the oral hygienists. Those participating could complete these questionnaires in their own time and deposit the completed documents and consent forms in depositories placed in designated areas. In the Second Questionnaire, Google Forms was set up with an information letter and a tick box for consent. Participants who chose to participate were directed to the questionnaire which was also made available by email (with a return email address of an independent recipient to ensure anonymity).

Data were entered and analysed using the STATA/IC\textsuperscript{16}. Open-ended questions were themed and coded. Frequency distributions were generated. The Spearmann’s correlation coefficient was used to determine the strength of the relationship between variables. Statistical significance was set at p<0.05.

RESULTS
Demographics
The results below relate to the process indicators (Questionnaire 1)

Participant profile and concerns prior to the face-to-face period.

Participant profile
The response rate was 100%. All participants were female, aged between 26 and 55 years (mean=44; SD 6.9). English was the first language of 16.7%, second language of 70.8% and third language of 12.5% of participants. Twenty-four participants had a Diploma in Oral Health obtained between 1980 and 2002, while one participant had a Degree in Oral Health. Areas of employment included general practice (63%), specialist practice (16%), public health sector (8%) and ‘other’ (4%). Experience in Information Technology included the use of the internet (96%), email (80%) and Facebook (37%).

Results of Questionnaire 1
Participant concerns
Concerns specific to the administering of local anaesthetic ranged from: inability to identify anatomical landmarks, mastering the skill of intra-oral injections, and injuring the patient. Concerns around learning were the ability to cope with the academic aspect of the module, anxiety about studying after a long break, and coping with the English medium. Concerns expressed as ‘fear’, ‘anxiety’ and being ‘overwhelmed’ were noted in the following statements: “Scared of injuring person in the wrong place, causing permanent damage”; “Nervous whether I would cope with the anatomy, will I be able to admin (sic) LA”, Participants also reported that patients may be sceptical of the ability of the oral hygienist to administer local anaesthetic; that time would be required to allow development of confidence to do the procedure; and that the dentist may not be available to render the necessary support.

Participant engagement with and experience of the learning programme
A large number of participants (>90%) found the pre-course reading, feedback sessions and video clips useful in developing competence. Participants elaborated on positive experiences (Table 2) such as lecturer availability, expertise, and interest in teaching students, noted by comments such as, “I feel very confident administering local anaesthesia”,”The lecturers put it across beautifully and they were very accommodating and patient with all the students”,”Negative experiences” (“no”, “to some extent” responses in Table 2) included insufficient time and opportunity to practise the skill, and a lack of integrating theory with practice. These were noted by comments such as “I am feeling more confident, but think more clinical practice is necessary”.

In response to the question on how their concerns prior to the commencement of the course were addressed, three themes emerged. These were:
1. The organisation and planning;
2. The teaching staff; and
3. The teaching format.
Participants elaborated on the above with reference to the availability of study material; having excellent, knowledgeable and patient teachers; and a format of explanations followed by demonstrations. Their views were highlighted by the following comments: “Tell-show-do method was very effective in helping me understand and implement practices”; “adequate information was given, techniques explained very well and my fear dispelled”; “With all the lectures it all made sense”; “The practical made sense and helped with theory”.

Participants’ views on the teaching methods
The most useful methods were the face-to-face teaching in the classroom and in the clinical environment; the
Table 2: Experiences of the learning programme

<table>
<thead>
<tr>
<th>Statements on teaching and learning of LA</th>
<th>Yes %</th>
<th>No %</th>
<th>To some extent %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinions of the pre-course online assessment (n=25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I did the online self-assessment prior to the course</td>
<td>76</td>
<td>76</td>
<td>4</td>
</tr>
<tr>
<td>2. The online self-assessment was useful to prepare for the LA course</td>
<td>75</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Participant engagement with resource material (n=25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I read the material placed on iKamva prior to the course</td>
<td>76</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>4. Reading the material prior to the course was useful in preparing for LA</td>
<td>96</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5. The PowerPoint lectures during the face-to-face period were useful in making me understand LA</td>
<td>88</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>6. I went through the lecture material provided after the lectures</td>
<td>84</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>7. The video clips were useful to my understanding of the application/content of LA</td>
<td>96</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>8. The video clips were useful to my understanding of the administering of LA</td>
<td>88</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>9. Watching the video clips helped develop my confidence to administer LA</td>
<td>84</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>

Participant engagement with lecturers

<table>
<thead>
<tr>
<th>Statements</th>
<th>Yes %</th>
<th>No %</th>
<th>To some extent %</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Lecturers’ response to questions clarified aspects that I was not clear on (n=24)</td>
<td>92</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>11. Feedback sessions were useful in developing skills of LA (n=21)</td>
<td>90.5</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>12. Feedback sessions were useful in developing confidence to administer LA (n=20)</td>
<td>90</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

The least useful teaching method was the simulated local anaesthesia model, consisting of battery operated jaws with 11 anaesthetic contact sensor points. Being orientated to injection techniques on a colleague, compared with practicing on the simulated local anaesthesia model, was reported to be more useful in developing skills and confidence to inject a patient.

Views on the inclusion of local anaesthesia within their scope of practice

All participants responded positively to the inclusion of local anaesthesia within the scope of practice of the profession. They noted an increased autonomy for the profession, greater independence in patient management, the provision of more comprehensive patient care, improved patient comfort, and an improved efficiency in patient flow as noted by the following comments: “Expand our boundaries and make it easier to apply our knowledge and to be of great help in the practice”; “It is fantastic broadening our scope in these areas”; “Will only empower us”.

Self-perceived competence to administer local anaesthesia

At the time that the questionnaire was administered, all participants had successfully completed the formative aspect of the assessment. The scales of ‘no’ and ‘definitely not’ were excluded as there were no reported values for these scales. All (100%) responded to having the knowledge and felt it important to have the right and competence to administer local anaesthesia (Table 3).

Perceived knowledge, competence and skills in local anaesthesia (Table 3: statements *) were used as a measure for self-perceived competence. The composite of self-perceived competence showed a very strong * correlation between local anaesthesia clinical skills (r=0.919, p=0.0005) and local anaesthesia confidence (r=0.911, p=0.0005); and a “strong” correlation between local anaesthesia skills and LA knowledge (r=0.768, p=0.0005). A “very weak” (r=0.00-0.19) relationship between most of the experiences of participants (Statements **) of the learning programme and their perceived competence, with the
Table 3: Self-perceived competence to administer local anaesthesia immediately after the face-to-face component (n=25).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Definitely</th>
<th>Yes</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I have the confidence to administer LA in my clinical environment</td>
<td>20%</td>
<td>64%</td>
<td>64%</td>
</tr>
<tr>
<td>2. I have the theoretical knowledge to administer LA in my clinical environment</td>
<td>32%</td>
<td>68%</td>
<td>0%</td>
</tr>
<tr>
<td>3. I have the clinical skills to administer LA in my clinical environment</td>
<td>24%</td>
<td>52%</td>
<td>24%</td>
</tr>
<tr>
<td>4. As an oral hygienist I feel it is important to administer LA in my clinical environment</td>
<td>44%</td>
<td>56%</td>
<td>0%</td>
</tr>
</tbody>
</table>

exception of ‘engagement with lecturers’ (Statements 10,11,12) which was found to be “weak” (r=0.20-0.39). Participants’ self-confidence as a component of their self-perceived competence was “moderately” (r=0.40-0.59) associated with ‘engagement with lecturers’.

QUESTIONNAIRE 2
Practices and perceptions of local anaesthesia

Administering of local anaesthesia in practice environment (n=19).

The response rate to the second questionnaire was 76% (n=19). Eighty-four percent (84%; n=16) reported that they administered local anaesthetic in their work environment. Participants reported that they used local anaesthesia for deep scaling and root planing (75%), restorative procedures (25%), management of tooth sensitivity (19%), removal of splints (6%) and orthodontic debanding (6%). The most common injection technique used was mandibular infiltration (n=16); followed by maxillary infiltration (n=13) and the mandibular block (n=11). None of the participants reported unsuccessful outcomes in the administration of local anaesthetic.

Perceived competence to administer local anaesthesia

‘Responses of ‘yes’ and ‘definitely’ were combined. Participants’ perceptions of their competence were lower after having had the opportunity to work in practice after the face-to-face period. However, the data was not matched for the two questionnaires and therefore statistical analysis was not performed. The view that administering of local anaesthetic added value to their work environment and that there was a need for oral hygiene students to administer it, was not shared by all participants.

Barriers and facilitating factors to performing local anaesthesia in the work environment

Barriers

Participants who perceived that they lacked experience and the practical skills to perform local anaesthesia, and who perceived a lack of confidence in their role in their practice, reported to administer local anaesthetic to a limited extent or not at all. They elaborated that having the theoretical knowledge did not translate to their ability to perform local anaesthesia in practice and that confidence and competence improved with time expressed by comments such as “more practical sessions would have built this”; “Neither myself, nor my employer feel I am sufficiently experienced to start doing these procedures in practice”; “Orthodontist not open to me infiltrating”.

Facilitating factors

Participants who felt supported and were clear about their role in their work environment, appear to do the procedure even when they did not feel fully confident, highlighted in the following comments “Patients depend on you and this builds more trust”; “The need to ease discomfort and

sensitivity is very important so that I can offer a thorough treatment to patients”; “Freedom to administer LA with confidence without having to interrupt the dentist”; “I am very nervous when I do it, but I try my best”; “I’m confident as OH because I put a lot of value in our practice”; “Not dependent on waiting for the dentist”.

DISCUSSION
Profile of participants

The participant profile affirms interest by this group of oral hygienists, as one of the health services professions, to maintain and improve their competence over “lengthy careers and diverse practice areas”24 Ryan (2003),8 reported that the top motivators for engaging in continuing education by health services professionals were: developing professional knowledge, updating existing qualifications, increasing the status of the profession and demonstrating professional competence. Participants viewed the inclusion of local anaesthesia in the scope of the profession as “empowering, expanding boundaries and helping the practice” shows that attendance at the course is also seen as part of the development of their profession rather than a narrow focus on procedures. There may be other factors, such as the multiple life roles that they occupy as women,19 increased remuneration, and the fact that completion of the 2000 Expanded Scope1 is a prerequisite for independent private practice.

Experience of the learning programme

Participants’ experience of the blended-learning programme, generally, was positive. Their access to resources and skills to engage in this approach may have been contributed to this. These factors should be taken into account by course developers when using a blended-learning approach. Participants’ pre-course concerns, to a large extent, were addressed through the quality of organisational, teaching, and teacher inputs, highlighting the views by Mattheos et al. (2010)14 on the characteristics of a successful continuous education course. Personal, relational and organisational factors to support good clinical learning experiences were also reported by nursing students.25

Although simulators have numerous benefits, ranging from use on demand; prevention of unethical or unnecessary practice on patients and honing of skills in a risk-free environment,26 the participants of this course found the ‘conduction anaesthesia model’ to be of limited value. This could possibly be because the training model does not resemble the human mouth accurately enough or that the instruction in the use of the simulator was not structured within a framework as suggested by Kneebone (2005).27 The interactive nature and hands-on approach used in this course appeared to be appreciated by this cohort of adult learners. This may indicate that these adult learners, who re-entered higher education many years
Table 4: Perceived competence to administer local anaesthetic on completion of the course

<table>
<thead>
<tr>
<th>Statement</th>
<th>Perceptions after the face-to-face period (n=25)*</th>
<th>Perceptions on completion of the LA course (n=19)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I have the confidence to administer LA in my clinical environment</td>
<td>84%</td>
<td>52.6</td>
</tr>
<tr>
<td>2. I have the theoretical knowledge to administer LA in my clinical environment</td>
<td>100%</td>
<td>84.2</td>
</tr>
<tr>
<td>3. I have the clinical skills to administer LA in my clinical environment</td>
<td>76%</td>
<td>63.2</td>
</tr>
<tr>
<td>4. As an oral hygienist I feel it is important to administer LA in my clinical environment</td>
<td>100%</td>
<td>84.2</td>
</tr>
<tr>
<td>5. Administering LA in my practice has added value to the practice</td>
<td>-</td>
<td>78.4</td>
</tr>
</tbody>
</table>

after acquiring their qualifications, may view technology less favourably. 27

The views of participants in this course highlighted the advantages of using a blended-learning approach combined with an interactive clinical component. Participants stressed that they were welcomed into the dental environment and that they had access to course material in their own time.

Perceived competence of participants

Participants responded positively to the availability of course material, yet there was a weak relationship between their self-perceived competence on completion of the face-to-face component and their engagement with material. The relationship between feedback and engagement with lectures is moderate to weak. These results suggest that although participants may find the study programme positive, their self-perceived competence is influenced primarily by their engagement with lectures through feedback and clarification of questions. Formative assessment with immediate feedback was done at different stages of the learning programme. The value of feedback in ensuring credibility and effectiveness of the learning process was also highlighted by Matheos et al. (2010). 24

Participants' self-perceived competence was "very strongly" correlated with their self-perceived confidence and clinical skills and "strongly" correlated with their self-perceived knowledge at the end of the face-to-face component. Although all participants had successfully completed the formative assessment at that time, and were considered competent to perform the procedure under supervision of the dentist, not all participants felt that they were competent. All participants indicated that they had the knowledge to perform local anaesthesia, but approximately one quarter did not perceive that they had the skill to do so (Table 3). This was emphasised in the open-ended questions by the comments of participants regarding the requirement of more clinical time, and, that knowledge does not necessarily translate to skills. An assumption of the learning programme was that, prior to their doing the summative assessment, participants would have the opportunity to perform local anaesthesia in their practice environments under supervision of the dentist, and in so doing, improve their clinical skills. The results show that such a process may have to be formalised in further continuing education courses offered by the university.

The use of local anaesthesia in their practice environments.

The views of the participants that oral hygienists should be able to perform local anaesthesia are consistent with those expressed in the international literature. 5 In rating their competence at the end of the course, most of the group of oral hygienists (84%) considered they had the knowledge to perform local anaesthesia, yet only 60% reported as being confident they had the skill. These perceptions may indicate that it takes time to develop mastery of this clinical technique. 27 A concern for the professional development of these participants is that self-perceived competence is an indication of the motivation to maintain and improve skills. 6,21

Although the literature confirms it has been shown that oral hygienists can perform this procedure safely. 5,10,22 concerns expressed by participants and by their dentists as employers regarding patient safety are valid. Those universities providing further education for Oral Hygienists may need to consider the option of engaging the employer dentist in the courses.

The frequency of local anaesthetic being administered by oral hygienists varies by practice type, with local anaesthesia being more frequently provided in specialist periodontal practices than in general practices. 6,7 Oral hygienists who completed a continuing education course reported that more than 90% of dentists delegated this procedure to them. Eighty-eight percent (88%) were administering local anaesthetic within one month of completion of the course and used the procedure primarily for root planing and debridement, and where tooth sensitivity was anticipated 10 as is also reported in this study. Although the literature indicates that dental hygienists have been shown to perform this procedure safely, 5,10,22 concerns regarding patient safety were expressed by this cohort and their employers. This may have contributed negatively to their perceived competence, 10 as also reported in this study.

More than half of the oral hygienists who completed a continuing education course found; local anaesthesia to be very valuable to their practice; that employers and patients appreciated their skill, that more comfortable treatment could be provided; and that their practices ran more efficiently. 10 This study indicated that providing the participant the confidence and capacity to perform local anaesthesia in the practices setting, independent of the dentist, increased their work satisfaction, built patient trust, contributed to reduction of patient discomfort, and allowed treatment to be completed without the need to disturb the dentist.

Suggestions for the review of this course.

Course developers should consider several concerns prior to delivery of the course. Requests by the oral
Dental hygienists for more clinical exposure during the face-to-face component and the dynamics within their own work environments should be taken into account in any review of this course. As continuing education is most often offered as short courses, it may not be possible to increase the practical time significantly during the face-to-face period. It is well documented that all learning cannot take place in the formal didactic environment, and course developers should investigate practical ways in which learning can be extended into the work environment by engaging employers. The necessary conditions are already prescribed by the HPCSA (Board for Dental Assisting, Dental Therapy and Oral Hygiene). Such collaboration may address concerns of professional boundaries as well as to focus on how patient outcomes can be improved. This notion creates an added role for the university in advocating a dental team approach in practice, with a focus on professional development and improved patient outcomes.

A limitation of the course was that the process of facilitating the entry of participants into the work environment was not done. Continuing education involving clinical skills could potentially influence the workings of a dental practice.

Limitation of the study
The results should be viewed against the following: the size of the sample; the fact that the process and outcome questionnaires were not paired and thus could not be compared; and, the low response rate to the second questionnaire. The results of this study cannot be generalised to continuing education courses on expanded functions for oral hygienists or for continuing education courses in general.

CONCLUSION
The results clearly show that the blended-learning approach was successful in developing participants’ knowledge and skill to administer local anesthesia. In spite of successful completion of the course, their self-perceived competence and work environment dynamics were determining factors to whether or not they would actually perform the procedure in practice. These factors should be taken into account when developing continuing education courses. Course developers should consider means of mediating with employers to enable the integration of oral hygienists with expanded functions into the practice environment. If not, the goals of professional development and improved patient care may not be met.

References
5. Boykses SG, Zivko J, Bastin MR, Gristo MA, Shingeldieker BO.
You are invited to join an excellent line up of International and Local speakers sharing innovative technology and services from within a melting pot of the best in oral health care that the world has to offer.
Welcome Note

2018 promises to be a year of great growth and exhilarating advances in the Dental industry, so in order to echo this sentiment, we are proud to announce a new name and identity for this premier congress, ensuring its brand and value are sustainable and contemporary.

Please join us at the 45th annual, SADA Dental & Oral Health Congress & Exhibition. After last year’s roaring success, we are proud to officially open the 2018 Congress to our valued members as well as the Dental and Oral Health community.

The objective of this annual event is to promote learning of new ideas and techniques at all levels within the dental fraternity. A platform to offer opportunities for all role players in dentistry in South Africa. Come rekindle relationships with colleagues and friends.

A congress of this magnitude is not possible without the support of our members and others parties with an interest in the dental industry. As the largest primary event of its kind on the African continent, we will be hosting in our capital, Pretoria, at the newest Sun International establishment, Times Square in the heart of Menlyn. This state-of-the-art entertainment and conference centre will host days of inspiring presentations, speaking engagements and dynamic, hands-on workshops, and we will enjoy an evening of networking and cocktails.

As one of our valued members we would love to host you at our biggest, but most focused and significant Congress to date, an event that will change your world.

Join the conversation #sadacongress18

It gives me great pleasure to welcome the South African Dental community to this, the premier event of the South African Dental Association. It has been a long term goal to have all the role players present at a single event including public and private oral health care practitioners, educators, traders and support staff.

The SADA Dental & Oral Health Congress & Exhibition is an exciting event that offers a unique opportunity to update our skills, reconnect with old friends, forge new relationships, network and engage with our ever present supportive traders who bring new materials and equipment. Together we can remain leading dental professionals.

I wish to thank our dedicated organising committee who worked tirelessly and were successful in signing up excellent local and international speakers from Europe and America, affording us all the opportunity to learn from the best across the globe, and from each other.

The scientific programme has been created to offer a wide range of topics for all delegates from dental implants to dental and human ethics. This excellent Plenary track is supported by Master Classes, Hands-on sessions as well as Parallel tracks for Oral Hygienists, Dental Assistants and Practice Managers.

In addition, we are pleased that our esteemed colleagues from the SASO and SASPIO groups will also deliberate over the 3 intense days of the Conference.

Many of you will have made significant sacrifices to join us at this event. We are deeply appreciative and look forward to share this time with you, convinced you will not leave disappointed.

See you in Pretoria!

*Plenary Session

<table>
<thead>
<tr>
<th>Time</th>
<th>Plenary</th>
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<tbody>
<tr>
<td>13:30</td>
<td>Congress Opening &amp; Awards</td>
</tr>
<tr>
<td>14:30</td>
<td>The Hypocritical Oath: Doing ethics in the wake of Life Esiidimeni</td>
</tr>
<tr>
<td>15:15</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>15:45</td>
<td>Lasers in Endodontics - Fact or Fiction</td>
</tr>
<tr>
<td>16:15</td>
<td>Immediate dental implant placement and functional loading for the full arch fixed prosthesis</td>
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<tr>
<td>17:00</td>
<td>No half Smiles</td>
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<td>18:00</td>
<td>Congress Welcome Function</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Plenary</th>
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<tbody>
<tr>
<td>08:00</td>
<td>Preventing dentistry “MI” way! A contemporary look at the minimum intervention preventive approach to managing early caries</td>
</tr>
<tr>
<td>08:45</td>
<td>Strategies to improve clinical colour matching of restorative materials for the replacement on teeth and gingiva</td>
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<tr>
<td>09:30</td>
<td>The Oral Microbiom - Recent advances in science</td>
</tr>
<tr>
<td>10:15</td>
<td>Tea Break &amp; Tradeshow</td>
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<tr>
<td>11:00</td>
<td>Best practice in record keeping</td>
</tr>
<tr>
<td>11:45</td>
<td>Managing the deep carious lesion “MI” way! - take it or leave it</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Plenary</th>
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<tbody>
<tr>
<td>12:30</td>
<td>Light Lunch &amp; Tradeshow</td>
</tr>
<tr>
<td>13:30</td>
<td>Clinical cases can present as difficult in several aspects: as sites, sextants, full arches or full mouths</td>
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<tr>
<td>14:10</td>
<td>What can Orthodontics do to improve the smile aesthetics of the patient</td>
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<tr>
<td>15:00</td>
<td>Closure and prize draw</td>
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*Master classes and/or Hands-on Programmes

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 1</th>
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<tbody>
<tr>
<td>10:30</td>
<td>Creating the perfect workflow in complex cases</td>
</tr>
<tr>
<td>10:00</td>
<td>Lasers in Endo Workshop SCIVISION</td>
</tr>
<tr>
<td>10:30</td>
<td>Lasers in Endo Workshop SCIVISION (repeat of 08:00 -10:00 Session)</td>
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<thead>
<tr>
<th>Time</th>
<th>Room 2</th>
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<tbody>
<tr>
<td>10:00</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:30</td>
<td>Lasers in Endo Workshop SCIVISION</td>
</tr>
<tr>
<td>Time</td>
<td>Room 3</td>
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<td>-------------------------------------------------</td>
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</tbody>
</table>
| 08:00 - 10:00| 1) Anaphylaxis and other life-threatening emergen-
|              | cies & 2) Sedation, the basics and pearls        |
|              | James Roelofse                                  |
| 10:00 - 10:30| Tea Break & Tradeshow                           |
| 10:30 - 12:30| 3) Pitfalls in sedation practice & 4) The single-
|              | operator sedationist and drugs during sedation  |
|              | James Roelofse                                  |

<table>
<thead>
<tr>
<th>Time</th>
<th>Room 4</th>
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<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>The role of the Dentist in Dental Sleep Medicine</td>
</tr>
<tr>
<td></td>
<td>Leif Brauteseth, Jeff King, Clyde Keevy,</td>
</tr>
<tr>
<td></td>
<td>Kevin Rosman</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Sleep Apnea Fundamental theoretical and practical</td>
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<td>concepts in the use of mandibular advancement</td>
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<td>devices to treat snoring and obstructive sleep</td>
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<tr>
<td></td>
<td>Avin Wee</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Room 5</th>
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</thead>
<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>Young Dentist Programme: Not all great dentists are successful / Getting the patient to trust you</td>
</tr>
<tr>
<td></td>
<td>Jean van Lierop</td>
</tr>
<tr>
<td></td>
<td>The Business of dentistry</td>
</tr>
<tr>
<td></td>
<td>Corne Smith</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Young Dentist Programme Continue: What I would do differently if I had the chance - My journey in dentistry</td>
</tr>
<tr>
<td></td>
<td>Avish Jagathpal</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Room 6</th>
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</thead>
<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>Composite restorations: Protocols for anterior aesthetics</td>
</tr>
<tr>
<td></td>
<td>Frederico Ferraris</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Composite restorations: Protocols for anterior aesthetics (Continued)</td>
</tr>
<tr>
<td></td>
<td>Frederico Ferraris</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Room 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 09:00</td>
<td>Laser applications in the young patient</td>
</tr>
<tr>
<td></td>
<td>Nico Verloop</td>
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<tr>
<td>09:00 - 10:00</td>
<td>Biomaterials in paediatric dentistry</td>
</tr>
<tr>
<td></td>
<td>Riaan Mulder</td>
</tr>
<tr>
<td>10:00 - 10:30</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:30 – 11:30</td>
<td>Nitrous Oxide/Oxygen minimal sedation:</td>
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<tr>
<td></td>
<td>Profitable practice</td>
</tr>
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<td></td>
<td>Mark Gillman</td>
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<tr>
<td>11:30 – 12:30</td>
<td>Substance abuse, addiction and nicotine addiction</td>
</tr>
<tr>
<td></td>
<td>Mark Gillman</td>
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</tbody>
</table>

**Parallel Programme**

<table>
<thead>
<tr>
<th>Time</th>
<th>Oral Hygienist Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 09:20</td>
<td>The Oral Microbiom - Recent advances in science</td>
</tr>
<tr>
<td></td>
<td>Michael Lynch</td>
</tr>
<tr>
<td>09:20 - 10:00</td>
<td>Best practice in record keeping</td>
</tr>
<tr>
<td></td>
<td>Alasdair McKelvie</td>
</tr>
<tr>
<td>10:00 - 10:45</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:45 - 11:30</td>
<td>What is in your water?</td>
</tr>
<tr>
<td></td>
<td>Jeanne Osthuysen</td>
</tr>
<tr>
<td>11:30 - 13:00</td>
<td>Assessing your infection control</td>
</tr>
<tr>
<td></td>
<td>Mary Govoni</td>
</tr>
<tr>
<td>13:00 - 14:15</td>
<td>Lunch Break &amp; Tradeshow</td>
</tr>
<tr>
<td>14:15 - 15:45</td>
<td>Getting along in the dental team</td>
</tr>
<tr>
<td></td>
<td>Kevin Henry</td>
</tr>
<tr>
<td>15:45 - 16:15</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>16:15 - 17:45</td>
<td>Living from the Inside Out!</td>
</tr>
<tr>
<td></td>
<td>Elsabe Aldridge</td>
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**Dental Assistant Programme**

<table>
<thead>
<tr>
<th>Time</th>
<th>Dental Assistant Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 09:20</td>
<td>5 Ways you can crush your Dental Assisting career</td>
</tr>
<tr>
<td></td>
<td>Kevin Henry</td>
</tr>
<tr>
<td>09:20 - 10:00</td>
<td>Current Trends and what Dental Assistants need to know</td>
</tr>
<tr>
<td></td>
<td>Jeanne Osthuysen</td>
</tr>
<tr>
<td>10:00 - 10:45</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:45 - 11:30</td>
<td>3 Battles Between the Back and the Front and how to solve them</td>
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<tr>
<td></td>
<td>Kevin Henry</td>
</tr>
<tr>
<td>12:00 - 13:00</td>
<td>Essential dental equipment maintenance and care</td>
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<tr>
<td></td>
<td>Riaan Els</td>
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<tr>
<td>13:00 - 14:15</td>
<td>Lunch Break &amp; Tradeshow</td>
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<tr>
<td>14:15 - 15:45</td>
<td>What the entire team needs to know about</td>
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<td></td>
<td>instrument management</td>
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<td></td>
<td>Mary Govoni</td>
</tr>
<tr>
<td>15:45 - 16:15</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>16:15 - 17:45</td>
<td>Battling and beating the demons of dental assisting</td>
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<tr>
<td></td>
<td>Kevin Henry</td>
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**Practice Management Programme**

<table>
<thead>
<tr>
<th>Time</th>
<th>Practice Management Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>All systems go for effective practice management</td>
</tr>
<tr>
<td></td>
<td>Dayna Johnson</td>
</tr>
<tr>
<td>10:00 - 10:45</td>
<td>The Practice Manager's Role in Creating a</td>
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<tr>
<td></td>
<td>Collaborative Positive Practice Culture</td>
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<td></td>
<td>Lizelle van der Walt</td>
</tr>
<tr>
<td>10:45 - 13:00</td>
<td>Lunch Break &amp; Tradeshow</td>
</tr>
<tr>
<td>14:15 - 15:45</td>
<td>The Practice Manager's Role in Creating a</td>
</tr>
<tr>
<td></td>
<td>Collaborative Positive Practice Culture (continue)</td>
</tr>
<tr>
<td></td>
<td>Lizelle van der Walt</td>
</tr>
<tr>
<td>15:45 - 16:15</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>16:15 - 17:45</td>
<td>The Practice Manager's Role in Creating a</td>
</tr>
<tr>
<td></td>
<td>Collaborative Positive Practice Culture (continue)</td>
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<td></td>
<td>Lizelle van der Walt</td>
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**SASO Programme**

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<tr>
<th>Time</th>
<th>SASO Programme</th>
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<tbody>
<tr>
<td>08:00 - 10:00</td>
<td>Introduction - The importance of the high torque</td>
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<td>(Full smile) in the occlusion, aesthetic of the</td>
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<tr>
<td></td>
<td>smile and biology in complex cases</td>
</tr>
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<td></td>
<td>Juan Carlos Pérez Varela</td>
</tr>
<tr>
<td>10:00 - 10:45</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>10:45 - 13:00</td>
<td>Treatment of Skeletal Class II in Adult Patients</td>
</tr>
<tr>
<td></td>
<td>Juan Carlos Pérez Varela</td>
</tr>
<tr>
<td>13:00 - 14:15</td>
<td>Lunch Break &amp; Tradeshow</td>
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<tr>
<td>14:15 - 15:45</td>
<td>Treatment of Skeletal Transverse Problems in Adult Patients</td>
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<td></td>
<td>Juan Carlos Pérez Varela</td>
</tr>
<tr>
<td>15:45 - 16:15</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>16:15 - 17:45</td>
<td>Treatment of Skeletal Class III in Adult Patients and Conclusions</td>
</tr>
<tr>
<td></td>
<td>Juan Carlos Pérez Varela</td>
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**SASPINO Programme**

<table>
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<tr>
<th>Time</th>
<th>SASPIO Programme</th>
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<tbody>
<tr>
<td>08:00 - 09:30</td>
<td>Geometry of the infrabony lesion and</td>
</tr>
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<td>quality and quantity of the soft tissue</td>
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<td></td>
<td>Andrea Pilloni</td>
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<tr>
<td>09:30 - 10:15</td>
<td>Understanding clot, from early phases to final</td>
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<tr>
<td></td>
<td>organized tissues</td>
</tr>
<tr>
<td></td>
<td>Andrea Pilloni</td>
</tr>
<tr>
<td>10:15 - 11:00</td>
<td>Tea Break &amp; Tradeshow</td>
</tr>
<tr>
<td>11:00 - 11:45</td>
<td>&quot;Closing&quot; vs &quot;sealing&quot; the flap margins</td>
</tr>
<tr>
<td></td>
<td>Andrea Pilloni</td>
</tr>
<tr>
<td>11:45 - 12:30</td>
<td>When biomaterials are necessary, choice,</td>
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<tr>
<td></td>
<td>manipulation and long term expectations after</td>
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<tr>
<td></td>
<td>their use</td>
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<tr>
<td></td>
<td>Andrea Pilloni</td>
</tr>
<tr>
<td>12:30 - 13:30</td>
<td>Light Lunch &amp; Tradeshow</td>
</tr>
<tr>
<td>13:30 - 15:00</td>
<td>Join Plenary Session</td>
</tr>
</tbody>
</table>

*Programme subject to change*
Excellent lineup of Speakers

International
Avijit Banerjee
Frederico Ferraris
Norbert Gutknecht
Dayna Johnson
Alasdair McKeilvye
Andrea Pilioni
Miguel Stanley
Steven Eckert
Mary Govoni
Kevin Henry
Michael Lynch
Juan Carlos Perez Varela
Thomas Salinas
Alvin Wee
Kobus Barnard
Heinrich Dippenaar
Riaan Els
Avish Jay Jagathpal
Jeff King
Matshediso Mohothi-Peri
Jeanne Oosthuysen
Kevin Rosman
Merliang Thokoane
Jean van Lierop

Local
Leif Brauteseth
Busisiwe Dlamini
Mark Gillmari
Clyde Keenly
Kirsten Kloppe
Riaan Mulder
James Roeiofse
Corne Smith
Lizelle van der Walt
Nico Verlooy

Motivational
Elsabe Aldridge
Jonathan Jansen
Siphiwe Moyo

Fabulous Social Function
A fabulous Carnival Style themed Welcome Function will be hosted, offering a superb opportunity for VIP’s, Speakers, Delegates, and other important guests as well as Exhibitors, to mingle whilst being entertained in the Exhibition Arena. Come and enjoy this luxurious evening of networking and cocktails in this state-of-the-art entertainment arena.

Accommodation

The Maslow Hotel Time Square Casino
238 rooms
R 1 750.00 – Double Occupancy
R 1 500.00 – Single Occupancy
Address: 295 Avenue Avenue, Waterkloof Glen Est 02, Menlyn, 0181 Pretoria, South Africa
Tel nr: 011 780 7855
Email: crobook@suninternational.com
Website: https://www.suninternational.com/

The Capital Menlyn Main
72 Standard and 60 executive rooms, 61 x 1 bedroom, 61 x 2 bedroom and 16 x 3 bedroom apartments.
From R 1 600.00 ppdm
Address: 104 Bantu Avenue, Menlyn, 0100 Pretoria, South Africa
Tel nr: 011 205 9700
Email: reservations@thecapital.co.za
Website: https://thecapital.co.za

Town Lodge Menlo Park
106 rooms
From R 998 to R1165 ppdm
Address: 221 Garsfontein Road, Menlopark, Pretoria, 0081 Pretoria, South Africa
Tel nr: 012 471 8600
Email: (Only web and phone reservations)
Website: https://thecapital.co.za

Protea Hotel Fire and Ice by Marriott
172 rooms
From R 2 348 ppdm
Address: 209 Tugela Road, Menlyn, 0081 Pretoria, South Africa
Tel nr: 012 471 8600
Email: (Only web and phone reservations)
Website: http://www.marriott.com/hotels/travel/

Menlyn Boutique Hotel
27 rooms
From R 1 500 pppn
Address: 1 Atterbury Rd & Klarinet Rd, Menlyn, 0100 Pretoria, South Africa
Tel nr: 012 471 8600
Email: reception@menlynhotel.co.za
Website: http://www.menlynhotel.co.za

General Information
Congress objectives
To promote learning of new ideas and techniques at all levels within the dental fraternity. A platform to offer opportunities for all role players in dentistry in South Africa and for you and for your company to rekindle relationships with colleagues and friends.

Target audience
All people involved in dentistry in South Africa. Our main target groups are General Dental Practitioners, Dental Specialists, Dental Technicians, Dental Assistants, Oral Hygienists, Dental Therapists, Practice Managers and other professionals with an interest in dentistry and dental Traders.

Expected number of delegates
900 Delegates

Invited speakers
The organising committee has been successful in signing up excellent local and international speakers from Europe and America to present at the Congress.

Follow us on:
sadacongress.co.za

Scientific Committee
Prof Dale Howes (Scientific Convener 2018)
Dr Mark Bowes
Dr Paul Brandt
Dr Nosipho Mzobe (Head Of Education SADA)
Dr Nadeem Osman (SADA OPSCOM Chair)
Dr Boela van der Merwe
Prof Andre van Zyli

More Information: Marlize van der Linde Events & Public Relations Manager Cell: +27 833 398 911
email: mvdlinde@sada.co.za
Rene Smolders Conference Organizer Cell: +27 83 291 0543
email: rene@edoc.co.za
Delegate Registration Form

12 - 14 October 2018

Online registration: www.sadacongress.co.za

If not registering online please complete the entire registration form, and submit with your Credit card details for singular transaction processing.

Send to SADA via fax to: 086 680 7390, or via E-mail to events@sada.co.za

Enquiries: Tel: 011 484 5288 or via E-mail to mvdlinde@sada.co.za

Office hours, Monday to Friday, 08:00 - 16:00.

For online registration and payment go to: www.sadacongress.co.za

25% CANCELLATION FEE WILL BE LEVIED ON CANCELLATIONS ON OR BEFORE 31 JULY 2018

50% CANCELLATION FEE WILL BE LEVIED ON CANCELLATIONS BETWEEN 1-31 AUGUST 2018

NO REFUND FOR CANCELLATION OR NON-ATTENDANCE FROM 1 SEPTEMBER 2018

SECTION A
PERSONAL INFORMATION

(PLEASE PRINT IN BLOCK CAPITALS AND INDICATE THE APPROPRIATE BLOCKS WITH AN ‘X’)

<table>
<thead>
<tr>
<th>SURNAME</th>
<th>ID NO</th>
<th>FIRST NAME</th>
<th>INITIALS</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

NAME ON BADGE

HPCSA REG NO (not practice no)

NAME OF PRACTICE/ACADEMIC INSTITUTION

POSTAL ADDRESS

CODE

TELEPHONE NO (W) | CELLPHONE NO

E-MAIL

FAX NO | COMPANY VAT NO

ACCOMPANYING PERSON

SURNAME | INITIALS | TITLE

SECTION B
REGISTRATION FEES (VAT INCLUDED)

25% CANCELLATION FEE WILL BE LEVIED ON CANCELLATIONS ON OR BEFORE 31 JULY 2018

50% CANCELLATION FEE WILL BE LEVIED ON CANCELLATIONS BETWEEN 1-31 AUGUST 2018

NO REFUND FOR CANCELLATION OR NON-ATTENDANCE FROM 1 SEPTEMBER 2018

REGISTRATION SECTION (MARK WITH AN ‘X’)

DENTAL CATEGORY

FULL REGISTRATION: 12 - 14 OCT 2018 | DAY DELEGATE REGISTRATION FEES PER DAY

<table>
<thead>
<tr>
<th>DENTAL CATEGORY</th>
<th>FULL 3 DAYS BEFO E 31 JULY 2018</th>
<th>FULL 3 DAYS AFTER 31 JULY 2018</th>
<th>MARK</th>
<th>FRI 12 OCT</th>
<th>SAT 13 OCT</th>
<th>SUN 14 OCT</th>
<th>DAY DELEGATE AFTER 31 JULY 2018</th>
<th>FRI 12 OCT</th>
<th>SAT 13 OCT</th>
<th>SUN 14 OCT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SADA Educational Member</strong></td>
<td>R 3 840</td>
<td>R 4 540</td>
<td>R 1 540</td>
<td>R 1 820</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><em>SADA Core Member</em></td>
<td>R 4 840</td>
<td>R 5 540</td>
<td>R 1 940</td>
<td>R 2 220</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SASO - SADA Educational Member</td>
<td>R 4 650</td>
<td>R 5 350</td>
<td>R 2 350</td>
<td>R 2 630</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SASO - SADA Core Member</td>
<td>R 5 650</td>
<td>R 6 360</td>
<td>R 2 750</td>
<td>R 3 030</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Non-SADA Member</td>
<td>R 5 740</td>
<td>R 6 860</td>
<td>R 2 300</td>
<td>R 2 755</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Dental Technician/Therapist</td>
<td>R 2 580</td>
<td>R 3 040</td>
<td>R 1 030</td>
<td>R 1 230</td>
<td></td>
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<tr>
<td>Oral Hygienist</td>
<td>R 2 060</td>
<td>R 2 430</td>
<td>R 830</td>
<td>R 970</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dental Assistant/Practice Management</td>
<td>R 1 630</td>
<td>R 1 950</td>
<td>R 660</td>
<td>R 780</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Registrar/Post Graduate Student</td>
<td>R 1 830</td>
<td>R 2 180</td>
<td>R 730</td>
<td>R 880</td>
<td></td>
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</tr>
<tr>
<td>Exhibition ONLY Visitor</td>
<td>R 1 010</td>
<td>R 1 420</td>
<td>R 410</td>
<td>R 570</td>
<td></td>
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</tr>
<tr>
<td>Spouse Visitor</td>
<td>R 810</td>
<td>R 1 220</td>
<td>R 330</td>
<td>R 490</td>
<td></td>
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</tr>
<tr>
<td>Undergraduate Student (5th year only)</td>
<td>R 710</td>
<td>R 1 110</td>
<td>R 290</td>
<td>R 450</td>
<td></td>
<td></td>
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</tbody>
</table>

TOTAL R | TOTAL R | TOTAL NO OF DAYS

TOTAL SECTION B R

* SADA Core Member - This member gets a preferential rate of R900 less on the Annual SADA Congress full registration fee which is not available to non - SADA Members.

** SADA Educational Member - This member who has purchased the Educational membership top - up package is entitled to a further discount of R1000 (total discount of R1900) on the Annual SADA Congress full registration fee.
**Delegate Registration Form**

**12 - 14 October 2018**

**Online registration:** www.sadacongress.co.za

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**SECTION C: PROGRAMME SESSION BOOKINGS**

Please note due to lecture room limited seating all bookings are processed on a first come first served basis. If you do not indicate which lecture you wish to attend you will not be registered to attend the lecture on that day. Please indicate your option with an ‘√’. Your registration will not be accepted, if the selection was not done.

**FRIDAY 12 OCTOBER: MASTER CLASSES / HANDS-ON**

<table>
<thead>
<tr>
<th>TIME</th>
<th>SESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:30 - 12:30</td>
<td>Room 1: Miguel Stanley Master Class</td>
</tr>
<tr>
<td>08:00 - 10:00</td>
<td>Room 2: Lasers in Endo Workshop (This session is repeated from 10:30 to 12:30)</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Room 2: Lasers in Endo Workshop (This session is a repeat from 08:00 to 10:00)</td>
</tr>
<tr>
<td>08:00 - 12:30</td>
<td>Room 3: 1) Anaphylaxis 2) Sedation 3) Pitfalls in sedation 4) The single operator sedationist</td>
</tr>
<tr>
<td>08:00 - 12:30</td>
<td>Room 4: Sleep Apnea</td>
</tr>
<tr>
<td>08:00 - 12:30</td>
<td>Room 5: Young Dentist Programme</td>
</tr>
<tr>
<td>08:00 - 12:30</td>
<td>Room 6: Federico Ferraris Master Class</td>
</tr>
<tr>
<td>08:00 - 10:00</td>
<td>Room 7: The Paedodontic Society: 1) Laser Applications in the Young Patient 2) Biomaterials in Paediatric Dentistry</td>
</tr>
<tr>
<td>10:30 - 12:30</td>
<td>Room 7: The Paedodontic Society: 1) Nitrous Oxide/Oxygen Minimal Sedation: Profitable Practice 2) Substance Abuse, Addiction, Nicotine Addiction and Dental Practice</td>
</tr>
</tbody>
</table>

**SATURDAY 13 OCTOBER: PARALLEL PROGRAMME**

<table>
<thead>
<tr>
<th>TIME</th>
<th>SESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 17:45</td>
<td>Oral Hygienist Programme</td>
</tr>
<tr>
<td>08:00 - 17:45</td>
<td>Dental Assistant Programme</td>
</tr>
<tr>
<td>08:00 - 17:45</td>
<td>Practice Management Programme</td>
</tr>
<tr>
<td>08:00 - 17:45</td>
<td>SASO Member Programme</td>
</tr>
</tbody>
</table>

**SUNDAY 14 OCTOBER: PARALLEL PROGRAMME**

<table>
<thead>
<tr>
<th>TIME</th>
<th>SESSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 12:30</td>
<td>SASPIO Member Programme</td>
</tr>
</tbody>
</table>

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**SECTION D: CONGRESS WELCOME FUNCTION**

Please indicate whether you will be attending the Carnival Style Theme Party on Friday 12 October 2018 by marking the appropriate block.

**SECTION E: DIETARY REQUIREMENTS**

Food served at the venue is not from a Halaal friendly kitchen.

If you require a Strictly Halaal menu, please indicate this below.

If you require a Strictly Kosher menu, please indicate this below.

If you have any allergies, please indicate this below.

Special dietary requirements: Register by: cut off date 20/09/2018

Please contact M van der Linde on mvdlinde@sada.co.za in this regard.

**SECTION F: PAYMENT DETAILS**

- **DEBIT / CREDIT CARD PAYMENTS ONLY:** Please fill in details below.

  - **Full payment of registration fees are required to confirm registration.**
  - **Delegates are responsible for their own accommodation and travel arrangements.**

  **CANCELLATIONS**
  - **25% Cancellation fee will be levied on cancellations on or before 31 July 2018.**
  - **50% Cancellation fee will be levied on cancellations between 1-31 August 2018.**
  - **No refund for cancellation or non-attendance from 1 September 2018.**
  - **Cancellation must be received in writing.**
  - **If notification is not received in writing and confirmed by this office, you will be liable for the full registration fee.**

**SECTION G: ACCOMMODATION ARRANGEMENTS**

Delegates are responsible for their own accommodation and travel arrangements, we have secured preferential rates for congress delegates at The Maslow Hotel.

**SADA BANKING DETAILS**

**Account name:** The South African Dental Association

**Bank:** Investec Bank Limited **Branch:** Sandton Branch Code: 58 01 05

**Account Number:** 10011847744 **Swift Code:** IVEZSAJJ

**Reference:** Account no as appeared on invoice & name of individual/company

**INTERNATIONAL TRANSFERS**

**International Swift no:** IVEZSAJJ

**Address Details:** 11 Diagonal Street, Newtown, Johannesburg, 2001

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**For a comprehensive list of more accommodation visit www.sadacongress.co.za**
Research

1. Diamond-like carbon coating (DLC) has been added as a drill coating to
   a. decrease heat generation and mass loss during implant site preparation
   b. increase the cutting efficiency and wear resistance during implant site preparation
   c. increase osseointegration

2. The success of dental implant treatment is dependent on
   a. bone reduction during implant site preparation
   b. the number of teeth replaced
   c. achieving successful osseointegration

3. During rotary root canal preparation
   a. greater friction is observed between nickel titanium rotary files and root canal walls when compared to hand instrumentation
   b. decreased craze lines are evident
   c. rotational forces are applied to the root canal apex
   d. the decreased rotations by rotary instrumentation may contribute to the dentine damage

4. ProTaper NEXT™
   a. is used in rotational motion and has an off-centre hexagonal cross-section
   b. is manufactured with N-wire
   c. has a constant taper of 8%
   d. has a swaggering motion in the canal

5. The chelating action of EDTA results in
   a. decreased dentine permeability
   b. the softening of calcified components of dentine
   c. increased micro-hardness of dentine
   d. increased smear layer accumulation

6. The following is a Panoramic Mandibular Index (PMI) measure
   a. The ratio between the mandibular cortical width in the mental area and the linear distance between the lower mandibular margin and the mental foramen's upper or lower margin
   b. The ratio between the mandibular cortical width in the mental area and the linear distance between the upper mandibular margin and the mental foramen's upper or lower margin
   c. The ratio between the mandibular cortical width in the central incisor area and the linear distance between the lower mandibular margin and the mental foramen's upper or lower margin

Clinical Communication

7. In South Africa and Zimbabwe, the population group in which OI III was found to be fairly common is
   a. Indigenous Black African population
   b. Cape Mixed Ancestry
   c. Indian
   d. Asian

8. At the beginning of the 20th century, OI was classified as
   a. Adult form of OI
   b. Lethal Infantile type
   c. ‘OI tarda’
   d. ‘OI congenita’
   e. C & D

Case Reports

9. Oral angioleiomyomas are
   a. rare, malignant smooth muscle neoplasms
   b. vascular in nature
   c. recurrent in nature

10. Differential diagnosis for oral angiomyomas include
    a. Hemangiomas
    b. Epulis
    c. Fibromas
    d. Gyrus

11. Angiomyomas are
    a. a common variant of leiomyomas within the oral cavity
    b. more commonly seen in males
    c. commonly found on the buccal mucosa

12. The following applies to the diode laser
    a. Functions at a wavelength of 10600nm
    b. Has a higher recurrence rate than that of the Er:YAG laser
    c. With a high frequency (20000 Hz) and short pulse width, can be used to successfully treat gingival pigmentation
    d. Has been shown to be more traumatic than the mechanical technique of using a scalpel with a number 15 blade

13. One of the techniques for gingival depigmentation with the diode laser
    a. involves direct contact with the initiated tip on the epithelium; with a paint brush motion
    b. never requires the use of local anaesthesia
    c. does not require a period of thermal relaxation
    d. Utilises a 1400 micron tip
Radiology
14. Bitewing radiographs are NOT used to evaluate
   a. proximal caries
   b. assessment of the extent of the caries
   c. periapical abscess
   d. assessment of the periodontium

15. Extra-oral techniques have proven to be inadequate due to
   a. showing poor detail
   b. excessive superimposition
   c. distortion
   d. All of the above

16. Bitewing radiographs show
   a. the whole tooth with its surrounding structures
   b. contact surfaces from distal of canine to most distal molars
   c. inferior mandibular cortex
   d. bone level attachment in-between teeth
   e. B & D

Observational Studies
17. In developed countries, the increase in diabetes (between 2010 and 2030) is anticipated to contribute approximately
   a. 69% and as high as 20% in developing countries
   b. 20% and as high as 69% in developing countries
   c. 30% and as high as 50% in developing countries

18. The following test is the criterion standard for monitoring long-term glycemic control
   a. Fasting blood glucose
   b. Random blood glucose
   c. Hemoglobin A1C test
   d. Oral glucose tolerance test

Dental Education
19. Important roles of the clinical teacher identified by all participants were
   a. Availability throughout the clinical session
   b. Identifying gaps in procedural/clinical aspects in the patient care
   c. Punctuality at a clinical session
   d. Inform students of their grade/mark attained for the session

20. The main concerns raised by participants with administering LA were
   a. Mastering the skill of intra oral injections
   b. Not being able to identify landmarks
   c. Causing injury to the patient
   d. All of the above

Ethics
21. The following individuals can provide consent for medical treatment
   a. Any person accompanying the child
   b. The foster parent
   c. The superintendent of a facility
   d. All of the above

22. The following individuals can provide consent for treatment under general anesthesia
   a. Unmarried biological father who sees the child once in a while
   b. Unmarried biological mother
   c. Adoptive parents
   d. Foster parents
   e. B & C

23. The following statement is true
   a. Foster parents have the same rights as the biological parents
   b. Foster parents cannot consent to treatment under general anesthesia
   c. Adoptive parents do not have full parental rights
   d. Biological parents cannot apply for a child care grant

24. The following persons do not have full rights over a child
   a. Unmarried biological mother
   b. Divorced mother and father
   c. Adoptive parents
   d. Unmarried biological father
   e. A & D

25. The following ethical issues should be considered when deciding to purchase new technologies
   a. Media
   b. Marketing
   c. Advertising
   d. User training
   e. All of the above

The Continuous Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provide members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

Online CPD in 6 Easy Steps
1. Go to the SADA website www.sada.co.za.
2. Log into the ‘member only’ section with your unique SADA username and password.
3. Select the CPD navigation tab.
4. Select the questionnaire that you wish to complete.
5. Enter your multiple choice answers. Please note that you have two attempts to obtain at least 70%.
6. View and print your CPD certificate.
Thank you for considering the submission of your work to the Journal for possible publication. We welcome papers which may be Original Research, Clinical Review, Case Reports, Letters or Notes.

We shall be obliged if your submission is prepared respecting all the details listed in these instructions. This facilitates our process and ensures more rapid responses to you.

The Journal is published ten times each year in electronic format. Hard copy is available by arrangement.

Address for submission of articles
The Editorial Assistant, Mr Noko Reagan Mojela, South African Dental Journal, South African Dental Association [SADA], Private Bag 1, Houghton 2041, South Africa. Electronic addresses: NMojela@sada.co.za and billevunny@wits.ac.za.

Language
All articles must be submitted in English. Spelling should be in accord with the Shorter Oxford English Dictionary.

Title
To be kept as brief, clear and unambiguous as possible.

Summary
The summary shall consist of not more than 200 words. This applies to both research and review articles. For research articles, the summary should be structured under the following headings: introduction, aims and objectives, design, methods, results and conclusions.

Text
• Please submit the paper in electronic format to NMojela@sada.co.za and to billevunny@wits.ac.za, accompanied by a covering letter signed by the author(s).

• The paper should be submitted in a single file including all Tables and Figures and their accompanying Legends.

• Articles should be clear and concise.

• Text should be typed in Times New Roman font, size 11: double-spaced with a 3 cm margin on sides, top and bottom. Each page must be clearly numbered.

• Tables should clearly identified, using Arabic numerals i.e. Table 1, Table 2 etc.

• The front page of the manuscript should list the title of the article, the author(s)’ name(s), qualification(s), affiliations and positions held, telephone and fax numbers and address(es), including e-mail address(es) if available. It is especially important that details of the Corresponding Author should be clearly stated.

• Please submit on the front page a list of up to eight Key Words.

• In the case of multiple authors, the role played and the respective contribution made by each should be recorded. For example “principal researcher, writing article, tissue analysis, microscopic examination etc.”

• Authors are requested to note and adhere to the current style of the Journal particularly with respect to paragraph settings and headings.

Length of the article
In general, papers should be between 4000 and 5000 words, although this is flexible. The Editor reserves the right to edit the length of an article in conjunction with the author(s) and SADJ reserves the right to charge for excess/additional pages. The first four pages of original research papers published in the SADJ will be free of charge after which a charge of R500 per page or part thereof will be levied.

Illustrations/graphics/photoengineers
• Illustrations/graphics/photographs must be appropriate to the content of the manuscript. Digital images with a DPI of at least 300 should be supplied. Photocopies and pdf files of photographs are not acceptable. Please note the request that Figures be included in the text AND sent separately in jpg format.

• The Figure number must be in Arabic style and clearly identified for each illustration, graphic or photograph. Remember also to record Figure numbers in the text.

• Permission: Where any text, tables or illustrations are used from previously published work, permission must first be obtained from the holder of copyright and a copy of the agreement must be submitted with the article. Suitable acknowledgement must be recorded in the article.

Continuing Professional Development
Please supply 5-8 questions related to your article, at least three of which should be in the multiple choice format. Answers must be either True or False or, if multiple choice, have only one correct answer. Please provide answers to the questions.

References
References should be set out in the Vancouver style and only approved abbreviations of journal titles should be used (consult the List of Journals Indexed in Index Medicus for these details at: http://www.nlm.nih.gov/tsd/serials/lj.html).

• References should be inserted serial in the text using superscript numbers and should be listed at the end of the article in numerical order. Do not list them alphabetically.

• It is the author’s responsibility to verify each reference from its original source. Please note that an article may be rejected if the referencing is inaccurate.

• Names and initials of all authors should be given unless there are more than six, in which case the first three names should be given, followed by ‘et al.’. First and last page numbers should be given. Where it is applicable the page numbers should be abbreviated by omitting redundant numbers e.g. pages 456 to 478 is recorded as 456-78, and 456 to 459 as 456-9, but 398 to 401 is recorded as 398-401.

• Notice that volume numbers are not given in bold, authors are not linked by ‘and’ or ‘&’, and the date of publication appears after the name of the journal. No item should appear in italics except for foreign terms, eg et al, in vivo.
Journal references should appear thus:

Book references should be set out as follows:


• “Unpublished observations” and ‘personal communications’ may be cited in the text but not in the reference list.
• Manuscripts accepted but not yet published may be included as references followed by the words ‘in press’.

Galley Proofs
Changes/corrections to the proofs supplied to authors must be submitted to the publishers by e-mail or by fax and not over the telephone. Galley proofs must be please be returned to the publishers within four days after receipt thereof.

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All sources of funding, possible financial interest/s or incentives in products or services mentioned in the article must be disclosed. Authors are kindly requested to read and sign the attached declaration.

No articles that have been published previously, or that are currently being considered for publication elsewhere, will be accepted. Authors are kindly requested to verify that their article complies with this condition. Where relevant, authors should indicate whether their research has been approved by the Ethics Committee of their Institution or by other research ethics committees.

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Small Advertisements on the new web platform

PLACEMENT PROCEDURE

Public Domain
Smalls advertising available to registered Dental Healthcare Practitioners
- All smalls advertisements are charged at R25.00 per word, with a minimum charge per placement of R250.00 for Public Domain advertising irrespective of SADA Membership standing.

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Smalls advertising available to registered Dental Healthcare Practitioners
- SADA Members have free placement of smalls advertisements meeting Advertising Rule criteria within the Members ONLY Platform.

Smalls Advertising Rules
- All smalls advertisements are restricted to a maximum 100 words per advertisement.
- All advertisement requests are required in writing with full contact details of the advertiser which should include
  - the wording of the advertisement as you require it to be published;
  - the members professional number; (will not be published);
  - the members contact details (will not be published);
- Advertisement lifespan is two weeks from the date of upload.
- Advertisements to be repeated follow the same process as the original placement request.
- All advertisements which exceed a word count of 100 words will be forwarded to our publishers E-Doc for further processing as a potential advertisement to be placed in the SADJ electronically or as website advertising. E-Doc will contact you thereafter regarding your requirements.
- Advertisement must be paid in full prior to uploading on the web platform for Public Domain advertising.
- Invoice may be settled telephonically with the use of a credit card to prevent delay of placement.
- Telephonically processed payments will result in uploading of advertisement within 24 hours of settlement.
- Advertiser remains liable for placement costs should payment be dishonoured and invoice remains unpaid.

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or via fax to 086 683 0392

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References:
3. Accepted for presentation at IADR 2017, Abstract no: 2635085.
5. GSK Data on File RH01897.

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