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*Paranthropus robustus*: a hominid who lived some 2.7 million years ago. Robustus refers to the teeth and jaws, not body size. The molars and premolars were enormous, with thick enamel, enabling mastication of tough fibrous food. These teeth are described as megadont. Heavy masticatory musculature was required, supported by a massive mandible and a pronounced sagittal crest.

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www.sada.co.za - Small advertising placement procedure and rules
“Put your hand on a hot stove for a minute, and it seems like an hour. Sit with a pretty girl for an hour, and it seems like a minute. That’s relativity.”

Einstein had a gift for simplicity and also showed a great sense of humour, but we may be testing that beyond measure if we take the most famous equation ever… E=mc², and reduce it to a relatively simple report of the world’s greatest sports event, The FIFA World Cup.

Thus: “E” becomes Expertise, “m” becomes Messi, “c” becomes control… Expertise equals Messi multiplied by control by control.

But you may argue that in fact Messi did not reach the expected levels of brilliance, so leave him out. No problem for there are two players of outstanding performance, both with names starting with "m"… Modric of Croatia was voted the Best Player overall, and Mbappe of France is regarded as the player to take over the Number One mantle. May be best for us to recover our sense of propriety and look more seriously at the original equation.

E represents Energy, measured in joules (I read that a joule is about the amount of energy required to lift an apple one metre!)

m represents mass, the resistance of a body to acceleration. Not the same as weight which is related to gravitational pull. Mass is also measured in kilograms.

c represents the speed of light. Why choose the letter c? There are two theories, one that it comes from the Latin word celeritas meaning swift, a good choice, but the second is more romantic in that it is told that Einstein asked a passing Mexican woman whether light was very fast, she answered “si”… and so…

The speed of light is indeed enormous, 300,000 kilometres per second. That brings the calculation of the energy possessed by a body into the realm of the extreme. Very small amounts of mass can be converted into absolutely huge amounts of energy. Nuclear fusion which transforms hydrogen into helium, the basis of the hydrogen bomb and the source of the energy of the sun, involves only 0.7 percent of the original rest energy of the hydrogen. An intriguing exercise carried out by Joshua Carroll shows that the average human body carries energy which is roughly the equivalent of 1.86 million kilotons of TNT.1 Consider that the bomb which destroyed Nagasaki was the equivalent of 21 kilotons of TNT explosive!! My goodness, the potential of humans is just beyond any imagination!

That potential was realised to some small measure when the Association geared up for World Oral Health Day. The message was delivered by members countrywide, “Oral Health for a Healthy Life”.

Even Head Office swung into action with a team of our staff delivering the Oral Health message and bundles of Oral Care products to Grade R and Grade 3 children at Bathabile Primary School. As always, Colgate, our constant partners in striving for Oral Health, came to support our efforts and the children were delighted to receive a package full of oral health products to start them on the road to a healthy mouth in a healthy body. Congratulations to all who contributed, participated, assisted and advised. The famous equation could be expressed: Extraordinary = members multiplied by commitment by commitment.

The burden of childhood caries in South Africa is forcefully recounted in this issue of the Journal. Extend those data into adulthood and we face an enormous challenge. Dental disease is exploding… not at a nuclear rate but nevertheless sufficiently fast to pose a frightening scenario. The Association has taken the lead but it will require the enthusiasm of members to make feasible the objective of achieving reasonable National Oral Health. Perhaps we can mobilise those impressive reserves of resting energy!. A forceful kick to overcome the inertia of the caries football. Einstein may well have observed that here is an exercise in Relativity…

One dentist placing one restoration BUT many dentists actively engaged in Prevention.

In this year, the 100th anniversary of his birth, Nelson Rolihlahla Mandela has the last, and best, words: “It always seems impossible, until its done!”
Dear Colleagues,

It is an honour to be addressing you as the new (well not so new anymore!) President of the South African Dental Association (SADA). It is a position I never expected to hold when I first joined the Association in the 1990s, but one in which I take great pride in accepting. I joined the SADA because I believed I could both add value and derive value, networking with like-minded professionals.

Growing up, dentistry was not on my radar. My parents had aspirations for me to become a doctor due to my aptitude for science in school. When applying for a scholarship, I naturally selected Medicine as my first choice. On the day my application was submitted, I decided to select Dentistry as my second choice. The truth is that I had never even been to a dentist before! I had no first-hand experience with the profession.

Many years down the line, I am still so grateful to have been chosen for Dentistry. Unlike practicing Medicine, it is a profession that offers the perfect work-life balance while still being really rewarding in terms of having a positive impact.

I would like to thank the members who have entrusted me with the responsibilities associated with this new role. It is my commitment to you that I will continue to serve the Association to the best of my ability and to stay focused on driving the SADA mission: promoting the interests of our members and - above all - encouraging accessible oral healthcare for all South Africans.

I ask that you never hesitate to reach out to me on president@sada.co.za to communicate any challenges you face within the industry. I have an open-door policy and appreciate the feedback of others driving the agenda of our profession. I promise to always do my very best in addressing the issues you divulge to me.

I would also like to extend a sincere thanks to my predecessor, Dr Roux Vermeulen, as well as the SADA National Council and the Board and Management Team. Your leadership to-date has laid the foundation for today’s transformation to be possible. The Association’s success is largely your doing and so, the current leadership team aims to build on your legacy.

I believe that what makes a good leader are the abilities to listen, pay attention to detail, and focus on the job at hand. These are qualities I aim to bring to the table as SADA President.

I hope to use this opportunity to further the significant progress made by SADA in terms of structural transformation. I also want to see the organisation grow to become more inclusive across oral healthcare professions. The majority of our members are in private practice.

However, I believe that it would make SADA more powerful and accessible if we also gave a voice to others in the industry – such as academic and public professionals with alternative expertise.

What has become clear to me during my time as a dental professional, a SADA member and Vice President is that the dynamic oral healthcare sector, which is always evolving with new and exciting innovations, demands that professionals constantly grow their knowledge and skills and keep up with the latest developments in the global industry.

In addition to the above, we still have to contend with challenges relating to the costs of starting and maintaining a practice, third party funding and commercialisation, marginalisation of the profession, the implementation of the NHI and many others. Only when we stand together as one voice as the Association, alongside our allied profession colleagues, will we be able to deal with these issues.

I believe that professionals within any industry should participate and get involved in professional associations so that they can engage with like-minded leaders and make a difference, no matter how small.

I look forward to working with all in the profession.

Kind regards,

Dr Pusetso Moipolai
Early childhood caries experience of children accessing selected immunization facilities in Johannesburg.

ABSTRACT

Introduction: Despite notable achievements in the enhancement of the oral health of populations globally, early childhood caries (ECC) remains a common condition, particularly in developing countries. Mother and child oral health programs at immunization facilities were piloted in two Gauteng Districts in 2015 in order to address the burden of disease. Hence there was an opportunity to assess the ECC experience and risk factors contributing to ECC at these sites.

Methods: This retrospective study included records of mother and child pairs who attended the Diepsloot and Vanderbijlpark clinics Mother and Child programs in 2015. The ages of the children ranged between six months and six years. Data were collected from the oral health assessments and questionnaires used in the program.

Results: Differences in the distal and proximal factors at the two sites were identified from the 446 records assessed. Children in Diepsloot had significantly higher levels of mean dmft at 0.43 (1.26) than those in Vanderbiljpark 0.22 (0.70), p=0.01.

Conclusion: Though the general caries experience in this population was low (13.6%), program planners still need to consider differences in oral health exposures and hygiene practices in order to implement activities that are appropriate to the communities being served.

Key Words: Early Childhood Caries; Proximal Risk Factors; Distal Risk Factors; Mother and child oral health program

ACRONYMS

ECC: early childhood caries

INTRODUCTION & BACKGROUND

Despite notable achievements in the enhancement of the oral health of populations globally, Early Childhood Caries (ECC) remains a common dental condition. In developing countries the prevalence of the condition is approximately 60%. Once dental caries occurs, the effects persist throughout life, even after the lesion is treated. Pain and suffering due to untreated tooth and gum disease can lead to problems in speaking, eating, and learning. When the primary teeth are lost early, the surrounding teeth may drift into the empty space, and lead to malocclusion of the permanent teeth in the future.

The causes of ECC are not confined to the biological mechanism but involve socio-behavioural factors which have been commonly observed among children from low socio-economic backgrounds. Although children from economically disadvantaged backgrounds are at risk of ECC, they are not all affected the same way as there are other socio-behavioural risk and protective factors at play.

According to the National Children’s Oral Health Survey undertaken in South Africa in 2004, dental caries amongst children was found to be more pronounced in the primary teeth. There was a 50.5% prevalence amongst 4-5 year olds, rising to 60.3% amongst 6 year olds. Furthermore, over 90% of these children went untreated for caries, reflecting on the inability of the country to address the caries burden.

One of the attempts made by the South African Department of Health at addressing the challenge of ECC was by including oral health examinations in the Road to Health immunization programme for children. Mother and Child oral health programmes were then proposed at various immunization sites at District Primary Health Care facilities. There are currently two pilot sites operating in Johannesburg, one is in Diepsloot and the other in Vanderbijlpark. The Oral Hygienists at the facilities conduct oral health assessments on the children and provide tailored oral health advice to individual mothers.
The oral health examinations are conducted at five initial immunization visits and the mother and child pairs are provided with oral health care and diet advice and sent home with a free toothbrush, fluoridated toothpaste and an educational pack.

Diepsloot is based in a densely populated township in the Northern part of Johannesburg. It is an informal settlement where many of the people live in shacks that are 3m by 2m in size, and are assembled from scrap metal, wood, plastic and cardboard. There is a high unemployment rate (40-50%) and some families lack access to basic services such as piped water in their homes, sewage and rubbish removal.10,11 There are two Primary Health Care clinics and there is a mobile dental facility located at one of the facilities.

Vanderbijlpark on the other hand is a town situated in Sedibeng which is a district located in the Southern part of Johannesburg. Its infra-structure is better developed than that of Diepsloot; 95.5% of the population have access to piped water and 91.2% have access to sanitation. This industrial town experiences approximately 35%-40% unemployment,12 and there are three Primary Care Dental Facilities located in the area.

Conceptual Framework
According to the WHO, Risk is defined as the probability of an adverse outcome, which does not occur in isolation and often stems from complex chains that occur over time.13,14 The chain of events leading to an adverse health outcome may be either proximal or distal. The proximal factors come close to directly causing the disease and the distal factors occur further back in the chain and are shaped by broader social determinants of health.13 Distal factors include oral health services, socio-cultural risk factors and environmental factors. Proximal factors include use of oral health services, oral hygiene practices, dietary habits, excessive alcohol and tobacco use. Outcomes include oral health status, impairment of function and quality of life (Figure 1).14

At the time of the study, the pilot sites had been operational for over a year and had not been evaluated. Therefore the study aimed to assess the caries experience and to evaluate the risk factors associated with the condition at these sites.

METHODS
This was a retrospective study which included records of mother and child pairs who attended the Diepsloot and Vanderbijlpark Mother and Child oral health programs in 2015. A technique of convenience sampling was applied in which all records of children between the ages of six months and six years were requested. Records that had missing data, and those of children that were outside the age range were excluded from the study. A sample of 446 records (223 from each site) was obtained which satisfied the requirements for the sample size as statistically determined for a 95% confidence interval (Epi-info version 3.5.4).

The data items which were recorded were selected after considering the variables from an adapted WHO framework. The variables specifically included in the study were oral health care availability; education; oral hygiene practices; sugar consumption and oral health status (Figure 2). The data were collected from programme records by a dentist and an oral hygienist who were calibrated in order to reduce intra- and inter-examiner variability (WHO, 2013).

The questionnaires used in the program had been adapted from those used by the Texas Department of State Health Services in 2015. These questionnaires were in English and they had been utilised by the examining oral hygienist and dentist as they were interviewing and advising the mothers. The form embraced socio-cultural and behavioural questions that included the following: demographic information of the mother and child; health history; dental history; diet and nutrition and oral hygiene information.

Information on the socio-behavioural risk factors was also collected from the questionnaires. Clinical data was determined from the decayed, missing, filled teeth index (dmft) component which was contained in the children’s Road to Health immunization booklet.

Data Collection and management
The data were captured onto Excel and then imported to STATA (version 7) for analysis. Each mother to child pair record was accorded an identity number which was the same for the clinical examination and the questionnaire. This ensured that the data from the clinical exam and the questionnaire were matched.

STATISTICAL METHODS
Descriptive statistics were utilised to analyse demographic variables, distal risk factors; proximal risk factors and the dmft. Numerical variables were analysed by using means and standard deviation. Caries prevalence rate and dmft
scores were calculated. The caries prevalence and odds ratios were additionally calculated. The t-test was used to assess any differences in the mean dmft scores. Bivariate analysis was undertaken to determine associations between the risk factors and the sites. Statistical significance was set at p<0.05.

RESULTS

Demographic characteristics

Half of the children (52.91%) whose records (n=446) were examined had been between the ages of 6-23 months. Caregivers were largely unemployed (69.28%). Vanderbiljpark had more than one Oral Health facility within a 5 km radius of the immunization site. Diepsloot had only one facility, which was a mobile dental unit (Table 1).

Oral health status

Although the mean dmft status of the children was generally low [0.32 (SD:1.02)], the Diepsloot facility recorded significantly higher levels of decayed teeth than did the facility in Vanderbiljpark [0.43 (SD:1.26)]; p=0.01 (Table 2). Decayed teeth contributed most to the dmft, whilst the categories of filled teeth and teeth missing teeth due to caries recorded negligible numbers. The overall caries prevalence was 13.6%. The 5-6 year olds had higher levels of caries and indeed the dmft appeared to increase with age (Table 3.)

Risk Factors

Feeding patterns of the children at the two sites were found to be different. These were in terms of bottle feeding and the intake of sugar in tea or porridge. Children in Vanderbiljpark were more likely to be bottle fed and were exposed to sugar to a greater extent than those in Diepsloot (Table 4).

Differences in oral hygiene practices were also identified, although in general a large number of caregivers (62.33%) reported to be cleaning their children’s mouths, particularly amongst those from Vanderbiljpark (59.99%), whereas most in Diepsloot (65.47%) reported not to have performed this practice (Table 4).

The bivariate analysis indicated that the 2-6 year old children were twice as likely to suffer from dental caries than the 6-23 month olds [OR 2.07; CI:1.77-2.43 (p<0.001)]. Significant differences between the means of the children’s data at the two sites are shown on Figure 3.

DISCUSSION

Diepsloot and Vanderbiljpark have similar socio-economic standings as was reflected in their general high unemployment rate (40-50%). Furthermore the results indicated that a majority of the mothers in the population were unemployed (69%). Despite these similarities, the oral health status of the children was found to be significantly different and moreover, there were differences in parental educational exposure and in accessing oral health care. The differences contributing to ECC were largely due to the mother’s educational levels, the behavioral patterns of feeding and of oral hygiene practices, as indeed is consistent with the literature.

<table>
<thead>
<tr>
<th>Table 1: Demographic information of the population</th>
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<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>No of individuals per location</td>
</tr>
<tr>
<td>Children’s ages</td>
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<tr>
<td>6-23 months</td>
</tr>
<tr>
<td>2-4 years</td>
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<td>5-6 years</td>
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<tr>
<td>Occupation of caregivers</td>
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<tr>
<td>Employed</td>
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<tr>
<td>Unemployed</td>
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<tr>
<td>Learners</td>
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<tr>
<td>Education of caregivers</td>
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<tr>
<td>Tertiary</td>
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<tr>
<td>High School</td>
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<tr>
<td>Primary School</td>
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<tr>
<td>No of Oral Health Facilities within 5km radius of immunization site</td>
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</tbody>
</table>

<table>
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<tr>
<th>Table 2: Oral health status according to location.</th>
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<tbody>
<tr>
<td>Variables</td>
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<tr>
<td>Total population (N=446)</td>
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<tr>
<td>Diepsloot</td>
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<tr>
<td>Vanderbiljpark</td>
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<th>Table 3: Oral health status according to age for the total population.</th>
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<tr>
<td>Variables</td>
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<tr>
<td>6-23months</td>
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<tr>
<td>2-4 years</td>
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<td>5-6 years</td>
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<th>Table 4: Feeding patterns &amp; oral hygiene habits</th>
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<tr>
<td>Variables</td>
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<tr>
<td>Breastfed</td>
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<tr>
<td>Dipsloot</td>
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<tr>
<td>Vanderbiljpark</td>
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<td>Bottled</td>
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<tr>
<td>Dipsloot</td>
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<tr>
<td>Vanderbiljpark</td>
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<tr>
<td>Sugar in porridge / tea</td>
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<tr>
<td>Dipsloot</td>
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<tr>
<td>Vanderbiljpark</td>
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<tr>
<td>Cleaning of gums &amp; teeth</td>
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<tr>
<td>Dipsloot</td>
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<tr>
<td>Vanderbiljpark</td>
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Figure 3: Risk factors associated with dental caries at the two sites.
The Diepsloot data indicated higher levels of dmft (0.43: SD: 1.26) which were accompanied by poor oral hygiene, low caregiver education and limited access to oral health care. These findings are consistent with some of those reported by Petersen et al (2005). In that paper the authors outline the global burden of disease and describe the socio-behavioral risk factors associated with the condition. They found, from a review of studies assessed, that prevailing risk factors in developing countries included the level of education of the parents, the location/urbanisation, ethnic group, tooth brushing habits and number of dental visits.14

Although the dmft was lower for children in Vanderbiljpark (0.22: SD:0.70), the feeding habits of sugar consumption and prolonged bottle feeding were high. A protective effect may be attributed to the fact that 59% of the mothers reported cleaning their children's teeth, which was found by a systematic review to have been an important parameter in the prevention of dental caries in children.13 Furthermore this community had more access to dental services, in contrast to the single mobile dental service in Diepsloot.

In the current study, the caries prevalence was shown to proportionally increase with increasing age. This could be attributed to the fact that as more teeth continue to erupt between the ages of six months and six years of age, there is an increased exposure of the teeth to sugar as children grow up, leading to dental caries.3 The study further demonstrates that both distal and proximal risk factors are at play in the development of ECC.3 Contextual socio-behavioural factors that emerged in this particular population included, specifically, the differences in accessibility to oral health facilities, the mother’s educational levels, oral hygiene practices and in sugar consumption.

According to the literature, the barriers to oral health care access among pre-school children are multifaceted. They not only are associated with a lack of oral health facilities, but also include a lack of awareness among the parents, the dental professionals and primary health care nursing staff in providing the appropriate preventative care.15-17 According to a study conducted in Tshwane which assessed integration of oral health within maternal and child health services, a study conducted in Tshwane which assessed the integration of oral health into maternal and child health services, the location/urbanisation, ethnic group, maternal and child health services, the location/urbanisation, ethnic group, maternal and child health services, in addition, distal and proximal contextual risk factors are at play in the development of ECC.3 Contextual socio-behavioural factors that emerged in this particular population included, specifically, the differences in accessibility to oral health facilities, the mother’s educational levels, oral hygiene practices and in sugar consumption.

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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.
ABSTRACT
The evolution of traditional techniques toward modern endodontic surgical procedures was discussed in Part 1 of this series. The clinical procedures usually comprise exposure of the involved area, root-end resection and preparation and placement of root-end filling material. This article is a review of the literature which has been published on those materials that have been suggested for clinical use as root end fillers and on the shift towards the current materials of choice.

INTRODUCTION
Endodontic surgery is considered when the peri-radicular disease process persists in an endodontically treated tooth and when retreatment has been unsuccessful or is not feasible. The sequence of procedures involved in periapical endodontic surgery includes reflection of a full-thickness flap, gaining access to the root apex via an osteotomy, root-end resection, root-end cavity preparation, and sealing off the root canal system with a root-end filling.2

The purpose of root-end filling material is to provide a hermetic physical seal, and in this way to prevent the egress of micro-organisms or their by-products from the root canal system into the peri-radicular tissues.3 Peri-radicular curettage alone, without root-end filling, eliminates only the effect of the leakage from the root canal system into the surrounding tissues. The curettage does not eliminate the cause of leakage, however, as most periapical lesions are the result of a leaking apical seal.4 In order to ensure that healing does not regress, the root canal system should be resealed with an appropriate root-end filling.2

It has been argued that a root-end filling might not be necessary should the existing root canal obturation appear well condensed radiographically.5 However, the two-dimensional radiographic appearance of white lines representing obturation might not indicate the presence of voids and cannot exclude the presence of micro-organisms within the root canal system.6,7 It is therefore mandatory to use a retrograde filling at the time of endodontic surgery.8 Harty, Parkins and Wengraf (1970) concluded in a retrospective study of 1016 apicoectomy cases that the most important factor in achieving successful surgical endodontics was the apical seal.9

PROPERTIES OF AN IDEAL ROOT-END FILLING MATERIAL
The ideal root-end filling material should be:3,10,11
1. capable of preventing the leakage of bacteria and their by-products by adhering to the dentine walls and sealing the root end three-dimensionally
2. non-toxic
3. non-genotoxic
4. non-carcinogenic
5. biocompatible with host tissues and not a cause of any inflammatory reaction
6. insoluble in tissue fluids
7. dimensionally stable
8. unaffected by moisture during setting and when set
9. radiopaque
10. able to inhibit or not to promote the growth of micro-organisms
11. able to stimulate the regeneration of the periodontium, especially cementogenesis directly over the root-end filling
12. non-corrosive and not electrochemically active
13. non-staining to the tooth or periapical tissues
14. easy to use with a long shelf life.

ROOT-END FILLING MATERIALS
Various materials have been suggested and tested for use as root-end filling materials in the quest for a suitable product that fulfils all the ideal requirements.

1. Amalgam
Farrar has been credited with first using amalgam as a root-end filling material in 1884.10 Since then amalgam has been the
most widely used retrograde filling material and has served as a standard to which other materials are compared.33

The advantages of amalgam are that it is inexpensive, readily available, easy to manipulate, has good radiopacity and is insoluble in tissue fluids.3,12 Its disadvantages as a root-end filling material include: initial microleakage,14 electro-chemical corrosion,15 induction of inflammation of adjacent peri-radicular tissues,16 amalgam tattoo formation,17 the need for an undercut in cavity preparation,13 zinc toxicity,18 delayed expansion,19 and concerns over the introduction of mercury into the peri-radicular tissues.3

In 1991, Friedman identified amalgam as the material of choice for retrograde filling.13 However, newer materials have since been developed to challenge the use of amalgam. According to Chong and Pitt Ford (2005), the use of amalgam as a root-end filling should now be confined to history.3

2. Gutta-Percha

Gutta-percha is derived from the sap of trees mostly of the genus *Palaquium* and in particular from the *palaquium gutta*.20 Gutta-percha was introduced by Bowman in 1867 to fill the root canal space.21 Gutta-percha for endodontic use contains 20% gutta-percha as a matrix, 66% zinc oxide as a filler, 11% heavy metal sulphates as radiopacifiers and 3% waxes or resins as a plasticiser.22

Gutta-percha is the most commonly used material to seal the root canal system during non-surgical endodontic treatment. When condensed, gutta-percha undergoes compaction and not compression. As a result there is no molecular spring-back to aid in the seal between the dentine-gutta-percha interface, which makes it necessary to use an endodontic sealer as a luting agent between dentine and gutta-percha.23 Both heat-sealed- and thermo-plastic gutta-percha used without sealer have displayed clinically unacceptable levels of leakage when tested as retrograde fillings,24,25 whilst an endodontic sealer will reduce that leakage.26 Cold burnishing of gutta-percha at the time of root-end resection has been a proposed technique for sealing the root-end. However, evidence shows that this technique results in significantly more leakage than amalgam and IRM.26,27,28 The use of gutta-percha alone as a root-end filling cannot be advocated because of its poor sealing ability.

3. Cavit (3M ESPE, St Paul, Minnesota, USA)

Cavit is a calcium-sulphate-based temporary restorative material and is available in a premixed state that is simple to manipulate and to apply to a root-end cavity.13 It is a hygroscopic material that undergoes linear expansion and sets when permeated with water, resulting in good marginal adaptation provided that a minimum thickness of 3.5mm of the material is placed.13,29,30 However, Cavit is soluble and disintegrates when in contact with tissue fluids. For this reason, it cannot be recommended as a root-end filling.31

4. Glass-ionomer Cements

Conventional glass-ionomer cement was introduced in 1972 as a restorative material.22 It is formed by a reaction between fluoro-alumino-silicate glass particles and an aqueous solution of polyalkanoic acid such as polyacrylic acid.21

The advantage of glass-ionomer cements is that they are able to form a chemical bond to dentine and provide a superior seal in this way.13 Initially, they cause an intense inflammatory reaction that subsides completely.3 Glass-ionomers are slow setting, difficult to handle and the setting reaction is adversely affected by moisture.12,13 Silver released from the metal-reinforced glass-ionomer can cause discolouration and the corrosion products are toxic.3 The resin-modified glass-ionomer such as Vitrebond (3M ESPE) has better handling properties and the setting reaction can be controlled by light-curing.32 As it is not possible to ensure that the surgical site will be moisture free during the setting reaction, glass-ionomer cements cannot be recommended as ideal root-end fillings.

5. Reinforced Zinc-Oxide Eugenol Cements

In 1962, Nichols wrote of a preference for zinc-oxide eugenol as a retrograde filling because of its good handling properties and satisfactory postoperative results.33 However, early zinc-oxide eugenol cements were weak, had a long setting time and were soluble.1 Two modifications of zinc-oxide eugenol cement have been recommended as root-end fillings. These are described under (a) and (b) below.

a) IRM (Dentsply Sirona, York, Pennsylvania, USA) In IRM, 20% by weight poly-methyl methacrylate has been added to the zinc-oxide powder and the eugenol liquid remains unaltered.3

b) Super EBA cements

a. Stainline Super EBA (Staffident International, Staines, Middlesex, UK) is the original Super EBA cement which has been developed.24 The powder consists of 60% zinc-oxide, 34% silicon dioxide and 6% natural resin. The liquid comprises 62.5% ortho-ethoxy benzoic acid (EBA) and 37.5% eugenol.24

b. Super EBA (Harry J. Bosworth Co., Skokie, Illinois, USA). In the powder component of this version of the cement, the silicon dioxide is replaced with 34% Alumina, but the liquid component is exactly the same as the Stainline Super EBA.24

Super EBA was first suggested as a retrograde filling in 1970.25 Oynick and Oynick (1978) recommended the use of Super EBA as a root-end filling, as it is easy to manipulate and place as a result of its plasticity, adheres to the dentinal walls in moist conditions, has an adequate mixing time and sets quickly once in contact with tissues.36 Super EBA has the ability to bond to itself unlike IRM and can, therefore, be placed incrementally.37 Under Scanning Electron Microscope, Super EBA displayed good marginal adaptation and collagen fibres were observed growing over the material and in cracks within it.36 Compared with traditional zinc-oxide eugenol cements, Super EBA has a high compressive strength, high tensile strength, neutral pH and low solubility.37 A solubility study by Poggio et al. (2007) proved that both Super EBA and IRM were minimally soluble in water after 24 hours and also at two months.38

Eugenol is believed to be the major cytotoxic component of zinc-oxide eugenol cements, as free eugenol trapped in the set mass of zinc eugenolate is released by hydrolysis of the cement surface.29 The modified reinforced ZOE cements can resist dissolution, which reduces the release
of eugenol. The eugenol in IRM might have an affinity for the polymethylmethacrylate and this may limit the release of eugenol.10 Both IRM and Super EBA exhibit cytotoxicity when freshly mixed; however, this is rapidly diminished as the cements set.6 In a histological study of root-end fillings in dogs, Trope et al. (1996) confirmed the excellent tissue response to Super EBA and IRM, with EBA performing better than IRM but not to a statistically significant extent.50 A cytotoxicity study by Al-Sa'eed, Al-Hiyasat and Darmani (2008) showed that super EBA was more cytotoxic than IRM, even though more eugenol is released from the latter.51 It was concluded, therefore, that the zinc released from zinc-oxide eugenol cements is the major toxic element in zinc-oxide eugenol cements.41 Zinc toxicity when released from amalgam has been reported previously.42

Super EBA and IRM displayed excellent sealing ability when compared with amalgam, gutta-percha and glass ionomer cement, with Super EBA displaying a superior seal to IRM.42,43,46 On the basis of this evidence Super EBA and IRM can be recommended as root-end filling materials.

6. Composite Resin Materials

Composite resins are composed of aromatic or aliphatic dimethacrylate monomers, such as bisphenol-A-glycidyl methacrylate (BisGMA), triethylglycol dimethacrylate (TEGDMA) and urethane dimethacrylate (UDMA).3

Retroplast (Retroplast Trading, Rønne, Denmark) is a chemically cured flowable resin composite comprising BisGMA and TEGDMA.3,47 A technique using Retroplast bonded with the dentine bonding agent GLUMA (Heraus Kulzer, Werheim, Germany) was introduced as a root-end filling in 1984.47 The advantage of using GLUMA instead of other bonding agents is that it contains glutaraldehyde, which provides a disinfecting ability.48

The benefit of using this technique is that the traditional cylindrical root-end cavity preparation is not required, which can be particularly advantageous in difficult-to-access roots, such as in mandibular molars.48 The advocated cavity design is shallow, concave and saucer shaped, with a cavosurface angle close to 180 degrees.47 This preparation design allows for a reduced volume of composite against the dentine surface and prevents contraction gaps forming between dentine and composite during polymerisation.46 EDTA is used to remove the smear layer after preparation of the root-end prior to the application of Gluma.49

An in-vitro study on apical dye leakage demonstrated that composite with a dentine bonding agent showed the least leakage when compared with amalgam, Cavit and gutta-percha.50 In a long-term follow-up study of Retroplast-GLUMA bonded retrograde fillings, 32 out of 33 cases maintained complete bone healing when evaluated at 8 and 9 years postoperatively.47 The regeneration of alveolar bone, periodontal ligament fibres and cementum over composite-bonded retrograde fillings has been reported in case studies involving both monkeys and humans.51

The use of bonded composite as a root-end filling is technique sensitive and dependent on the maintenance of a completely dry field during placement.3 In cases where haemostasis was unsuccessful, healing was incomplete probably as a result of bond failure between composite and dentine.49

7. Compomer Materials

Compomers are polyacid-modified composite resins that have a glass-ionomer component.3 The inflammatory response of compomer after four weeks was comparable to that of Super EBA when implanted in rat femurs, and bone healing was observed for both materials at 12 weeks.52 A clinical study comparing compomer and glass-ionomer cement as root-end fillings showed that a significantly higher success rate was observed in the compomer group (89%) than in cases in the glass-ionomer group (44%).52 An electrochemical study by Park et al. (2004) found that there was no significant difference between MTA, Super EBA and Dyract-flow compomer.54

8. Gold Foil

The first two reported uses of gold foil as a retrograde filling were by Schuster in 1913 and by Lyons in 1920.51 Gold foil exhibits excellent marginal adaptation and biocompatibility.55 Improvement of biting forces was recorded following intentional replantation, and the group in which gold foil was used as a root-end filling material was found to be superior to amalgam and polycarboxylate cement.56 No significant difference was observed in bone healing when gold-leaf and amalgam were used as root-end fillings.56 A moisture-free environment is however required for the placement of gold foil, making it impractical to use as a root-end filling.57

9. Diaket (3M ESPE, St Paul, Minnesota, USA)

Diaket is a polyvinyl resin that is formed between zinc oxide and diaketone, and was originally developed for use as a root canal sealer when used in the ratio 1:1 powder to liquid.3,57 A thicker consistency made from two or three parts powder to one part liquid is recommended for use as a root-end filling.57 Diaket has good radiopacity and a working time of more than 30 minutes.3

When tested as a retrograde filling, Diaket proved to have a superior sealing ability to that of amalgam and glass-ionomer cement, as well as to IRM and EBA.58,59 Gerhards and Wagner (1996) found Diaket to have a similar sealing ability to amalgam and an inferior sealing ability compared with glass ionomer cement.60

Nencka, Walia and Austin (1995) reported excellent handling characteristics and biocompatibility of Diaket when implanted in rat bone.61 Complete regeneration of the periodontium was observed when MTA and Diaket were used as retrograde fillings in dogs and Diaket was reported to have superior handling properties over MTA.62 A histological evaluation of the tissue response to Diaket showed a hard-tissue matrix with periodontal ligament and cementum formation over the material, indicating that it is a bio-inductive material.62 Diaket compared with gutta-percha displayed a better healing response with bone formation, periodontal ligament regeneration and cementum formation.63

10. Polycarboxylate Cement

Zinc polycarboxylate cement was introduced in 1968 by Dr Dennis Smith and is made up of powder and liquid components that harden when mixed, via an acid/base reaction.64 The first reported use was by Schuster (1949) and it is available today as MTA (Microseal Bio Material, Dentsply Maillefer, Ballaigues, Switzerland) and ArteRoot (Esthetic Dental Laboratory, Inc., Torrance, CA, USA).65,66 The first report of MTA was by Schmitz et al. (2005) who found that MTA cement had the lowest radial expansion compared to the other cements evaluated.67 In a histological study of MTA root-end fillings it was found that MTA induced more bone regeneration than a calcium alginate dressing and that MTA enhanced cementum formation.68 MTA is also proven to be effective in treating periradicular lesions, as demonstrated by a study by De Almeida et al. (2019) who reported that MTA was able to heal root-end lesions in dogs.69
reaction.\textsuperscript{64} The powder comprises modified zinc-oxide with fillers and the liquid is an aqueous solution of polyacrylic acid.\textsuperscript{64} Polycarboxylate cement has a strong bond with enamel and a far weaker bond with dentine, as a result of a chelation reaction between the carboxyl groups of the cement and the calcium in tooth structure.\textsuperscript{64} Polycarboxylate cement is used as a luting cement and restorative material. Owing to its low water solubility, it was considered as a root-end filling material.\textsuperscript{13} In a dye-penetration study, Barry et al. (1976) showed that polycarboxylate cement leaked significantly more than did amalgam when used as root-end fillings.\textsuperscript{65} Owing to its viscosity and accelerated setting time in a warm environment, application as root-end filling is difficult.\textsuperscript{13} The demanding handling properties and poor sealing ability as a root-end filling render polycarboxylate cements unsuitable for this purpose.

11. Bioceramic Cements
Bioceramic materials could be described as biocompatible ceramics that are appropriate for use in the human body.\textsuperscript{66} The first bioceramic cement patented for use as a root-end filling was ProRoot MTA (Dentsply Sirona), and is commonly referred to as Mineral Trioxide Aggregate (MTA).\textsuperscript{2} MTA was developed for use as a root-end filling material at Loma Linda University by Professor Mahmoud Torabinejad and colleagues in the early 1990s.\textsuperscript{68} The first description of MTA in the scientific literature was in 1993 and by 1998 the U.S Food and Drug Administration had approved MTAs for endodontic treatment.\textsuperscript{65,69}

MTA is a fine hydrophilic powder derived from a Portland cement parent compound.\textsuperscript{68} Portland cement is a basic ingredient of concrete used in the construction industry, and was first used as a root canal filling in 1878 by Witte.\textsuperscript{70,71} Bismuth is a heavy metal and is added to the cement in the form of Bismuth oxide ($\text{Bi}_2\text{O}_3$) in the ratio of 4:1 to provide radio-opacity to MTA for radiological diagnosis.\textsuperscript{72} MTA cement is prepared by mixing its powder with sterile water using a 3:1 powder-to-liquid ratio.\textsuperscript{11} Upon hydration, calcium hydroxide and a calcium silicate hydrate gel are formed, which solidify into a hard structure in approximately 165 minutes.\textsuperscript{11,72} The pH of MTA is 10.2 which is antibacterial.\textsuperscript{90}

MTA can be described as a hydraulic cement because it is primarily dependent on hydration reactions for its setting.\textsuperscript{77} This contrasts with the usual acid-base reactions of other dental materials.\textsuperscript{77} The main constituent of MTA is calcium silicate.\textsuperscript{78} MTA can therefore be described as a hydraulic calcium silicate cement (HCSC).\textsuperscript{79}

The advantages of MTA as a root-end filling are:

1. MTA has the ability to set in a moist environment, including blood.\textsuperscript{11}
2. The excellent sealing ability of MTA has been well established by numerous studies on microleakage and marginal adaptation.\textsuperscript{60}
3. MTA is biocompatible with human tissues and was shown to be one of the least cytotoxic materials in various studies on cell culture.\textsuperscript{80}
4. MTA is a bioactive material, as is evidenced by the formation of hydroxyapatite crystals on its surface when it comes into contact with a physiologic solution.\textsuperscript{74,81,82} MTA releases calcium ions that react with extrinsic phosphate ions in the surrounding environment in order to form hydroxyapatite.\textsuperscript{83} The formation of hydroxyapatite on the surface of MTA enhances the chemical bond between MTA and dentine and can promote the remineralisation of the surrounding hard tissues.\textsuperscript{81}
5. Osteoconductive: MTA and Super EBA were found to be osteoconductive, as they stimulated osteogenesis when implanted in bone.\textsuperscript{84} The promotion of osteoblastic activity by MTA in bone has been well established.\textsuperscript{85,86,87}
6. Stimulates cementogenesis: A histological study performed on beagle dogs by Torabinejad et al. (1995) showed that when MTA and amalgam were used as root-end fillings, cementum formed directly over MTA, whereas no cementum formed over amalgam.\textsuperscript{88} In a similar histological study carried out on monkeys and in which MTA and amalgam were used as root-end fillings, a thick layer of cementum was found over the MTA that continued over the resected dentine and joined the cementum on the side of the root.\textsuperscript{89} The combination of the physical bond that MTA forms with dentine and the regeneration of cementum results in the formation of a double seal.\textsuperscript{77}
7. Anti-bacterial: The release of calcium hydroxide upon the hydration creates a highly alkaline environment which is antibacterial.\textsuperscript{90}

The drawbacks of MTA include:\textsuperscript{90,91}

1. Long setting time
2. Potential to cause tooth discoloration
3. Presence of toxic elements within the material
4. Difficult handling properties
5. Expensive to purchase
6. No known solvent
7. Difficult to remove once set
8. Washout in the early stages of placement

Several versions of hydraulic calcium silicate cements for endodontic use have emerged since the introduction of the ProRoot MTA material. Some of the materials that have addressed the limitations of the pioneer material include those set out in the paragraphs that follow (a to e)

a. MTA Angelus (Angelus, Londrina, Parana, Brazil)
MTA Angelus comprises 80% Portland cement and 20% bismuth oxide for radiopacity. Calcium sulphate has been excluded from the manufacture process of MTA Angelus so as to reduce its setting time to approximately 14 minutes.\textsuperscript{66}

b. MTA Plus\textsuperscript{TM} (Prevest Denpro Limited, Jamu, India)
MTA Plus\textsuperscript{TM} is a novel mineral trioxide aggregate material that has a finer particle size than MTA.\textsuperscript{20} The MTA Plus\textsuperscript{TM} powder is supplied with a proprietary salt-free polymer gel and water, either one of which can be used as mixing vehicles.\textsuperscript{77} The finer particle size improves the handling and placement of MTA Plus\textsuperscript{TM}, and the purpose of the gel is to provide an anti-washout property to the material.\textsuperscript{71,93}
The setting time of MTA Plus™ mixed with water (180 mins) was found to be longer than for MTA Plus™ mixed with the anti-washout gel by 65 minutes.96

It is necessary to irrigate the osteotomy site prior to closing a periapical flap to avoid complications.93 One of the drawbacks of MTA is washout, which can be defined as the tendency of a cement to disintegrate upon early contact with blood and other fluids.94 Washout resistance is an important quality of a root-end filling, as the final irrigation and resuming of blood flow to the area might result in the loss of some of the material placed in the root-end cavity and the compromising of the apical seal in the process of loss.95

During the construction of underwater structures a water-soluble polymer is added to concrete in order to modify its rheological properties and make it resistant to washout.95 Resistance to washout is achieved by increasing the viscosity of the liquid used to mix the cement powder, which increases the resistance of the cement to segregation by an external washing action.95 A similar concept was employed in the development of the gel additive to MTA PlusTM.95

c. Biodentine™ (Septodont, Saint-Maur-des Fosses, France)

Biodentine™ is a synthetic tricalcium-silicate-based cement that is advertised as ‘bioactive dentine substitute’.96 The production of Biodentine™ is based on ‘Active Biosilicate Technology™’, which results in a pure tricalcium silicate that is free of metallic impurities.97

Biodentine™ has a powder component in a capsule and liquid packaged in a pipette. The powder is made up of tricalcium silicate (main core material), dicalcium silicate (second core material), calcium carbonate and calcium oxide (filler materials), iron oxide (colouring agent) and zirconium oxide (radiopacifier).98 The liquid consists of a hydrosoluble polymer (water-reducing agent) and calcium chloride(setting accelerator).97 The hydrosoluble polymer can also be described as a superplasticizer and maintains the flowability of the mixture in a low water-to-solid ratio.99 The advantage of synthesising pure tricalcium silicate compared with purifying natural tricalcium silicate is that the mineralogy is not altered by sintering conditions or variable composition of raw materials.99 The absence of metallic impurities has been confirmed by the analysis of acid extracts and leached trace elements of Biodentine™.100 The particle size of the Biodentine™ powder was found to be much finer than that of MTA.99

The aqueous solution is mixed with the powder within the capsule in a triturator for 30 seconds at a speed of 4000-4200 rotations per minute.97 The hydration reaction results in the formation of a calcium silicate hydrate gel and the release of calcium hydroxide.101 According to Camilleri, Sorrentino and Damidot (2013), the calcium carbonate acts a nucleation site for the calcium silicate hydurate; as a result there is a shorter induction period and therefore an initial set within 12 minutes.99 The final setting time of Biodentine™ was found to be 45 minutes.100

d. MTA Flow (Ultradent Products Inc., Utah, USA)

MTA Flow is a mineral trioxide aggregate repair cement that comprises a powder constituted of ultrafine-grained tricalcium and dicalcium silicate powder, and a proprietary water-based gel.102 The powder gel formulation is smooth because of the small particle size of less than 10 microns of MTA Flow powder. The formulation is also resistant to washout as a result of the gel formulation.102 MTA Flow, like other calcium silicate cements, is indicated for root-end filling, pulp capping, pulpotomies, apexification, root resorption and perforation repair.102 The mixing ratio of MTA Flow is adaptable according to the consistency required for the specific procedure, which may range from thin, thick to putty.102 A putty consistency is mixed for root-end filling purposes. An added advantage of this product is that it is placed into a Skini syringe after mixing, which allows it to be accurately expressed from the Black Micro® Tip (22 gauge) when used for pulp capping and perforation repairs, or a NaviTip® Tip (29 gauge) for resorption repairs, apexification, or placement of an apical plug to the desired site.102 The working time of MTA Flow is 15 minutes, and it may be rinsed or air dried after 5 minutes without risk of it being dislodged.102

e. Calcium Phosphate Silicate Cements

The latest generation of bioceramic cements is a Calcium Phosphate Silicate Cement (CPSC) that has phosphate salts added to the conventional calcium silicate cements.94 The main components of CPSCs are calcium silicates, zirconium oxide, tantalum oxide and calcium phosphate monobasic.64 The addition of phosphate salts is intended to enhance the mechanical properties and biocompatibility of the cement. Examples of CPSCs are: EndoSequence Root Repair Material Putty (ERRM Putty; Brasseler USA, Savannah, GA, USA), EndoSequence Root Repair Material Paste (ERRM Paste; Brasseler USA), iRoot BioAggregate (Innovative Bioceramix, Vancouver, Canada) and TotalFill™ BC PRM™ Putty (FKG, La Chaux-de-Fonds, Switzerland). The materials are available either as a premixed mouldable putty or as a paste in a syringe with delivery tips for intra-canal delivery and the material begins to set when in contact with moisture.46

CONCLUSION

The root-end filling material of choice during the 19th century and most of the 20th century was amalgam. The reinforced ZOE materials, IRM and Super EBA were on the verge of superseding amalgam as the preferred root-end filling material toward the end of the 20th century. Calcium silicate cement MTA introduced at the turn of the century outclassed all materials previously tested because of its ability to appreciate moisture, its excellent sealing ability, and its bioactivity and biocompatibility. The continuous evolution of calcium silicate materials has resulted in products with improved handling properties and has provided the endodontic field with appropriate and effective repair- and root-end filling materials.

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Applying the perceptions of graduates on their dental training to inform dental curricula from the perspective of occupational health.

ABSTRACT
Introduction: Dental education, one of the most stressful fields of study, is associated with many occupational health hazards. Clinical training is focused on patient care and occurs under the supervision of a qualified practitioner, and is thus the most appropriate time to educate students about the prevention of occupational health problems. The study aimed to report on the reflections of dental graduates on their undergraduate training from the perspective of occupational health.

Methods: This cross-sectional, descriptive study used both quantitative and qualitative methods in the collection of data from a study population comprising dentists, dental therapists, and oral hygienists in KwaZulu-Natal, South Africa.

Results: The response rate was 41% (n=169), 80% (n=138) and 40% (n=46) for dentists, dental therapists, and oral hygienists, respectively. There was little focus (77.7%) on health and well-being of students and self-care in their dental training. Clinical work had started in the first year for 30% of the participants, and in the third year for 54.4% of the students. Undergraduate training lacked modules on occupational health, practice/business management, posture training, ergonomics, and stress management.

Conclusion: The perceptions of this study population indicated a need for the inclusion of occupational health training in undergraduate dental curricula.

Keywords: dental education, self-care, occupational health, ergonomics

INTRODUCTION
Dentistry, although regarded as a rewarding profession, is both physically and mentally challenging. Clinical practice requires a need for precision and high concentration. Dental practice is unfortunately associated with many occupational problems i.e. musculoskeletal disorders, percutaneous injuries, stress and biological hazards. Occupational health problems not only affect dental practitioners but according to the World Health Organisation, two million people die each year as a result of occupational accidents and work-related illness and disease. A further 160 million new cases of work-related illness occur each year. A significant 8% of the global burden of disease from depression is due to occupational risks.1

For the purpose of the study the term "oral health practitioner" or "dental practitioner" will refer to an oral health worker, whether dentist, dental specialist, dental therapist, or oral hygienist. This study was part of a larger study investigating how curricula could possibly change to include the awareness of occupational health problems, their causes and their prevention. Participating dental practitioners were asked to reflect on their undergraduate dental training and to answer a series of both closed and open-ended questions.

It is noteworthy that the first phase of the larger study has indicated that the prevalence of musculoskeletal disorders among dental health practitioners is high, dentists being identified as most affected by occupation-related health problems. The next most prevalent affliction was percutaneous injury.2

Dental education is regarded as one of the most challenging fields of study. It is a normal requirement for students to demonstrate their achievement of many competencies prior to graduation. Clinical training is focused on patient care and conducted under the supervision of a qualified practitioner and is thus regarded as the most appropriate time and place to educate the student about...
the prevention of occupational health problems. Dental education can draw from the Theories of Learning. This is not just transmitting information from the teacher to the learner but should recognise the different types of knowledge i.e. tacit, structured, codified, disciplinary and pedagogic. Tacit knowledge refers to intuitive, hard to define knowledge that is largely experience-based. The acquisition of tacit knowledge thus depends on the context and the students’ personal experience. It is hard to communicate and is deeply rooted in action, commitment, and involvement. It is not directly taught but is demonstrated and the need for attention should be communicated to students. Clinical feedback should be structured, comprehensive, positive and encouraging. Feedback and assessment rubrics as used in dental training should therefore include consideration of posture and positioning of both the practitioner and patient.

The integrated approach to workplace health programs should include the work environment, work organisation, lifestyle and health behaviours. Ergonomics is the study of a workers’ efficiency in a working environment. Ergonomics provides a framework to improve physical and organisational structures at work. It is argued that the dental curriculum should prepare the dental student for efficient practice in the workplace, since the training environment simulates the actual practice environment, and offers a start to healthy work-based practices. In a study of a similar nature, Thornton and colleagues concluded that preparing a student for ergonomic challenges involved recognising physical and psychosocial stress factors, then reinforcing ergonomic concepts that might be taught didactically, and training students to understand biomechanical principles and how to reduce or eliminate risk factors. The question may be posed: Does the curriculum in dentistry prepare our students for safe work-based practice?

This article reports on the reflections of dental graduates on their undergraduate dental training with a view to understanding the extent to which the dental curriculum had prepared them for self-care in clinical practice, and, further, to gather their input regarding the inclusion of occupational perspectives in the dental curriculum.

**METHODS**

This cross sectional, descriptive study used both quantitative and qualitative data collection methods to explore the perspectives of dental practitioners about their undergraduate training. The training period in dentistry in South Africa (SA) is a five year programme in comparison with dental therapy and oral hygiene, both of which extend over three years. The typical dental curriculum offers exposure to basic sciences in the first year, to diagnostics and therapeutic aspects in the second year and to the clinical sciences in the third year. The first clinical exposure for dentists was thus in their third academic year while therapists and hygienists received their first clinical exposures from the second and first years.

The study population comprised all dentists \( n=400 \), dental therapists \( n=119 \) and oral hygienists \( n=115 \) based in KwaZulu-Natal (KZN) and registered with either the South African Dental Association (SADA), South African Dental Therapy Association or Oral Hygiene Association. All registered practitioners were invited to participate through email, telephone or physical visits to their practices. A link to the online questionnaire was emailed to all practitioners on the respective registers (KZN branches). The researcher also attended conferences of the relative associations to distribute questionnaires and to encourage improvement in the response rate.

A self-administered questionnaire was used for data collection. The questionnaire was piloted \( n=10 \) and minor changes were made prior to the study. The questionnaire explored the nature and extent of exposure to clinical work, aspects relating to self-care and well-being and the suggestions of practitioners regarding aspects which may be considered for review in the dental curriculum. This study formed the second phase of a three-phase project for which ethical clearance had been obtained from the Humanities & Social Sciences Research Ethics Committee (UKZN) - reference no: HSS/1490/015D.

All participants were informed of the purpose of the study through an information sheet and gave informed consent prior to participation. They were also informed of their right to withdraw from the study at any stage.

Quantitative and qualitative data were exported from QuestionPro. Quantitative data were analysed in SPSS version 24. Frequencies and means with standard deviations were calculated for categorical and continuous variables. Qualitative data collected in response to open ended questions that explored dental curricula were entered in an Excel spreadsheet to allow for thematic analysis.

*QuestionPro Inc. (US) [http://www.questionpro.com.](http://www.questionpro.com.)*

**RESULTS**

The response rate was 41% \( n=169 \), 80% \( n=138 \) and 40% \( n=46 \) for dentists, dental therapists and oral hygienists respectively. The majority of participants were female \( n=203; 57.5\% \) and 24.6%; \( n=87 \) held postgraduate qualifications (Table 1). On average the participants had been in practice for 12 years and had graduated 13 years ago. Participants were asked to reflect on the nature of their clinical work, duration of practice and typical self-care behaviour in relation to how they had been taught in the curriculum at university. The participants were asked, as experienced dental practitioners, to reflect on their training.

Table 2 provides a summary of the data pertinent to the first exposure to clinical work, the number of hours spent...
on clinical work by each group and the extent to which they worked under pressure. Also recorded were reactions to questions relating to working under time constraints and exposure to considerations of occupational health.

Participants were asked to reflect on their undergraduate dental curriculum, exploring what was lacking in their undergraduate training from the viewpoint of occupational health. The responses are summarised in Table 3, which presents the themes, frequency of response and supporting quotes.

Participants provided the following suggestions to improve dental training in the future when considering occupational health. They suggested the inclusion of:

- "A subject on occupational health, not just mentioned in the clinics."
- "A course on occupational health identifying effects and risks and preventative measures. Also recommendations to ensure that different procedures are imperative- avoid repetitive motions that can cause musculoskeletal damage acutely and chronically."

The most frequent suggestion related to the inclusion of ergonomics, posture, equipment and surgery design:

- "Ergonomics and how to purchase equipment ...some guidelines"
- "Ergonomics and occupational hazards in the dental profession"

The inclusion of health and wellbeing was also frequently suggested and participants suggested the inclusion of information and recommendations on exercises to prevent musculoskeletal disorders in dental curricula.

Others thought that stress management programs and self-care should form part of the dental training programme. They also expressed the need for training sessions to model and include discussions on how to work in a multidisciplinary team.

**DISCUSSION**

The study sample consisted of dentists, dental therapists and oral hygienists. A post graduate degree had been attained by 23.1% of dentists in this sample. This percentage was higher than the percentage reported in 2011 among participants in a Brazilian study (5.5%).

As noted in the results, 30% of the participants had started clinical work in their first year. Among the dentists 54.4% had started clinical work in the third year. Early clinical exposure is beneficial and has a positive impact on students. Ali et al. noted that whilst on one hand early clinical exposure eliminates stress by spreading out the workload and clinical training through the curriculum, it tended to inflate the first year. Students already had to deal with anatomy, physiology and life sciences during their first academic year. Early clinical contact was supported by McHarg and Kay as it gives students the opportunity to learn the affective dimension of learning, the "heart" skills.

The results of the study indicate that self-care as recommended for inclusion in the curriculum would benefit dental students. It is relevant to note that 77.7% of participants responded that there was little or no focus...
on their health and wellbeing in their undergraduate training. When dental practitioners reflected on the dental curriculum, 71.7% stated that almost no attention was directed to discussion on how they should take care of themselves in practice from an occupational health perspective. Seventy-three percent of the participants had never or perhaps sometimes, learnt about self-care (Table 2), Self-care programs that focus on coaching and stress management have the potential to benefit dental students.11,12 Greeson et al. in their intervention study introduced a skills building and self-care workshop for medical students, which included mind-body skills with relaxation exercise and meditation. Students tracked their progress on their smartphones and it was revealed that 100% of the group benefitted from the program having started practicing mind-body skills in the week.

The researchers in the Greeson study concluded that the "an occupational health course pertaining to dental health practitioners would have made a world of difference if included in our curriculum" (participant 73662819 – dentist)

The inclusion of dental ergonomics and awareness as curricular topics was also suggested by participants in the current study and this recommendation has been backed by many studies.19,21 Ergonomics includes the kind of work done, the tools used in practice and the working environment. The aim is to find a good fit between the practitioner and the work condition and to ensure that all practitioners are safe during work and not be prone to work based injuries. The prevention and reduction of MSD among dental practitioners should be included in dental training and teaching ergonomics is recommended by participants. Gupta et al. in their systematic review concluded that ergonomic training in dental schools is a good prevention strategy. He went on to further recommend it as a separate course that should be periodically assessed.20 Instrument handle size, width and weight affects muscle load and pinch force, therefore knowledge of these factors when selecting instruments is important for young dentists as this will reduce the prevalence of hand symptoms.22

The participants in this study reported a lack of exposure to stress management during their undergraduate training and they thought that the topic needed proper exposure in the dental curriculum. Stress among dental students is not uncommon.23,24 When one draws from the Pau et al. study one realises that not only is stress management needed in the curriculum but also required is the development of emotional intelligence so that the coping mechanism of dental students is improved.24

Table 3: Reflection on undergraduate training (n=353)

<table>
<thead>
<tr>
<th>Themes</th>
<th>Frequency (n, %)</th>
<th>Quote/supporting evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Occupational health module</strong></td>
<td>81; (22.9%)</td>
<td>&quot;Module on occupational health, it's benefits and the importance to us as health care practitioners&quot; (participant 67407103 – dental therapist)</td>
</tr>
<tr>
<td><strong>2. Practice/business management</strong></td>
<td>80; 22.6%</td>
<td>&quot;How to manage a practice, and work faster; private practice is extremely stressful, none of us was prepared for it; a lot of mental strain; university needs to teach us about business management rather than psychosocial orientation... What a waste of a module&quot; (Participant 61058000 - dental therapist)</td>
</tr>
<tr>
<td><strong>3. Posture</strong></td>
<td>71; 20.1%</td>
<td>&quot;Correct working posture was included in the pre-clinical lab and sometimes when working in the clinic but more intense sessions should be done in occupational health. Only daily posture is covered minimally but no one talks about repetitive posture - causes and impact on your body, detail preventative measures of such risks to your health&quot; (Participant 73719952 - dental therapists)</td>
</tr>
<tr>
<td><strong>4. How to deal with stress?</strong></td>
<td>60; 16.9%</td>
<td>&quot;Two year diploma, as the course is too intensive and the time constraints to finish such a vast scope of practice leaves room for increased occupational health hazards for an already stressed student&quot; (Participant 67459422 - oral hygienist)</td>
</tr>
<tr>
<td><strong>5. Ergonomics/surgery design</strong></td>
<td>45; 5.3%</td>
<td>&quot;Ergonomics related to our field and correct posture&quot; (participant 73873685 – dentist)</td>
</tr>
<tr>
<td><strong>6. Multidisciplinary approach</strong></td>
<td>40; 11.3%</td>
<td>&quot;Clinical training should include proper ergonomics training&quot; (Participant 88607868 – dental therapist)</td>
</tr>
<tr>
<td><strong>7. Exercise and fitness</strong></td>
<td>32; 9.0%</td>
<td>&quot;An inclusion on how to take care of yourself as a clinician is important, for example there should be an emphasis on good posture and guiding exercise routines that a dental clinician can carry out to alleviate pain and to prevent any long term physical damage&quot; (Participant 61443711 - dental therapist)</td>
</tr>
</tbody>
</table>

Proposing inclusion of occupational health as a topic into the dental curriculum is not new and has been suggested by many studies.13,17 A cross sectional study among dental students in Croatia led to the introduction of a module entitled “Occupational diseases in dental medicine”. The course was introduced in the 6th semester just before preclinical training. This was a multidisciplinary course and included lectures and practical sessions. The researchers in this Croatian study concluded that students should be aware of occupational health diseases and prevention prior to starting independent practice.18 Participants in the current study indicated that a course in occupational health should be included in the dental curriculum with emphasis on both preclinical and clinical training.
Dental training institutions should collaborate with educational experts to have a curriculum aimed at the psychological health of students.13

Practice management and financial training were a concern as participants reflected on undergraduate training. Many practitioners enter private practice with minimal financial planning experience and practice management skills. Baldwin et al. in their research stated that dental graduates enter practice already burdened with debt and the undergraduate curriculum does not have sufficient input in administrative training and in running a practice.15 Poor practice management and lack of financial planning adds to the stress levels of dental practitioners.

Developing information into knowledge requires understanding of the four different types of knowledge and how people learn, as discussed in the introduction.25 The theory of occupational health principles, self-care, correct posture and health and safety can be discussed in lectures but it is irrelevant if not practiced and reinforced in clinical training. This is explained well by researchers McHarg and Kay who describe learning about bicycles as explicit knowledge and learning how to ride a bicycle as tacit knowledge.26 Thus clinical training requires a positive attitude, constant reinforcement, attention to detail and repetition to promote learning.

Limitations of this study were that it was conducted in KZN and was not a national study so it has limits affecting its generalisability. The participants had trained at various institutions in South Africa and the curriculum is not standard throughout SA.

CONCLUSION

This study provided insights into the perceptions of dental graduates of their exposure to occupational health in dental curricula. The study population indicated a need for the inclusion of occupational health training in the undergraduate dental curriculum. It also provided relevant indicators of the curriculum changes needed to make it more amenable to the inclusion of occupational health issues. Further research into the impact of stress is needed in SA. It would be prudent to engage with multiple stake holders to inform dental education considering occupational health.

References

Prevalence and aetiological factors of maxillofacial trauma in a rural district hospital in the Eastern Cape.

SADJ June 2018, Vol 73 no 5 p348 - p353
L Pillay¹, M Mabongo², B Buch.³

ABSTRACT

Aim: To determine the prevalence, aetiological factors and demographic data of patients presenting with injuries sustained from maxillofacial trauma over a six month period at Zithulele Hospital.

Materials and Methods: In a retrospective, descriptive study, data collected and analysed included records of all patients who had suffered maxillofacial trauma, their demographics, clinical features and the aetiology. The radiographic records were assessed by a maxillofacial surgeon and a radiologist for a diagnosis as well as gaining opinions regarding the types of fractures observed.

Results: A total of 239 patients sustained maxillofacial trauma. The most common aetiological factor was interpersonal violence (55%) followed by road traffic accidents (16%), falls (10%), animals (4%) and other causes (2%). The male to female ratio was 2.6:1 and the 18-24 years age group endured the most trauma. A total of 210 (88%) patients sustained soft tissue injuries while 29 (12%) experienced hard tissue injuries, with 39 fractures diagnosed. A total of 165 maxillofacial radiographs were assessed, 37% were diagnostically acceptable, 56% had poor diagnostic value and 7% had no diagnostic value.

Conclusion: Maxillofacial trauma is prevalent in rural parts of South Africa. Males aged 18-24 years are frequent victims, with interpersonal violence being the major aetiology.

INTRODUCTION

Maxillofacial trauma is any injury sustained to the face, jaws and related structures and includes both soft and hard tissue injuries. The maxillofacial region, composed of the following bones: frontal, nasal, ethmoid, zygomatic, maxillary bones and the mandible, is divided into three parts: the upper face, midface and lower face.1 The lower third of the face is formed by the mandible along with its dento-alveolar arch. The middle third of the face is the area between the supraorbital margins and the occlusal plane of the upper teeth and the upper third of the face is the region above the supraorbital margins. Amongst these, the most commonly fractured is the mandible followed by fractures in the nasal, zygomatic and maxillary bones.²

LITERATURE REVIEW

Facial injuries are a common feature in trauma units worldwide and are known to cause significant deformity, loss of function and in severe cases, can be life-threatening.³ The type of injuries range from harm to soft tissue to damage to hard tissue. Soft tissue injuries include burns, lacerations, bruises, avulsions and abrasions and in the face may involve damage to the major salivary glands, muscles, cranial nerves, eyes and connective tissue.4 Hard tissue injuries include trauma to the dentition, dislocations of the temporomandibular joint and fractures to the bony maxillofacial complex. A major concern with soft tissue injuries is wound contamination and, for cosmetic reasons, tissue scarring.⁵

The management of these injuries is carefully planned and coordinated by maxillofacial and plastic surgeons. Depending on the object and the velocity reached when it contacts soft tissue, soft tissue injuries can range from superficial harm to deep penetrating wounds with significant tissue loss. The biomechanics of trauma is the biological response of tissue to the mechanics of the impact.⁶,⁷ The extent of maxillofacial trauma can be determined by considering the biomechanics involved during the injury, information which is usually obtained through a correlation of the results of a thorough clinical examination with a detailed history of the traumatic event.

Patel et al. reported that 12.6% of the trauma patients in their study suffered post traumatic cranial nerve injury. The
facial nerve was the most frequently damaged, followed by the oculomotor and optic nerves. It can therefore be said that the results of maxillofacial trauma can be quite complicated.

On completion of a comprehensive clinical examination, specific radiographs are usually requested for the diagnosis of facial fractures. A complete radiological examination forms a crucial part in the diagnosis of hard tissue injuries and in determining the location of foreign bodies within soft tissue. It provides valuable information on the site of the fractures, the degree of displacement and the effects on surrounding structures. Radiographs used routinely for the diagnosis of maxillofacial trauma include: lateral cephalometric projection; submentovertex; Waters view; posterior-anterior skull projection; reverse Townes; mandibular lateral projection and panoramic views. However, conventional radiographs are becoming less popular with the availability of computer tomography and magnetic resonance imaging.

The treatment of maxillofacial trauma is more complex and challenging than trauma elsewhere in the body. Most of the treatment modalities for trauma sustained on other parts of the body are aimed at restoring function, whereas in the maxillofacial region aesthetics are a major concern and pose difficulties for the medical personnel. Studies have shown significant psychological and functional problems that are associated with maxillofacial trauma and depression is often seen when aesthetics are compromised.

The most common causes of maxillofacial trauma have been reported to be: traffic accidents, mainly motorcycle accidents, followed by physical assaults, falls and sports-related accidents. The major factors influencing the incidence of maxillofacial trauma are age, gender, geographic region, substance abuse, compliance to traffic legislation, domestic violence and interpersonal violence. A South African investigation has determined the main cause to be interpersonal violence.

Around the world, these causative factors are largely influenced by differences in socio-economic status, culture and environmental factors. Sports-related trauma tends to occur more frequently in higher socioeconomic areas, while Brasileiro et al. reported a high incidence of violence-related trauma in lower socioeconomic strata. A number of studies indicate substance abuse to be a major contributing factor to the occurrence of facial injuries within the variable of interpersonal violence. A South African study conducted by Desai et al. reported that 65% of their cases of maxillofacial trauma were associated with alcohol. This suggests that there is a significant correlation between alcohol consumption, interpersonal violence and maxillofacial trauma. Different geographical areas also demonstrate different patterns of cause and presentation.

All age groups may be affected by maxillofacial trauma. The incidence has been shown to ranges from 1 to 99 years with a median of 22 years and mean of 25.8 years. In the geriatric population, studies have shown that falls were the most common cause of maxillofacial trauma. This is due to age-related changes in the sensory systems of these older people. Of note is the report that amongst the paediatric population, falls are also reported to be a major cause. These studies suggest that aetiologies are related to age and that certain age groups are more predisposed to specific aetiologies.

In studies on the gender distribution of maxillofacial trauma, Boffano et al. reported a male to female ratio of 11.8:1. The male to female ratio of maxillofacial trauma was higher in rural areas than in urban areas and the most commonly affected age group was between 21-30 years. In another South African study on the patterns of interpersonal violence, males were mostly affected and the face was the second most commonly injured area. Males are more at risk to trauma as compared with females, attributable to differences in behavioural activities. Studies have shown the type of injuries that males sustain are significantly more serious than those which are sustained by females, with a higher mortality and morbidity rate. The rapid change in the socio-economic status of populations has created both the opportunity and the need for females to perform a broader range of work. This has required greater physical demands and has increased their vulnerability to maxillofacial trauma.

A South African study showed that alcohol consumption is a greater contributing factor in males. In 2014, the World Health Organizations global status on alcohol and health showed alcohol to be the leading risk factor for mortality in males and that females are predisposed to suffer alcohol related harm. Overall, the incidence and characteristics of maxillofacial trauma differ depending on the geographical area and socio-economic status of populations.

In South Africa, the referral system in the health sector requires that patients are expected to present for immediate primary care at the primary healthcare centres and at community healthcare centres, for intermediate or generalist care at the district hospitals, and for advanced diagnostic procedures and treatment, at the tertiary hospital. Anecdotal evidence suggest that most primary health care facilities do not have adequate resources, such as radiology for diagnosing maxillofacial fractures, and that those primary health care workers who may be managing maxillofacial injuries are not familiar with correct diagnostic imaging and lack skills in the diagnosis of maxillofacial fractures. There has been no research conducted in the Eastern Cape on the epidemiology and aetiology of maxillofacial trauma. A project to investigate these factors may gain knowledge of the maxillofacial trauma in a South African rural region. This will allow clinicians within the region to adopt appropriate diagnostic aids and treatment modalities. Specialised training programs can then be developed, thus saving time and money and allowing for scarce resources to be allocated more effectively.

The aim of this study was to evaluate the prevalence, aetiological factors and demographic data of patients presenting with maxillofacial trauma over a six month period at Zithulele, a 140 bed district hospital located in rural Eastern Cape. The facility services a population of 130 000 inhabitants, and is about 300km from East London, where may be found the nearest maxillofacial surgeon to whom referral can be made.
MATERIALS AND METHODS

Study Design and Population

Study Design
A retrospective, descriptive study was undertaken to analyse the prevalence and aetiological factors of maxillofacial trauma at Zithulele Hospital, over a six month period (October 2015 – March 2016).

Study population
The method of convenience sampling was used to determine the study population within a specific time frame (October 2015 – March 2016). A total of 8262 patients who were triaged in casualty within the specified period were considered for inclusion in the study. Of this total, it was determined that the records of 239 patients who had sustained maxillofacial trauma met the requirements. Incomplete records, missing records and any recorded trauma not within the specified period lead to exclusion of the case from the study.

Data Collection
A data collection sheet was used by the principal investigator to record the data. Variables collected were aetiology, gender, age, diagnostic quality of radiographs, nature of injury (soft or bone) and site of fractures. A maxillofacial surgeon and a radiologist skilled in maxillofacial interpretation assessed the quality of the radiographs and their suitability as a basis for an adequate diagnosis. The patterns of hard tissue trauma were classified anatomically into different types of fractures with the assistance of these clinicians who were also requested to offer their own diagnoses and opinions of the types of fractures seen. The radiographs were classed as: a) no diagnostic value; b) poor diagnostic value; and c) acceptable diagnostic value.

Data Analysis
The assessor’s interpretation of the radiographs was captured on an Excel sheet. Reliability was determined with Cohen’s Kappa inter-rater reliability test. Descriptive statistics were used to demonstrate the results. Tables and graphs were used to illustrate the outcomes.

Ethical consideration
The Clinical Manager of Zithulele Hospital granted permission to conduct research at the Institution and the Human Research and Ethics Committee at the University of Witwatersrand granted ethical clearance to conduct this study (M160832).

Limitations
A limitation in the study were hospital-held records that were not as descriptive as would have been those for a study with a predetermined format for capturing data. Some of the records were missing data or presented incomplete information. Many radiographs had no or poor diagnostic value making it difficult to accurately diagnose the type of fracture seen.

RESULTS

Prevalence of maxillofacial trauma
A total of 8262 outpatient records for the period 1st October 2015 – 31st March 2016 was considered. During this period 239 (2.89%) patients had sustained maxillofacial trauma.

Frequency of aetiological factors
The most common aetiological factor was interpersonal violence which accounted for 131 patients (55%), the second most common being road traffic accidents (38 patients, 16%). Falls had resulted in 25 (10%) of the injuries and in nine cases, the trauma had been caused by animals (4%). Other causes (2%) included four patients who sustained burns to the face, one having been cut by a roofing sheet (Figure 1).

Females versus males
Of 239 patients, 173 (72%) were male and 66 (28%) female (Figure 2). The male to female ratio was 2.6:1. Data analysis showed that males were more prone to maxillofacial trauma than females ($\chi^2 = 74.55$, d.f. = 1, $p < 0.001$).

Age range
The age of patients ranged from 1 to 74 years, with a median of 24 and a mean of 26.3 (standard deviation: 15.4). The age group diagnosed with the most maxillofacial trauma was that between 18 to 24 years, accounting for 27% of the patients. The second most frequent age group fell into the category of under 18 years, 24% of the sample (Figure 3).
Patterns of trauma
A total of 210 (88%) patients sustained soft tissue injuries while 29 (12%) suffered hard tissue injuries, often multiple. Of these, there were 39 fractures diagnosed. The most frequently fractured bone was the mandible at the body (Table 2). Zygomatic bone fractures were the second most frequently observed followed by the nasal bones and Le Fort I displacements. Among the soft tissue injuries, 41.9% sustained lacerations, 7.6% presented haematomas while in 40% of cases the soft tissue injuries were unspecified (Table 1).

### Table 1: Patterns of Maxillofacial trauma

<table>
<thead>
<tr>
<th>Hard tissue injuries</th>
<th>Number of fractures</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Upper third fractures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frontal bone</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td><strong>Middle third fractures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior wall of maxillary sinus</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Ethmoid bone</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Lateral wall of the nose</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Le Fort I</td>
<td>3</td>
<td>7.7%</td>
</tr>
<tr>
<td>Le Fort II</td>
<td>2</td>
<td>5.1%</td>
</tr>
<tr>
<td>Le Fort III</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Nasal bones</td>
<td>3</td>
<td>7.7%</td>
</tr>
<tr>
<td>Orbital floor</td>
<td>1</td>
<td>2.6%</td>
</tr>
<tr>
<td>Zygomatic bones</td>
<td>4</td>
<td>10.3%</td>
</tr>
<tr>
<td><strong>Lower third fracture</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mandibular fractures</td>
<td>21</td>
<td>53.8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>39</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soft tissue injuries</th>
<th>Number of patients</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasions</td>
<td>7</td>
<td>3.3%</td>
</tr>
<tr>
<td>Bruises</td>
<td>9</td>
<td>4.3%</td>
</tr>
<tr>
<td>Burns</td>
<td>6</td>
<td>2.9%</td>
</tr>
<tr>
<td>Hematomas</td>
<td>16</td>
<td>7.6%</td>
</tr>
<tr>
<td>Lacerations</td>
<td>88</td>
<td>41.9%</td>
</tr>
<tr>
<td>Soft tissue injuries unspecified</td>
<td>84</td>
<td>40.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>210</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Table 2: Types of Mandibular fractures

<table>
<thead>
<tr>
<th>Site</th>
<th>Fractures</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alveolar</td>
<td>2</td>
<td>9.5%</td>
</tr>
<tr>
<td>Angle</td>
<td>3</td>
<td>14.3%</td>
</tr>
<tr>
<td>Body</td>
<td>8</td>
<td>38.1%</td>
</tr>
<tr>
<td>Condyle</td>
<td>1</td>
<td>4.8%</td>
</tr>
<tr>
<td>Subcondylar</td>
<td>5</td>
<td>23.8%</td>
</tr>
<tr>
<td>Symphysi</td>
<td>1</td>
<td>4.8%</td>
</tr>
<tr>
<td>Parasymphysi</td>
<td>1</td>
<td>4.8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21</td>
<td>100%</td>
</tr>
</tbody>
</table>

Diagnostic quality of radiographs
A total of 165 maxillofacial radiographs were sent to both a maxillofacial surgeon and a radiologist skilled in maxillofacial interpretation for assessment. Their findings indicated that 7% and 56% were of no or poor diagnostic value, whilst 37% were diagnostically acceptable (Figure 4). The were 39 fractures which had been diagnosed from those radiographs that had diagnostic value. Assessment of the panoramic images confirmed that 71% of the mandibular fractures were minimally displaced (Figure 5). Cohen’s Kappa inter-rater reliability test was used to assess the agreement between the two assessors. This demonstrated a Kappa (κ) value of 0.97 (0.81-0.99), an almost perfect agreement.33

DISCUSSION
Maxillofacial trauma is still a common presentation in emergency units worldwide.3 The prevalence of maxillofacial trauma in this study was 2.89 %, rather lower than the 16% which was found in a similar study conducted in Australia (16%). This difference could be attributed to variation in the socioeconomic status of the study population and their exposure to risk factors.34 In fact, the prevalence found in this study is also lower than that reported from tertiary hospitals in other parts of South Africa.13 Variation of prevalence in different geographic regions could be influenced by factors such as urbanization, socioeconomic status, cultural differences, crime rate, period of study and environmental factors.

The most common aetiological factors were interpersonal violence (55%), road traffic accidents (16%) and falls (10%). This sequence was also reported in a Bulgarian study.2 The findings are closely related to a Brazilian study which identified a high incidence of violence-related trauma in lower socioeconomic areas.16 A recent study compared two maxillofacial units in South Africa, finding interpersonal violence to be the leading cause.15 In contrast, certain studies have revealed road traffic accidents to be the leading cause of maxillofacial trauma.28,35,36 However,
in this study, only 16% of the patients had suffered road traffic accidents. Only one patient had sustained maxillofacial injuries from a gunshot, whereas in other parts of South Africa maxillofacial gunshot wounds are a common finding.37

In this study males were more frequently injured as compared with females, with a male to female ratio of 2.6:1. Other South African studies on maxillofacial trauma have shown a similar trend with males being mostly affected.3,13,15,16,37,38 Batista et al. reported a higher male to female ratio in rural areas as compared with urban areas.24 This higher prevalence in males can be correlated with a South African study which showed that alcohol consumption is a much more significant contributing factor in males as compared with females.3,30 Desai et al. found that 65% of maxillofacial trauma was associated with alcohol.18 Urban areas record much higher levels of alcohol consumption than do rural areas.29 Whilst alcohol usage predisposes females to alcohol-related harm,31 it is the leading risk factor for mortality in males, possibly related to behavioural activities which expose them to trauma.

The prevalence of maxillofacial trauma in this study was higher (52%) in patients younger than 24 years. This finding concurs with the study by Lee on the Global Trends in Maxillofacial Fractures, which showed a high prevalence of maxillofacial trauma in males aged 16 to 30 years and also agrees with the data of similar studies conducted in tertiary hospitals in South Africa.31,15,16,37

The majority of hard tissue injuries were fractures in the lower third of the face, while soft tissue injuries were mainly lacerations. This is consistent with various South African studies which have reported mandibular fractures to be the most common fractures of the face.15,37,38 However, due to the low number of maxillofacial fractures, no conclusions can be made on the site most commonly affected with fractures.

Imaging of the maxillofacial region can be challenging in trauma patients and conventional radiographs are becoming less popular as a result of the availability of computer tomography.40,41 The specialists who reviewed the radiographs agreed that most of these radiographs were inappropriate for the diagnosis of maxillofacial fractures. This suggests that either maxillofacial fractures were incidental findings or that the attending clinician had requested inappropriate radiographic projections for the diagnosis of these fractures. Since most of the mandibular fractures that were diagnosed on the panoramic radiographs were minimally displaced, almost all of these fractures could in fact be managed by closed reduction by a general dentist.

CONCLUSION

The prevalence of maxillofacial trauma at Zithulele Hospital for the study period was 2.89 (%) 239 patients) indicating a low prevalence. Interpersonal violence is still the leading cause of maxillofacial trauma around the world and more especially in rural areas of the Eastern Cape. Younger males aged 18-24 years are still common victims of trauma, with interpersonal violence being a major contributing factor. Patients in rural areas are exposed to low velocity trauma that result in injuries easily managed by a generalist.

RECOMMENDATION

This information will allow clinicians within the region to adopt specific diagnostic aids and treatment modalities and will be useful in the creation of preventative programs involving the healthcare provider, police, schools and non-government organizations and which are designed to reduce the crime rate. Most of the identified mandibular fractures were minimally displaced indicating that conservative management would be possible by closed reduction at rural hospitals. Dentists should receive more intense training on minor oral surgical procedures if they intend working in rural parts of South Africa. There are very few maxillofacial surgeons who work in the public sector in the Eastern Cape. The Department of Health needs to work closely with the tertiary education centres to create more supplemental posts, thereby enhancing the possibility of increasing the number of maxillofacial surgeons in the Province.

The maxillofacial region is a complex region requiring a multidisciplinary team approach with detailed imaging for the diagnosis of fractures. The conclusions in this study regarding the radiographs suggest that more training is required on maxillofacial imaging to improve the diagnostic quality of radiographs. Medical doctors and dentists need to be adequately trained in the choice and interpretation of maxillofacial radiographs. This can be achieved by seminars, lectures and short courses on maxillofacial trauma, which could reduce the chances of fractures being missed or misdiagnosed.

References


13. Chrcanovic BR. Factors influencing the incidence of maxillofacial fractures. Oral and Maxillofacial Surgery
Pathology of *Candida* infection in oral HIV-associated Kaposi sarcoma: a descriptive study.

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S Meer¹, A Sibda²

ABSTRACT

Aims and objectives: To determine the frequency and histomorphology of secondary *Candida* infection in oral HIV-associated Kaposi sarcoma (HIV-KS) and to describe the demographics of patients with oral HIV-KS with and without secondary *Candida* infection.

Materials and methods: Haematoxylin and eosin, and periodic acid-Schiff stains of 32 oral HIV-KS were examined histologically for intensity and morphology of *Candida* colonisation, depth of invasion, number of organisms, epithelial reactions and inflammatory response. Depth of *Candida* invasion and severity of infection were correlated with CD4 T-cell counts of HIV-positive patients.

Results: Forty-one percent of oral HIV-KS were secondarily infected with *Candida* (n=13). Intensity varied from an isolated single pseudohyphus to matted colonies. Whilst in most cases, organisms did not invade beyond the parakeratin layer, pseudohyphae extended into stratum spinosum in two cases, and a single case showed a pseudohyphus within the lamina propria. Two cases showed pseudohyphae in the pyogenic membrane. Neutrophilic permeation of epithelium, commonly associated with *Candida* infection was frequently present even in absence of *Candida* infection.

Conclusion: Oral HIV-KS is commonly secondarily infected with large numbers of *Candida* organisms. Morphological characteristics of secondary *Candida* infection in surface epithelium of HIV-KS suggest an altered pathogenetic pathway. Further studies are indicated.

INTRODUCTION

The surface epithelium in oral human immunodeficiency virus-associated Kaposi sarcoma (HIV-KS) frequently shows secondary *Candida* infection with varying degrees of tissue invasion. The pathogenesis of such opportunistic fungal infections probably differs in oral HIV-KS, other HIV-related oral disease, and infection of normal oral mucosa in HIV-positive patients. Differences in pathogenetic pathways may vary in histomorphology, frequency or intensity of infection. The aim was to determine the frequency and histomorphology of secondary *Candida* infection of surface epithelium in oral HIV-KS, and to highlight patient demographics in oral HIV-KS with and without secondary *Candida* infection of overlying epithelium.

MATERIALS AND METHODS

Thirty-two oral HIV-KS diagnosed in the Department of Oral Pathology, University of the Witwatersrand, South Africa were histologically studied. Of these, 13 were secondarily infected with *Candida*.

### Table 1: Criteria for which Oral HIV-KS were histologically examined

<table>
<thead>
<tr>
<th>Frequency and presence of secondary Candida infection</th>
<th>surface epithelium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site of infection</td>
<td>pyogenic membrane</td>
</tr>
<tr>
<td>Foci and intensity of Candida infection</td>
<td>fibrinopurulent exudate over ulcer</td>
</tr>
<tr>
<td>Depth of Candida penetration</td>
<td>epithelium only</td>
</tr>
<tr>
<td></td>
<td>epithelium and pyogenic membrane</td>
</tr>
<tr>
<td></td>
<td>epithelium and connective tissue</td>
</tr>
<tr>
<td></td>
<td>pyogenic membrane only</td>
</tr>
<tr>
<td>Presence of Candida organisms</td>
<td>mild, moderate or severe</td>
</tr>
<tr>
<td></td>
<td>number of pseudohyphae and yeasts</td>
</tr>
<tr>
<td>Presence of epithelial hyperplasia</td>
<td>superficial parakeratin only</td>
</tr>
<tr>
<td>Presence and type of inflammatory cells in lamina propria</td>
<td>parakeratin and superficial spinous layer</td>
</tr>
<tr>
<td></td>
<td>parakeratin, deep spinous layer and lamina propria</td>
</tr>
<tr>
<td></td>
<td>pyogenic membrane in ulcerated areas</td>
</tr>
<tr>
<td>Correlation of presence, intensity and depth of invasion of Candida infection with CD4 counts at time of biopsy</td>
<td>pseudohyphae only</td>
</tr>
<tr>
<td></td>
<td>pseudohyphae with yeasts</td>
</tr>
<tr>
<td></td>
<td>association with neutrophilic micro-abscesses</td>
</tr>
</tbody>
</table>

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Africa over a five-year period were analysed. Data included patient age, gender, site of lesion, HIV status and CD4 counts. Ethics clearance was granted by the Human Research Ethics Committee (Medical), University of the Witwatersrand, Johannesburg (M00/08/29; M08.03.25).

Haematoxylin and eosin (H&E) and periodic acid Schiff (PAS) stained 4µ sections of HIV-seropositive oral KS (HIV-KS) were histologically examined for the criteria listed in Table 1. This is primarily a descriptive histomorphologic study with data being of a descriptive nature without statistical comparison.

RESULTS

The 32 patients who presented with oral HIV-KS ranged in age from 20 to 63 years and were mainly in the fourth decade (M:F=1:1.7). The age of males was not statistically different from females (p>0.5). The site most affected was the palate (37.5%) followed by the tongue (31.57%) (Table 2).

Only 40.6% of oral HIV-KS showed secondary Candida infection with PAS positive pseudohyphae and yeast cells in the surface epithelium or pyogenic membrane. The remaining 59.4% showed no Candida infection. The age of patients with oral HIV-KS secondarily infected with Candida ranged from 21-63 years; with most cases in the fourth and third decades (M:F=1:1.2). The site most affected was the tongue (46.2%) followed by the palate (30.8%) (Table 2).

Of the 13 oral HIV-KS positive for Candida, pseudohyphae penetrated the parakeratin layer only (46.2%) (Figures 1a,b,c), both the pyogenic membrane and parakeratin layer simultaneously (7.7%), the superficial epithelium (7.7%) and deep stratum spinosum (15.4%) (Figures 2a,b). In 15.4% of cases, Candida pseudohyphae were noted in the necrotic slough only (Figure 1d). There was a single exceptional case of severe Candida colonisation with pseudohyphae penetrating the lamina propria and HIV-KS tissue (Figure 2c).

Secondary Candida infection ranged from severe (46.2%) to moderate (23.1%) to mild (30.8%) (Figures 1a,b,c). Mild infection showed penetration into tissues by only single, isolated Candida organisms, usually in the superficial parakeratin layer (Figure 1e). Moderately infected cases showed greater numbers of Candida pseudohyphae and yeasts. The parakeratin layer was thicker, with desquamation, and organisms mainly in the desquamated keratin and superficial parakeratin layers (Figures 1b,c).

<table>
<thead>
<tr>
<th>Age and Gender</th>
<th>HIV-KS n=32</th>
<th>HIV-KS 2º Candida + n=13</th>
<th>HIV-KS 2º Candida – n=19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Mean</td>
<td>45.5</td>
<td>41.5</td>
<td>45.5</td>
</tr>
<tr>
<td>Mean (total)</td>
<td></td>
<td></td>
<td>41.5</td>
</tr>
<tr>
<td>Median (total)</td>
<td></td>
<td></td>
<td>41.5</td>
</tr>
<tr>
<td>Total</td>
<td>12 (37.5%)</td>
<td>20 (62.5%)</td>
<td>6 (46.15%)</td>
</tr>
<tr>
<td>M:F ratio</td>
<td>1:1.7</td>
<td>1:1.2</td>
<td>1:1.2</td>
</tr>
</tbody>
</table>

Table 2: Comparative clinico-pathologic demographic data in HIV-seropositive group regardless of secondary Candida infection, and specifically in oral HIV-KS with Candida and oral HIV-KS without Candida

Inflammation: intensity

<table>
<thead>
<tr>
<th>Inflammation: intensity</th>
<th>HIV-KS n=32</th>
<th>HIV-KS 2º Candida + n=13</th>
<th>HIV-KS 2º Candida – n=19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Acute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>11</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Moderate</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Chronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>9</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acute and chronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>11</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No inflammation</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inflammation: intensity</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>22.9</td>
<td>12.5</td>
</tr>
<tr>
<td>Chronic</td>
<td>18.8</td>
<td>0</td>
</tr>
<tr>
<td>Acute and chronic</td>
<td>22.9</td>
<td>4.2</td>
</tr>
<tr>
<td>No inflammation</td>
<td>16.7</td>
<td>0</td>
</tr>
</tbody>
</table>
Severe infection showed matted colonies of Candida pseudohyphae and yeasts in both the desquamated keratin and parakeratin layers (Figure 1c), sometimes reaching the stratum spinosum (Figures 2a,b). The yeasts always remained on the surface.

Neutrophilic micro-abscesses in superficial parakeratin were present in 53.8% of cases, however no Candida organisms were seen in close association to the micro-abscesses in 46.2% of cases. Surprisingly, Candida pseudohyphae were present without micro-abscesses in 53.8% of cases (Figures 2d,e,f).

Inflammation beneath Candida infected areas in the lamina propria ranged from severe (7.7%) to moderate (23.1%) to mild (53.8%), with areas having no inflammation (15.4%) (Figure 2). Epithelial hyperplasia (Figure 1a) was noted in 61.5% of infected cases, usually with severe infection. Candida positive cases were characterised by hyperparakeratosis and hyperplasia of surface epithelium compared to non-infected cases. Pseudoepitheliomatous hyperplasia was present in 7.7% of cases with severe infection.

An inverse relationship was noted between the CD4 count in the 13 oral HIV-KS secondarily infected with Candida and the presence, intensity and depth of penetration of Candida infection (Table 3). Cases with low CD4 counts showed deeper penetration of Candida pseudohyphae (Table 3). The 19 oral HIV-KS with no Candida growth showed equally low CD4 counts as the 13 oral HIV-KS secondarily infected with Candida; 9 cases had CD4 counts of < 100 cells/mm³.

**DISCUSSION**

HIV/AIDS has reached epidemic proportions in South Africa, with a dramatic increase in KS frequency. In 21% of HIV-positive people with KS, the initial presentation is in the mouth, while in 71.5% the mouth is affected at some time during the course of the disease. The number of oral KS cases in the Department of Oral Pathology increased from 84 cases over a 29-year period (1973-2002) to 133 new cases during the five-year study period (2003-2007). There has however been a 70-80% reduction in the risk of developing KS in South Africa, where up to 48% of HIV-infected adults are positive for HHV8.

This study showed a secondary Candida infection rate of oral HIV-KS of only 40.6%. Many histopathologists anecdotally believe that the secondary Candida infection rate of HIV-KS is much higher. There are no comparable studies of infection rate or histomorphology of Candida secondary infection of oral HIV-KS to which the results of this study can be compared.

When considering reasons for the relatively low infection rate, it must be realised that the surface epithelium covering oral KS or oral HIV-KS may be unique and not comparable with other HIV-related lesions or even with normal epithelium in an HIV-positive patient. Oral HIV-KS may well influence the surface epithelium by induction from cytokines, prostaglandins and genetic influences, all of which influence the oral epithelial response to C. albicans penetration. Oral HIV-KS cells may create a unique micro-milieu not reproducible in other situations.
One cannot infer that mechanisms by which secondary *Candida* infection of oral HIV-KS occur are the same as those of primary *Candida* penetration in HIV-positive and HIV-negative patients or in other situations of oral *Candida* infection, and more importantly in other mucosal sites. For example, whilst oropharyngeal candidiasis occurs commonly in HIV-positive women *Candida* infection is rarely seen in vaginal mucosa of the same cohort.

Oral *Candida* infection rates in HIV-positive patients vary from 26.3% (India) and 38% (Tanzania) to 94% (Zaire), and range from 37.8% to 63% in South Africa. Our findings of predominantly in males, greater female involvement in South Africa, though KS was regarded as occurring in all ages; mainly in the third and fourth decades of life. Our study reported a predominance in third and fourth decades with no difference in age between HIV-KS patients secondarily infected with *Candida* and those who were not. Oral KS most frequently affects the palate, gingiva and dorsum of tongue. Our study demonstrated a similar predilection of oral HIV-KS for the palate followed by the tongue in HIV-positive patients regardless of secondary Candida infection.

Oral HIV-KS may develop at any stage of HIV infection and especially when CD4 T-cell counts fall below 200 cells/mm³. Our study confirmed that most oral HIV-KS occurred at CD4 counts <100 cells/mm³. There was no difference in CD4 counts between lesions infected and those not secondarily infected with *C. albicans*. This implies that CD4 cells are not a determining factor in the pathogenesis of secondary candidiasis in oral HIV-KS. This remains to be confirmed with a larger study sample. A similar study showed 75% of 130 HIV-KS had CD4 counts of <200 cells/mm³ confirming that low CD4 counts are not a prerequisite for HIV-KS development.

Table 3: Histological features of tissue biopsy specimens at time of serological analysis

<table>
<thead>
<tr>
<th>CD4 T cell count (cells/mm³)</th>
<th>Histological Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>599 – 500</td>
<td>- Candida pseudohyphae and yeast cells in epithelium in all cases</td>
</tr>
<tr>
<td></td>
<td>- multiple loci of infection</td>
</tr>
<tr>
<td></td>
<td>- mild acute and/or chronic infection in all cases</td>
</tr>
<tr>
<td></td>
<td>- mild epithelial hyperplasia</td>
</tr>
<tr>
<td>499 – 400</td>
<td>No correlating data available for this subset</td>
</tr>
<tr>
<td>399 – 300</td>
<td>No correlating data available for this subset</td>
</tr>
<tr>
<td>299 – 200</td>
<td>- Candida pseudohyphae and yeast cells in epithelium in all cases</td>
</tr>
<tr>
<td></td>
<td>- multiple loci of infection</td>
</tr>
<tr>
<td></td>
<td>- mild acute and/or chronic infection in all cases</td>
</tr>
<tr>
<td></td>
<td>- a single case each of moderate and severe infection</td>
</tr>
<tr>
<td></td>
<td>- moderate epithelial hyperplasia</td>
</tr>
<tr>
<td>199 – 100</td>
<td>No correlating data available for this subset</td>
</tr>
<tr>
<td>99 – 0</td>
<td>- Candida pseudohyphae and yeast cells in epithelium in all cases</td>
</tr>
<tr>
<td></td>
<td>- 2 cases with Candida invasion into spinous epithelial layer</td>
</tr>
<tr>
<td></td>
<td>- multiple loci of infection</td>
</tr>
<tr>
<td></td>
<td>- mild acute and/or chronic infection in all cases</td>
</tr>
<tr>
<td></td>
<td>- a single case of severe infection</td>
</tr>
<tr>
<td></td>
<td>- moderate epithelial hyperplasia</td>
</tr>
</tbody>
</table>

This study is the first to establish the frequency of secondary Candida infection in oral HIV-KS and to describe the histomorphology. *Candida* pseudohyphae were present in epithelium overlying oral HIV-KS. Severity of *Candida* infection varied from single isolated pseudohyphae to matted colonies of fungal organisms. Morphology of less severe *Candida* infections closely mimicked that of immune competent hosts whereas severe *Candida* infections in oral HIV-KS showed more numerous and deeper penetration of *Candida* organisms than that in immune competent hosts.

Our study confirmed that *Candida* infection regardless of severity, rarely reaches the lamina propria by penetration through epithelium. In the single case where the organism penetrated connective tissue and KS tissue, it entered through the necrotic ulcerated surface, and not through intact epithelium. The reasons for this are unclear but perhaps the more anaerobic conditions found deep in the epithelium limit the depth of infiltration by organisms.

Further, *Candida* is epitheliotrophic and depends on attachment and penetrative biological processes to infect host tissue. It is uncertain whether these characteristics are inherent in either or both the organism and the host epithelium. Invasion of pyogenic membrane shows that epithelial factors are not absolutely essential for organism growth but that under exceptional circumstances organisms are capable of living in the fibrinopurulent exudate.

**CONCLUSION**

Only less than half of the cases of oral HIV-KS were secondarily infected with *Candida*. This may be due to the fact that many oral HIV-KS are covered by a pyogenic membrane. Furthermore, *Candida* is strongly epitheliotrophic and Candida infection in the fibrinopurulent
exudate overlying oral HIV-KS is unusual. The relatively low frequency of secondary Candida infection of oral HIV-KS, its deep tissue penetration, and its presence in the absence of inflammation requires further investigation.

Acknowledgements
The authors thank Ms Amina Kaskar for her excellent technical assistance.

References
Detecting chronic apical periodontitis for improved endodontic success

SUMMARY
Endodontic treatments are frequently carried out in daily clinical practice. The presence or absence of a periapical radiolucency, assessed using intraoral radiographs, is one of the criteria used to determine endodontic success. When such a lesion is present around the apex of a tooth, the condition is known as chronic apical periodontitis. While this is common around root treated teeth, it can also be associated with otherwise healthy teeth. In both instances, it represents an inflammatory response to bacteria or irritants in the periapical space, and results in bone loss and areas of reduced density, which can then form apical granulomas or cysts. The literature has shown that periapical lesions can go undetected, due to the two-dimensional limitations of periapical radiographs. These “hidden” lesions can compromise the longevity of the tooth. Considering that apical periodontitis can be far more accurately detected and diagnosed on cone beam computed tomography, it has been recommended by several authors that endodontic treatment outcomes ideally should be evaluated using this imaging modality, whenever possible.

INTRODUCTION
Endodontic success has largely been based on three basic principles known as the “endodontic triad of success” which includes: cleaning (debridement and disinfection), shaping, and obturation (sealing). It is believed that if all of these are carried out meticulously, then the treatment will be effective. However, many clinicians can attest to the fact that endodontic failures occur despite their strict adherence to these principles. Instrumentation and antibacterial irrigation with sodium hypochlorite will render around only 50% of canals to be microbial-free. Any remaining canals will contain small numbers of recoverable bacteria, and these are eliminated only if antimicrobial dressings are applied to the canals before obturation. Possible causes of these failures could be related to the anatomical complexity of root canal systems, creating areas that cannot be cleaned and obturated adequately, missed canals, and even the composition of any residential bacterial in canal systems. Studies have also shown that the microorganism Enterococcus faecalis is resistant to intracanal medicaments and is then a possible cause of endodontic failure. Some failures become more perplexing when seen alongside other cases that have succeeded despite comparatively substandard treatment. Believing that these opposing scenarios can occur simultaneously is referred to as cognitive dissonance and poses a dilemma for the clinician. One possible explanation could be that many clinicians do not pay enough attention to the evaluation of periapical regions surrounding endodontically treated teeth (ETT).

APICAL PERIODONTITIS
Patient-reported symptoms following endodontic therapy are very subjective and variable. Clinicians often judge success by assessing the status of the periapical tissues surrounding the tooth in question, using periapical radiographs (PR) to detect the presence (or absence) of radiolucencies in this region. When a radiolucency is present, the tooth is diagnosed as having apical periodontitis, which is an inflammatory response to bacterial infection and irritants within the root canal system, and may be referred to as chronic apical periodontitis (CAP) for the response develops over a long time. Considering that these lesions are often associated with ETT, they are generally used as a criterion in the

ACRONYMS
CAP: chronic apical periodontitis
CBCT: cone beam computed tomography
CT: computed tomography
ETT: endodontically treated teeth
FOV: field of view
PAI: periapical index
PDL: periodontal ligament
PR: periapical radiographs

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assessment of endodontic success or failure. Rarely, such lesions may also occur in teeth that have not been endodontically treated, such as those subjected to occlusal trauma, and teeth presenting with periapical cemento-osseous dysplasia or benign cysts.

CAP involves a host inflammatory response that develops over time, resulting in structural bone changes (bone resorption) and granulation tissue formation, which are characteristic of chronic inflammation. The quality of the endodontic treatment affects the extent of the lesion. While it is agreed that the technical quality of root obturation has a significant impact on the presence or absence of CAP, endodontic success can be achieved only if canal disinfection and coronal sealing have also been adequately performed. This is because the latter procedures directly influence the introduction of bacteria into the periapical region, or the persistence of bacteria arising from the treated canals. There are five biological factors which may cause a chronic periapical radiolucency following endodontic therapy. These include: intra-radicular infection in the apical root canal system; extra-radicular infection due to actinomycosis; cystic lesions; foreign body reactions (endogenous and exogenous), and scar-tissue healing of the lesion. However, persistent microbial infection in the apical portion of completed endodontic therapies remains the major cause of CAP. Accepting that final confirmation of the diagnosis of CAP can be made only with a histopathological examination, several researchers have conducted studies in the endeavour to correlate the radiographic appearance of CAP with associated histological findings. Histologically, these tissues all contain a variable chronic inflammatory cell infiltrate composed of macrophages, lymphocytes, and plasma cells, surrounded by a fibrous capsule. Depending on their contents, these lesions are referred to either as periapical granulomas or radicular cysts. Making this distinction is important, as it impacts on the type of treatment (surgical or non-surgical) required for resolution of the lesion.

RADIOGRAPHIC FINDINGS
Radiographically, CAP is diagnosed when there is a radiolucency in the apical part of a root which is at least twice the width of the normal periodontal ligament (PDL) space. To aid in diagnosing these lesions, an index known as the periapical index (PAI), was developed over 30 years ago, which quantified the extent of these lesions. This index has been used in several epidemiological studies, and was previously accepted as the gold standard for assessing treatment outcome following endodontic therapy. PAI quantified periapical inflammation via a scoring system (Table 1), from 1-5, ranging from no disease (healthy periapical region) to severe periodontitis. However, this index was based on a single study of correlations between radiographic appearance and histologic findings, using only anterior maxillary teeth. This raised concerns regarding its validity in assessing the periapical health for all teeth wherever positioned in the mouth. These misgivings are due to the fact that conventional PR are not very sensitive or specific, and though the radiograph may be useful in the detection of disease to varying degrees when radiolucencies are present, the lack of such features is not always indicative of periapical health. Another major limitation is that PR are two-dimensional (2D) representations of three-dimensional (3D) structures, and are thus prone to distortion, as a result of which several clinical features may not be visible. For example, bony lesions present within the cancellous bone may be obscured by an overlying thicker cortex, and go undetected. This lack of sensitivity is compounded by the fact that 30-50% of bone mineral loss is required before radiolucencies become apparent radiographically. Radiographic interpretation is also sensitive to small changes in the angulation of the x-ray tube-head which can severely affect the size of the images. The surrounding bone density also plays a role, and lesions are more easily detected in areas of reduced bone density (anterior maxilla), when compared with denser areas (posterior mandible). Relying on conventional radiographs in assessing the periapical status of teeth may be problematic, as the probability of inaccurate diagnoses is high.

CONE BEAM COMPUTED TOMOGRAPHY
Cone beam computed tomography (CBCT) is a 3D imaging system which was specifically developed for the maxillo-facial region. CBCT scans allow for multi-planar assessment of oral structures, that is in the transverse (axial), frontal (coronal), and cross-sectional (sagittal) planes, at significantly lower radiation doses than those delivered by medical computed tomography (CT). A cone-shaped beam of radiation captures the entire 3D volume of the required area of investigation, known as the field of view (FOV), in a single rotation of the CBCT scanner. As the entire volume is captured at the same time, a 3D assessment of the area of interest can be performed at a sub-millimeter spatial resolution. This technology is becoming ever more prevalent in Dentistry, with several recognized endodontic applications already in use. These include: the assessment of root canal anatomy (e.g. accessory canals such as MB2), root fractures, root resorption, periapical pathology, and pre-operative planning of apical surgery (apicectomy).

Numerous studies have found that CBCT is considerably more accurate in assessing the periapical regions surrounding teeth than are conventional periapical radiographs. Results showed that as many as 30-40% of CAP lesions diagnosed on CBCT, were not visible on PR. CBCT has also been shown to be a reliable method of distinguishing between solid (granulomas), and fluid-filled (cystic) lesions, as determined by differences in grayscale values which can be used to measure density. This distinction was previously possible only on histological examination. Thus CBCT offers a more rapid and non-invasive means of diagnosis.

CBCT has also been shown to be more accurate in determining periapical health following endodontic treatment. Teeth showing reduced periapical radiolucencies on PR were often diagnosed as resolving, yet have been found to have

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<tr>
<td>1</td>
<td>Normal periodontium apically</td>
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<tr>
<td>2</td>
<td>Small changes in bone structure (apical periodontitis)</td>
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<tr>
<td>3</td>
<td>Structural bone changes with some mineral loss</td>
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<tr>
<td>4</td>
<td>Periodontitis with a well-defined radiolucency</td>
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<tr>
<td>5</td>
<td>Radiolucency with radiating bone expansion</td>
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enlarged lesions on CBCT. This occurs if there has been an expansion of a lesion confined to the cancellous bone, whereby its volumetric expansion can only be detected on 3D imaging, such as CBCT.\textsuperscript{6} Thus, what appears to be endodontic success and healing on PR, may be in fact, failure, as evidenced by CBCT. While the advantage of limiting the FOV to 3-4 individual teeth significantly reduces radiation doses, they are still considerably higher than those of conventional radiographs.\textsuperscript{6} In addition, high costs, limited availability of CBCT, and increased radiation dosage may preclude its routine use.

Complete radiographic resolution of CAP seldom occurs, but this factor alone should not define endodontic success or failure. Correlation between radiographic findings and clinical symptoms should always be made and if previous radiolucent areas become arrested, with no associated pain, loss of function, or surrounding tissue destruction, then the treatment can be regarded as being successful. However, radiographic evidence of an expanding lesion, causing bone resorption, should be considered as failure even in the absence of clinical symptoms, and should be further evaluated on CBCT imaging. Indeed, there may be cause to further investigate previously reported systematic reviews of endodontic success rates, whose findings were based on PR alone.

As the number of CBCT scans being taken on patients is increasing, so too are more endodontic failures being noticed, many of which are a result of undiagnosed CAP. If one considers that most post-endodontic complications usually occur within the first six months to two years after completion of treatment, patients should routinely be recalled during this time to assess the periapical status of root treated teeth. If failures are suspected or detected, then decisive interventions can be undertaken at an early stage rather than waiting longer periods. Prolonged waiting times, in the hope that a “questionable” tooth will eventually heal itself, should be avoided as this allows long-standing infections to cause significant amounts of bone loss/resorption (Figure 1).\textsuperscript{7,15,18}

around a tooth, inadequate endodontic therapy leading to persistent intra-radicular microbial infection is by far the most common cause. Failure to detect and to intervene timeously to remediate endodontic failures may radically compromise the survival of teeth and limit future treatment options due to the associated bone destruction and loss.

References

Figure 1: 3D volumetric reconstruction of a CBCT scan taken on a patient referred for apical surgery (root-end resection) on tooth 22. Note the extensive bone destruction that has taken place because of failed endodontics.

CONCLUSION
CAP is commonly found associated with endodontically treated teeth. Inadequate obturation significantly increases the risk of CAP. This often goes undetected on PR, but is seen with increasing frequency on CBCT scans. Though other factors may contribute to the development of CAP...
ABSTRACT

Introduction: There are various etiological and predisposing factors for dentine hypersensitivity (DH). Management of the problem requires modification of these factors for successful and long-lasting resolution. There will be value in identifying these factors.

Aim: To identify the predisposing and etiological factors for DH in a population of patients at a teaching hospital.

Design: A cross sectional descriptive study involving adult patients diagnosed with DH.

Materials and methods: Patients that presented with symptoms suggestive of DH over a period of twelve months were screened to confirm the diagnosis. Presence and frequency of predisposing factors as well as clinical findings of tooth wear lesions, gingival recession and fluorosis were documented on a questionnaire.

Results: The frequency of hypersensitive teeth (mean $11.5 \pm 3.8$) was significantly ($p<0.05$) higher for hard compared with soft bristled toothbrush users. The majority of the subjects consumed orange (80.9%) and carbonated drinks (83.3%) frequently, but without significant effect on the mean number of hypersensitive teeth. Gingival recession was observed in 37.4% of the hypersensitive teeth, while abrasion was seen in 2.4%.

Conclusion: The use of a hard bristled toothbrush is a risk factor while attrition and gingival recession are the predominant etiological factors for DH in this environment.

INTRODUCTION

Dentine hypersensitivity (DH), is a common dental complaint among young adults. It has been defined as “a chronic condition characterized by a short, sharp pain arising from exposed dentine in response to stimuli, typically thermal, evaporative (air), tactile, osmotic or chemical, and which cannot be ascribed to any other form of dental defect or pathology”. The first part of the definition points out the cause of the clinical symptoms experienced. As with all conditions or diseases, management strategies which include prevention are usually more successful than treatment alone. Understanding the etiology of a disease condition forms the basis for the preventive measures which may be instituted as part of treatment. The aim in the preventive management of DH is to reduce the risk of exposing the dentine, either as a result of the removal of enamel, or of cementum following gingival recession. Equally, the objective is to prolong the efficacy of prescribed treatment. Ciaramicoli demonstrated the importance of prevention in a study that showed that the effects of laser treatment of DH increased when etiological factors were removed.

Enamel loss may result from several factors, while gingival recession is most often attributed to either overzealous tooth brushing in a healthy mouth or periodontal disease and or periodontal treatment. Enamel loss with subsequent dentine exposure occurs with tooth wear processes like attrition, abrasion, erosion and abfraction. Attrition is associated with occlusal function resulting in wear of teeth at sites of direct contact between teeth. Abrasion as a cause of tooth wear describes tooth tissue loss caused by objects other than another tooth, such as is seen with toothbrush/toothpaste abrasion. Enamel erosion involves dissolution by acids which are not of bacterial origin. Sources of the acid may be dietary, environmental or intrinsic from regurgitation. Abfraction or cervical stress lesions has been hypothesized as an etiological factor in tooth wear, and can lead to...
hypersensitivity. These lesions occur most commonly in the cervical region of teeth, where flexure from eccentric loading may lead to breaking away of the extremely thin layer of enamel rods, as well as microfracture of the cementum and dentine.

In addition to these factors, dental fluorosis has been implicated in the etiology of the condition. Tong et al. reported a positive association between dental fluorosis and DH. High concentrations of fluoride are known to reduce the mineralization of the teeth, with resultant fluorosis and sensitivity to external stimuli. This is supported by Vieria’s study which showed that a higher dentine fluoride level results in wider dentinal tubules.

Any situation which predisposes to enamel loss or gingival recession will contribute toward the development of DH. The type of toothbrush, frequency of toothbrushing and the diet are some of the factors that have been implicated in the occurrence of gingival recession, tooth wear lesions and DH. The majority of studies have identified erosion and abrasion as the main types of tooth wear lesions associated with DH. These studies may however reflect findings peculiar to the population studied. There is limited direct clinical evidence in the literature of the association of these etiological and predisposing factors to DH in the local environment. Identifying the etiological and predisposing factors among patients with DH seen in the study population will clarify understanding of the condition and will contribute to successful control and prevention of the hypersensitivity.

MATERIALS AND METHODS

The study included all adult patients with complaints of sensitive teeth and diagnosed to have DH at the Oral Diagnosis and Restorative clinics of the Hospital over a one year period. Approval for the study was obtained from the Research and Ethics Committee of the Hospital. All the patients received a detailed explanation about the study and their written consent was obtained before they were included in the study. The diagnosis of DH was based on the history and a clinical examination relying on both tactile and thermal/evaporative stimuli by scratching the tooth surface with a dental explorer followed by a blast of air from the air-water syringe of the dental unit. Patients having teeth with suspected pulpitis, extensive caries, cracked enamel, defective or extensive restorations, and teeth with restorations extending into the test area were not included. Patients who had undergone periodontal surgery, orthodontic appliance treatment and tooth-whitening procedures within the previous three months were also excluded.

A questionnaire was used to collect data from all the subjects included in the study. The information included name, age, sex, occupation, nature of the pain, initiating stimulus, mode of cleaning the teeth and frequency, and intake of acidic drinks. All teeth diagnosed as hypersensitive were examined for the presence of wear facets, the type of non-carious cervical lesions and gingival recession.

Gingival recession was diagnosed when there was apical migration of the gingival attachment with any amount of root exposure. Wear facets on the cusps of the posterior teeth or on the incisal edges of the anterior teeth with flattening of the cusp tips or the incisal edges were recorded as attrition. The abrasive lesions were diagnosed as the presence of a horizontal groove running mesiodistally across the surface of the natural crown at the cemento-enamel junction (CEJ). Abfraction lesions were diagnosed as sharp, angular wedge-shaped lesions, located supragingivally or subgingivally around the CEJ with or without marked wear facets on the occlusal surface of the involved posterior teeth. Fluorosis was diagnosed in the presence of loss of translucency, and or discoloration with or without enamel pitting using the Dean’s index (DI). The data were analyzed using Statistical Package for Social Sciences (SPSS) for Macintosh (version 21 SPSS Inc., Chicago, IL, USA). Level of statistical significance was set at p<0.05.

RESULTS

A total of 68 adult subjects were diagnosed with DH comprising 36 (52.9%) males and 32 (47.1%) females with ages ranging from 20 to 53 years and a mean age of 33.8±9.2 years. The 68 study subjects had 508 teeth diagnosed as hypersensitive.

Analysis of the predisposing factors.

The majority of the subjects used toothbrush with paste (77.9%) and had a lower mean number of hypersensitive teeth compared with those who used both toothbrush and chewing stick. None of the subjects used chewing stick alone. The use of a hard bristled toothbrush was significantly associated with a higher mean number of hypersensitive teeth (p= 0.001) (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Distribution of hypersensitive teeth and comparison of mean hypersensitive teeth by type of toothbrush, mode and frequency of cleansing</th>
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<tr>
<td><strong>Mode of cleaning teeth</strong></td>
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<td>Toothbrush and paste</td>
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<td>Toothbrush and chewing stick</td>
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<td><strong>Type of toothbrush</strong></td>
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Post hoc tests showed a significantly higher mean number of hypersensitive teeth for subjects using a hard toothbrush when compared with those who use medium or soft toothbrush (df =3, F= 5.894, p= 0.005).

Intake of acidic drinks/drugs
About 83.8% of subjects with DH took carbonated drinks, 80% of subjects consumed orange drinks, while slightly less than half of the subjects consumed chewable vitamin C often or occasionally. However, there was no statistically significant association between the mean number of hypersensitive teeth by frequency of intake of chewable vitamin C, carbonated drinks and orange drinks (p >0.05) (Table 2).

Etiological factors of DH among hypersensitive teeth
Of the 508 diagnosed hypersensitive teeth, gingival recession was the lesion most commonly associated with DH (190, 37.4%) while abfractive lesion was the least frequent (Figure 1). The hypersensitive teeth occurred more often on the upper and lower left quadrants and accounted for 151 (29.7%), and 139 (27.4%) of the 508 total hypersensitive teeth (Figure 2). Figure 3 illustrates the distribution of the hypersensitive teeth and the associated tooth wear lesions and dental fluorosis among the quadrants.

DISCUSSION
Evidence suggests that the preventive aspects of the management of DH are not usually considered by many clinicians when treating the condition. Indeed, the treatments available for DH have limited efficacy over time, requiring repeated applications. Addy thus proposed that the clinician should identify and modify the etiological and predisposing factors of DH as part of the management of a patient with the condition.

This study set out to identify the predisposing and etiologic factors for DH that should be modified in people suffering from the condition. In the subjects studied, those who used both toothbrush with paste and chewing stick had a higher mean number of hypersensitive teeth than subjects who used only toothbrush and paste although the difference was not significant. The higher mean number of hypersensitive teeth in the former group may be due to the additional use of chewing stick, which has been documented as causing gingival recession and tooth wear. Omani patients were reported to have significantly more sites with gingival recession among chewing stick users when compared with toothbrush users. However, the effect of chewing stick alone on DH could not be ascertained in the present

| Table 2: Distribution of hypersensitive teeth by type of drinks and Vitamin C intake |
|---------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                                | Subjects N = 68 | %   | Hypersensitive Teeth (n) | Mean ±S.D | t     | p     |
| Orange drinks                  |                |    |                          |           |       |       |
| Don’t drink                    | 2              | 2.9 | 16                        | 8.0±2.8   | 0.382 | 0.76  |
| Rarely drink                   | 11             | 16.2| 69                        | 6.6±3.0   |       |       |
| Occasionally drink             | 30             | 44.1| 225                       | 7.8±3.6   |       |       |
| Often drink                    | 25             | 36.8| 198                       | 8.1±4.5   |       |       |
| Chewable Vit C                 |                |    |                          |           |       |       |
| Don’t take                     | 4              | 5.9 | 30                        | 7.5±3.3   | 3.094 | 0.083 |
| Rarely take                    | 33             | 48.5| 227                       | 6.9±3.2   |       |       |
| Occasionally take              | 24             | 35.3| 208                       | 8.7±4.5   |       |       |
| Often take                     | 7              | 10.3| 43                        | 8.9±4.2   |       |       |
| Carbonated drink               |                |    |                          |           |       |       |
| Don’t drink                    | 3              | 4.4 | 30                        | 7.0±3.5   | 1.467 | 0.232 |
| Rarely drink                   | 8              | 11.8| 121                       | 9.3±4.9   |       |       |
| Occasionally drink             | 20             | 29.4| 207                       | 8.7±4.0   |       |       |
| Often drink                    | 37             | 54.4| 150                       | 6.9±3.4   |       |       |

Figure 1: Frequencies of the hypersensitive teeth and associated etiological factors

Figure 2: Distribution of the hypersensitive teeth among the quadrants
Bamise et al.6,22 also supported the prevalence of DH among the subjects in his study who had DH used hard-bristled toothbrushes. Colak21 reported that more than half of the subjects in his study who had DH used hard-bristled toothbrushes. Bamise et al.6,22 also supported these findings in two separate studies, where there were significant correlations between tooth wear, DH and the use of hard bristled toothbrush.

A direct relationship was observed between the mean number of hypersensitive teeth and the frequency of tooth brushing, though this was not statistically significant. This result should be interpreted with caution as there was only one subject who brushed three times a day and had the highest mean score for hypersensitive teeth. Also, two subjects brushed more than three times a day, but, surprisingly, had the lowest mean number of hypersensitive teeth. The literature supports the notion that there is an association between the frequency of toothbrushing, gingival recession and occurrence of DH.23,24

Higher percentages of subjects in this study consumed carbonated drinks and orange juice as opposed to those who chewed the flavoured vitamin C. This is similar to the findings of Bamise et al.15 who reported a strong association between DH and the consumption of citrus drinks and carbonated drinks, but not with vitamin C. This implies that erosion may have contributed to the prevalence of DH among the subjects in this present study. Most people consume vitamin C rarely, except those on medications by prescription. However, most of those who take vitamin C also consume orange juice and carbonated drinks. Orange juice and carbonated drinks are commonly consumed on daily basis in Nigeria and the demand for these drinks has grown rapidly over the past decade.25,26 It may be expected to contribute to the development of DH. The drinks could either be primary etiological factors, causing dental erosion, or exert a secondary effect, by removing the smear layer from already exposed dentinal tubules.

There was however no significant difference in the mean number of hypersensitive teeth when those who drink orange juice, carbonated drinks and take chewable vitamin C often were compared with those who do not consume these items at all. This may signify the presence of other important etiological or predisposing factors in these subjects. It is also important to note that the contribution of the acidic drinks to the formation of erosive lesions may be influenced by behavioral characteristics of the consumers. These include the manner of intake (with or without straws), and the duration of contact with the teeth.27,28

Gingival recession was the most common etiological factor associated with DH among the subjects, followed by attrition, abrasion, fluorosis, erosion and abfraction in that order. Overall, 190 of the 508 hypersensitive teeth (37.4%) had some associated buccal gingival recession. Gingival recession exposes the CEJ as well as the cementum, predisposing the tissue to toothbrush abrasion. Hypersensitivity at sites with gingival recession in the absence of abrasion may partly be explained by the presence of exposed dentine at the CEJ due to anatomical variations. Addy et al.29 and Rees and Addy30 also report that most teeth in their sample of hypersensitive teeth had some degree of gingival recession. These findings are in contrast to reports by Bamise et al.15 and Özcan and Çanaci6 who reported attrition as the most common etiological factor for DH in their studies. This probably reflects differences among populations studied by different researchers. In the study by Bamise et al.15 the consumption of coarse diets by patients was suggested as the reason for the attrition. The present study is in consonance with those of Bamise et al.15 and Özcan and Çanaci6 that attrition was the most common tooth wear lesion associated with DH. Although not evidenced in this study, the reason for the association may be due to the consumption of coarse diet in this population.

Presently, DH studies on populations that are endemic for dental fluorosis are rare. Zhang et al.31 in a Chinese study, associated DH to dental fluorosis in a rural community with dental fluorosis. Tonguc et al.11 compared two different populations and observed a significantly higher prevalence of DH in the population endemic for dental fluorosis. Dental fluorosis is prevalent in the present study area because of high fluoride content in the drinking water, as high as 4.6mg/l.31,32 Fluorosis may present with pitting of the enamel, which may result in dentine exposure. This study revealed the presence of DH in teeth with dental fluorosis accounting for 9.7% of the total number of teeth with DH. Unlike the study by Tonguc et al.11 this study did not compare the prevalence of DH among those with signs of fluorosis and those without.

![Figure 3: Distribution of the etiological factors for DH among the quadrants.](image-url)
DH resulting from abfraction is the factor recording the least influence in this study. Bamise et al.,15 and Özcan and Canaci6 also observed abfraction as the least etiological factor associated with DH in their groups of subjects. It was however suggested that the low result with abfraction may be due to difficulty in diagnosing such lesions.6 Strong attention was paid in the current study to the diagnosis of these abfraction lesions, and yet it remained the least influential cause of DH. More controlled studies on abfraction and DH are indicated.

CONCLUSION

The majority of the subjects consumed acidic drinks but this was not shown to be a major contributory factor for DH. The use of hard bristled toothbrush is a risk factor for DH, especially when combined with the use of chewing stick. Gingival recession and attrition are the most common etiological factors. Although not one of the major etiological factors, dental fluorosis was identified as contributing to the occurrence of DH in the subjects studied. The findings from this study may be used to recommend individualization of preventive treatment for every patient as elicited from the history and examination to prevent further exposure of dentine, as well as to improve the efficacy and longevity of the treatment. In the samples studied, preventive emphasis will be on the type of toothbrush, and the use of chewing stick. Further studies to look at the association between the intakes of coarse diet, attrition and DH should be considered.

References

Below are images of a condition caused by a deficiency of organic bone matrix; however, there is normal mineralization of the remaining bone. This condition is a common disorder affecting post-menopausal middle-aged women. What are the important radiological findings and diagnosis?

INTERPRETATION

A figure 1 and 2 are pantomographs of two elderly women shows thinning of the cortex at the inferior border at the angle of the mandible. There are cortical laminations with endosteal detachment. The alveolar bone is denser (darker) than normal, although the teeth are exposed correctly; trabeculae are fewer in number, coarser and showing reduced density. Figure 3 of another patient shows a classic appearance of the same condition in the vertebral column; loss of horizontal trabeculae; thicker, more prominent vertical trabeculae; and more radiolucent vertebral body (red arrow). The posterior vertebral plate is coarser, with irregular endosteal surface. There is a wedge-shaped deformity of the disk, as can be seen by the V-shape of the intervertebral space (green arrow). In several places there is complete loss of the intervertebral space. A diagnosis of osteoporosis was made in all these cases. Figure 4 demonstrates changes from normal bone (a) to severe osteoporosis (b). Primary osteoporosis refers to a condition that is not associated with any of the diseases known to cause an osteoporotic state. No known causal condition has been established. According to Garn (1970), normal bone mass increases as a person progresses from infancy to 30 to 40 years of age and then decreases continuously at a rate of 8% per decade in women and 3% in men. This bone loss is particularly evident in the cortex and continuous until a person dies. Fifty percent of men exhibit cortical bone erosion by age 80; among women, 50% show cortical bone loss by the age of 70 and 100% by age 90. Trabecular bone is affected earlier than cortical bone, and the vertebral column is the prime site of advanced cases. In women osteoporosis results from increased resorption that is associated with menopause. During menopause, there is diminished production of oestrogens, which tend to protect the skeleton against the resorbing action of parathyroid hormone. In men primary osteoporosis may develop from diminished androgen production. It has been shown in aging men that parathyroid levels increase, yet urinary excretion of calcium decreased with age. It is presumed that there is an increased tubular resorption of ionic calcium resulting from mild secondary hyperparathyroidism. This calcium-saving mechanism is missing in women. Regardless of the cause, osteoporosis results in an increase of fractures in the axial skeleton and possibly tooth loss and alveolar ridge resorption in the jaws.

References

CASE PRESENTATION

The cases presented highlight the typical experiences of patients who have lost their teeth, and are enduring the consequences of toothlessness and immense negative impact on the quality of life. Many patients attending public dental services endure a variety of complications resulting from multiple extractions leading to toothlessness.

Case 1: A dentectomy was performed on a teenage girl, as no other treatment was deemed clinically appropriate or suitable to manage her aggressive localised juvenile periodontitis. Bereft of her teeth, she shied away from her friends and started missing social engagements. Virtually ostracized, she withdrew from the social activities typical of a teenager due to a sense of inadequacy and embarrassment.

Case 2: A nursing sister presented at a dental surgery after her partial dentures broke while she was having lunch. She subsequently missed two days of work while waiting to have the prostheses repaired. The ordeal affected her ability to enjoy a variety of food. Her ability and desire to communicate and engage with family and in social activities were also adversely affected.

BACKGROUND

In South Africa, as in many developing countries, extractions are the mainstay of dental treatment. This practice has been medically socialised as an acceptable and inconsequential alternative care by patients and dental professionals. Data from the South African National Oral Health Directorate on public oral health service indicate that at least five of seven patients will undergo dental extraction as part of their clinical management.

This translates into an average of 14 extractions for every restored tooth in ‘resourced’ facilities. In some regions the ratio of extractions to restorations is as high as 44:1, and in the worst instances, no restorations are performed at all, but only dental extractions.

It is quite plausible that this trend will continue unabated, unless (i) a radical paradigm shift occurs in the delivery of oral health services; (ii) the perceptions and attitudes of patients regarding dental care are drastically altered and (iii) clinicians focus on oral health promotion, prevention and restorative care.

The genesis of this unprecedented extraction epidemic is complex and controversial. In South Africa the phenomenon can be traced back to historical legacies of the segregated health care system in the pre-democratic era (long before 1994). Unfortunately the effects of the unequal health system remain deeply entrenched. Structurally and operationally, Oral Health Services remain relatively underfunded and less prioritised when compared with other health programs. Consequently, the under-resourced Oral Health Services are restricted to offering limited treatment options for attending patients.

Under these circumstances, we ask if it is indeed moral or just for dental professionals, especially those in the public sectors, to continue a practice that renders populations edentulous at an unprecedented rate? Phrased differently, is it moral for the oral health system to provide dental extractions as the predominant form of dental care? Is the oral health system so designed (structurally and otherwise), that dental extractions are offered, almost exclusively, is that just or fair, especially to the indigent patients who rely solely on the public oral health system?

CORRECTUALISING TOOTHLESSNESS AS A CLINICAL CONSEQUENCE

Despite being the most common dental procedure, extractions are physically and psychologically traumatic to patients. Dental extraction could be indicative of the end
of clinical possibilities in managing diseases or conditions related to the teeth. Ceteris paribus, it is mandatory that the clinician explore alternatives to save the tooth instead of recommending amputation. This clinical endpoint has in some instances become intuitive structurally and socially accepted dental service option, especially for the indigent and vulnerable patients. Dental extractions are the standard of care available in oral health services in most developing countries. Whether by necessity or convenience, the scourge of tooth amputation continue in these settings. Dental professionals have become desensitised to the impact of extractions; and patients have become socialised to accept or demand extractions even when alternatives exist. To that extent, the oral health service has to confront and deal with the eventual clinical sequelae of dental extractions, whether leading to partial or complete toothlessness.

Edentulism is a form of impairment which result in disability and functional limitation, since affected patients are unable to perform normal functions such as biting, chewing and swallowing and that affects their food choices. Overwhelming evidence points to the devastating impact of toothlessness on the patient’s psychological and general wellbeing and overall quality of life. The extent of impairment, disability and handicap, and the effect on quality of life is influenced by sex, gender social and cultural factors, among others.

The aim of this paper is to evaluate the morality of the sustained levels of dental extractions as presently undertaken in the Public Oral Health Services. Normative analysis of this moral question is premised on philosophical theories as explicated by Daniels, Kant, Bentham and Mill.

BRIEF OVERVIEW OF MORAL THEORIES

The morality of an act is determined by the extent to which it complies with common or particular moral norms or principles. In this paper, we evaluate how dental extractions and eventual toothlessness may not be morally just, nor beneficial or harmless to patients.

According to egalitarian moral theories, all mankind share common human characteristics, are created equally, and have equal moral status. As a consequence, all persons are owed rights and obligations given their moral status. The existence of any inequalities in a society is therefore an indictment on this principle of equal distribution of benefits and burdens, and is a violation of the equality of rights and obligations.

Rawls’ interpretation of liberty and justice provides an eloquent discussion of rights and obligations owed to moral being. His assertion is based on the assumption of “original position” in which all persons are subjected to a veil of ignorance. From that starting point, it may be proposed that: (i) all persons should achieve similar maximum levels of liberties and basic rights (Liberty Principle); (ii) offices and positions be open to all in pursuit of fair equality of opportunity (Opportunity Principle) and (iii) inequality is only permissible if it benefits all, especially the least advantaged (Difference Principle). This Rawlsian idealisation of justice sought to redress the effects of societal inequality. However, Rawls observed that the “natural lottery” or immutable disposition acquired at birth, somewhat limited individual opportunities to attain life goals. Similarly, “social lottery” or structural and socially designed barriers, denied individuals fair and equal opportunities. Hence the focus of Rawls’ theory was on the distribution of income, wealth, choice and did not specifically address health. The application of his theory to health issues was further developed by Norman Daniels to give effect to consideration of justice in the distribution of health as a social good.

Daniels’ central premise is that justice will be achieved when there is equal and fair opportunity “for all to realise their maximum species- typical level of functioning”. Daniels further argued that health care needs are special and morally important due to their contribution to the achievement of normal functioning and the protection of the equality of opportunity. Consequently, any deficiency in health would minimize the attainment and maintenance of normal function, and would limit the range of opportunities, predisposing individuals to pain, suffering and unhappiness. Therefore, all health activities are just to the extent they ensure fair equal opportunity necessary for the individual to construct and achieve life plans and objectives. The range of opportunities due to individuals or societies will vary according to the level or stage of development, cultural preferences and other material factors. Despite these differences, just societies ought to provide a minimum standard of care for all, which would enable individuals to attain acceptable levels of function.

According to Daniels, prioritization of health needs and the implementation of appropriate programs will depend on the relative importance attached to a particular health need and its expected impact on achievement of life plans. This means that resources will be allocated to a basket of health services depending on their impact on function and the opportunities they provide to individuals. In the case of dental services and in particular the sole provision of extractions, the question must be raised as to whether oral health services are adequately prioritised and funded to enable achievement of functioning and opportunities? In other words, are dental extractions in public oral health services a reasonable treatment that contributes to the individual’s ability to achieve and to construct one’s life plans? If not so, why do we continue to perform dental extractions?

Daniels regards health as a special “good”, hence the moral requisite to make access to health universal, and not dependent one’s financial resources. Yet given the limited nature of health resources, some form of rationing is necessary, as long as it is just and fair. Daniels suggests that transparent judgment be made according to needs, in order to determine which healthcare resources are allocated and to whom. This means that limits have to be set on what services can be provided universally, given that the resources are finite and are sometimes indivisible, rendering it not possible to permit “equal” allocation. According to Daniels a just health system should defend Rawls’ idealization of health, by assuring that species-specific opportunities are realised. With regards to oral health, is it morally just for dental extractions to be the primary and most accessible service in the public service? What other treatment modalities should constitute a basic
dental care package that would ensure realization and protection of normal functioning?

Bentham and Mill teleological philosophical ethics emphasise that the consequences, or the ends or the utility of an action determines its moral value. Therefore, an action that produces greatest happiness for the greatest number of persons is consequently moral.\(^{20,21}\) Dental extractions result in short term relief of pain and suffering for patients, which, according to consequentialism or utilitarianism, makes the provision of this form of care morally just. Patients receiving dental extractions get relief from pain and discomfort, which maximises happiness. However, this short term gain is offset by huge costs of toothlessness, as patients would require rehabilitative services which are financially, socially, psychologically costly.

An alternative viewpoint is advanced by Kant, that any action is moral not because of its utility or associated consequences, but because it is inherently right.\(^{22,23}\) Specific to Kant’s deontology, an act is moral if persons are treated with respect or as morally autonomous agents, in so doing we ought to “…treat human not as a means to an end but as an end in itself”.\(^{21,24}\) Furthermore an act is moral if it can be wished to be a universal law or rule.\(^{25}\) It can be concluded, according to deontology, that extractions on consenting patients satisfy the principle of respect of persons or autonomy. It is debatable, whether dental extractions can be universalised for the relief of pain and sepsis, without exploring alternatives.

The mantra of Beauchamp and Childress espouses the belief that the ethical principles of autonomy, beneficence, non-maleficence and justice are critical to the evaluation of morality. Therefore a moral act should be voluntary and uncoerced, should be beneficial and not harm the individual. Furthermore the distribution of the act should be fair, equitable and non-discriminatory. Dental extractions are in all likelihood autonomously requested by patients without undue coercion from clinicians. This dental procedure provides relief of pain and sepsis and result in patient’s “happiness”. Indigent patients have the worst oral health status, are most likely to miss dental appointments and thus are unlikely to benefit from preventative dental services.\(^{20}\) Consequently, the treatment of choice for these patients remains emergency dental treatment including dental extractions.\(^{27}\) Therefore, dental extractions and related complications are disproportionally distributed by socio-economic status and impact the poor negatively.

**DISCUSSION**

Are dental extractions performed in the public oral health service, moral? According to Daniels we ask if dental extractions improve opportunities for the individual to achieve dreams and goals? In terms of Kant, we ask whether patients receiving this treatment are used as means to an end or as an end in themselves? Bentham and Mill would question whether dental extractions provide the greatest benefit for the greatest number of individuals? Similarly, Beauchamp and Childress evaluate the benefit to harm ratio of dental extractions as an indicator of moral status.

Dental extractions eventually lead to toothlessness, which is arguably detrimental to the normal functioning of affected patients. Edentulism is associated with limitations in speech, mastication and nutritional choices, which restricts the choices and opportunities possible for dentate individuals.\(^9\) Toothlessness negatively affects appearance and aesthetic concerns, self-perception and overall quality of life.\(^7,9\) Hence the failure to manage dental diseases and the subsequent provision of “exclusive” dental extractions can have a debilitating effect on oral health related quality of life.

The oral health system that focuses exclusively on dental extraction is, according to Daniels, failing to maintain and protect those oral health opportunities which may be accumulated by preserving a full dentition. Consequently, such a system is also limiting the ability of the individual to “participate in the economic, social and political life of the society”. By opportunities, Daniels refers to maximization of range of career prospects, social accomplishments, and productivity options, typical of a species.\(^9\) For example premature loss of anterior teeth normally affects aesthetics, which gravely compromises social equity among the young and socially engaged groupings. Similarly, extractions of posterior teeth may change the facial profile, and impact negatively on the masticatory function, choice of diet and nutritional status especially among the frail and old.\(^2\) According to Daniels such health states limit the range of “species specific” life plans and associated opportunities that affected individuals would like to construct for themselves.

Daniels’ argument is premised on the proposition that dental extractions are unjust to the extent that they compromise the attainment and maintenance or protection of normal functioning of individuals within the realm of the species. Patients who have lost a significant number of teeth, are unable to consume a variety of foods, which further compromise their nutrition. Speech, aesthetics and social interaction can be gravely impacted. Viewed within the social context in which these individuals exist, the effects, while different, would compromise quality of life, life plans and overall happiness. Edentulous patients are unable to attain their plans and dreams, as they find it difficult to take all the opportunities open to them.

Pursuing further the mantra of Beauchamp and Childress’s mantra, dental extractions may satisfy the principle of beneficence, as treated patients do not suffer further pain or “harm”.\(^{28,29}\) However, unplanned and symptomatic serial tooth extractions lead to toothlessness, a form of dental disability and a serious handicap. The resultant effects of toothlessness produce harm beyond only clinical outcomes, including, social and psychological effects. Proportionally high extraction rates are contrary to the principle of non-maleficence,\(^{26}\) as other forms of harm occur as a result. Health managers can argue that dental extractions are the most affordable and accessible alternative care, which provide relief from pain and sepsis. Overall the cost benefit or harm benefit of multiple extractions is high, to provide some justification to continue the practice.

Unfortunately, this treatment is largely reserved for the poor, uninsured, rural and largely African patients in the country. Dental extractions within the South African context are therefore unjust and discriminatory according to socio-economic and other factors. By design or necessity, this form of treatment would remain the only
option for this population group unless drastic measures are implemented to change the system.

Evidence indicates that a plethora of treatment options are available for dental professionals to manage emergency dental problems, before resorting to dental extractions. Therefore, dental extractions cannot be made a universal treatment for the relief of pain and sepsis. Instead public oral health services must provide treatments alternative to dental extractions.

According to Kant, our social systems do not provide moral agency, hence informed patients cannot choose the treatment they deserve due to limited or no options. The public oral health system therefore does thwart the ability of moral beings to be an end in themselves.

In conclusion, Beauchamp and Childress, Bentham and Mills, Daniels and Kant provide compelling argument that while dental extractions result in immediate relief of pain and sepsis, they present with long term complications. Furthermore, extractions are discriminatory and unfair as they are unevenly offered and accepted by sections of the society. Lastly, extractions do not enable the individual to achieve life goals and dreams or exercise the autonomous choice of treatment they deserve. Therefore the high rates of dental extractions in the public oral health services are unjust, harmful, not wholly beneficial, and thus are not moral.

IMPLICATIONS FOR DENTAL PRACTICE

Notwithstanding the structural limitations and financial challenges facing the public oral health services, the spate of dental extractions remains morally unacceptable. Health professionals working in these areas are therefore morally obligated to be creative about averting this impending epidemic. As part of health promotion initiatives, oral health professionals should advocate for a change in the financing of oral health services and should focus on preventative initiatives to reduce the burden of caries and periodontal disease. Probably and most importantly, is for the oral health professionals to change their mindset about dental extractions. We ought to reject indiscriminate extractions and advocate for retention of permanent teeth for life. It is incumbent on oral health professionals to engage with patients in order to change their mindset about dental treatment and dental extractions in particular.

References


Cementum is a specialized calcified substance covering the root of a tooth. The cementum is the part of the periodontium that attaches the teeth to the alveolar bone by anchoring the periodontal ligament. Cementum may be classified in a number of ways, viz., by location (radicular cementum—found on root surface; coronal cementum—forms beneath enamel covering the crown of a tooth); by cellularity (cellular & acellular); by the presence of collagen fibrils in the matrix (fibrillar & afibrillar); and by origin of the matrix fibres (extrinsic fibres [Sharpey’s fibres], intrinsic fibres, mixed fibres). These descriptors for the classes of cementum can be used in various combinations to more precisely describe a specific type of cementum.

The major role of cementum is to serve as the site of attachment for principal collagen fibres (Sharpey’s fibres). In particular, cementum, by virtue of its structural and dynamic qualities, provides tooth attachment and maintenance of occlusal relationships between the jaws. Periodontal disease may alter cementum, resulting in the loss of connective tissue attachment to cementum. As the relationship between local bacteria and periodontal disease is widely recognized it is generally accepted that removal of pathogenic micro-organisms that form plaque and calculus on cementum is the major goal of periodontal treatment. This therapy currently consists of scaling and root planing, using mechanical instrumentation. Previously it was accepted that bacterial endotoxins or bacteria penetrate the cementum of periodontally diseased root surfaces. This concept resulted in the removal of the subgingival plaque and calculus deposits, and the removal of all or most of the cementum as a primary endpoint of periodontal healing. In contrast, recent approaches in the treatment of periodontal disease have recommended that a less aggressive removal of cementum was necessary for optimal periodontal health as well as for periodontal regeneration. With this goal in mind, Bozbay and colleagues (2018) reported on a trial that sought to evaluate the effect of four procedures on cementum removal from diseased root surfaces that had never been periodontally treated: the use of piezoelectric ultrasonic scalers (U), with or without subgingival air polishing (AP), or air polishing with glycine powder alone, compared with the use of hand curettes (HC). The aim of the trial was to evaluate how much cementum could be retained as well as the surface characteristics of the retained cementum following in vivo root instrumentation.

MATERIALS AND METHODS

Twenty-seven patients (aged >18) with teeth diagnosed with severe chronic periodontitis and scheduled for extraction were included in this study. The inclusion criteria included participants who were systemically healthy, were non-smokers, had single-rooted teeth or molars with fused roots and had bleeding on probing. The patients participated on the basis of a periodontal probing depth (PPD) ≥5 mm in at least two sites per tooth with radiographical bone loss for more than two-thirds of root length and hence having single-rooted teeth which were hopeless for periodontal treatment. Exclusion criteria for subjects included subjects who were pregnant, breastfeeding, had been treated for periodontal disease (either non-surgical or surgical), had dental caries or restorations on the mesial or distal tooth surfaces or had Class III dental mobility.
All the subjects of the study received a supragingival tooth cleaning one week prior to the measurements with the use of ultrasonic scaler and glycine-based air polishing. Before treatment, probing depths (PD) and clinical attachment levels (CAL) were measured on all teeth, at six locations per tooth and to nearest 1mm, using a standardized periodontal probe.

Prior to extraction, the teeth (n = 48) were randomly divided into these four treatment groups:

(i) piezoelectric ultrasonic scaler (U);
(ii) U followed by air polishing with the glycine powder (U + AP);
(iii) air polishing with the glycine powder (AP); and
(iv) hand instruments (HC) (Gracey curettes 5/6, 11/12, 13/14).

Treatment options were randomly assigned to the operator immediately prior to treatment. Instrumentations with air polishing and U devices were performed with medium power settings and with the use of water cooling (as instructed by the manufacturer). One approximal root surface (distal or mesial) of each tooth was randomly subjected to debridement, and the other approximal surface was used as control. All the measurements and instrumentations of teeth were performed by a single operator. The criteria for adequate treatment were smooth, hard root surfaces, with no clinical evidence of calculus. The cleanliness and smoothness of the root surface were checked using a fine dental explorer. The procedures were carried out under local anaesthesia. The length of time required for scaling, air polishing and root planing with each instrument was recorded in seconds. The mesial and distal locations of the gingival margin were determined and defined on the root surface with shallow ‘V’-shaped notches cut with a diamond flame bur. Following instrumentation, the teeth were immediately extracted atraumatically and wiped with wet gauze to remove debris. The teeth were stored in numbered and labelled jars in a solution of 0.9% w/v of NaCl for a maximum 30 days.

Before sectioning, the root surface characteristics of 20 randomly selected teeth were analysed using a scanning electron microscopy (SEM). Remaining Calculus Index (RCI) and Roughness Loss of Tooth Substance Index (RLTSI) were calculated to determine remaining calculus, root surface roughness and loss of root substance. Additionally, scratches, gouges, cracks, cementum presence and any other changes in the cementum were noted.

The teeth were rinsed in NaOCl for two minutes to remove deposits and periodontal fibres before sectioning. The teeth were sectioned perpendicularly to the root axis with a microtome to produce slices of between 10 and 15 μm thickness which were stained with haematoxylin and eosin. Two horizontal root sections of each tooth were taken from the coronal and apical portion of the instrumented root for a total of 96 histologic specimens. Coronal sections were taken 1mm. coronally from the notched root surface (i.e. endpoint of periodontal pocket). Both histologic and SEM measurements were carried out by blinded examiners.

RESULTS

Ninety-six sections of 48 teeth were processed for histologic examination. The mean age of patients (14 females and 13 males) was 42.5 years. The mean values of PD and CAL for all teeth were 5.08 ± 1.64mm and 7.77 ± 2.10mm, respectively.

Regardless of the type of subgingival instrumentation, a statistically significant amount of cementum was removed in both coronal and apical surfaces of the root. Despite the consistent removal of cementum, there were differences between the treatment modalities with regard to the amounts of cementum retained following the subgingival instrumentation. The percentages of coronal cementum retained were 84% with the piezoelectric ultrasonic scaler (U), 80% with the piezoelectric ultrasonic scaler + air polisher with glycine powder (U + AP) and 94% with air polishing with the glycine powder only (AP), whereas hand curettes (HC) retained only 65% of the cementum.

In the apical sections, cementum loss was similar with an 84% retention with U, an 83%, with U + AP, 88% with AP and 70% with HC. When comparing the cementum retention for coronal and apical sections, only AP had a statistically significant effect on reducing the amount of remaining cementum in apical sites when compared with coronal sites (P = 0.027).

Overall, power-driven instruments were statistically more efficient at retaining cementum when compared with hand instruments. More specifically, HC and U + AP produced significantly greater cementum removal than AP in coronal sections (P = 0.002, P = 0.004, respectively); HC caused significantly greater removal of cementum than AP in apical sections (P = 0.016). It should be noted that in both the coronal and apical sections, AP produced the least amount of cementum loss and therefore the greatest retention of residual cementum.

With regard to mean time to complete root instrumentation, the shortest was recorded when using AP and the longest was U + AP. In comparison with HC, AP required 31% less time for root preparation, whereas U + AP required 30% more time.

SEM results found the smoothest root surfaces were produced by the HC followed by the AP, while root surfaces instrumented by U or U + AP presented grooves and scratches.

CONCLUSIONS

The study found that air-polishing with glycine powder alone (AP) was significantly more effective in preserving cementum than the other treatment modalities. The use of hand curettes (HC) resulted in more removal of cementum than did (ultrasonic scaling (U) and air polishing with glycine powder (AP).

IMPLICATIONS FOR PRACTICE

Clinicians seeking more conservative treatment options aiming for maximum preservation of the cementum layer should consider the superior performance of air polishing with glycine powder to achieve this outcome.

Reference

Orthodontic appliances increase dental plaque retention and make oral hygiene more difficult for patients due to the increased surface area on which plaque can then accumulate. Essentially there are two types of fixed orthodontic bracketss: - metal and ceramic. The popularity of ceramic brackets has grown during the last few years due to increased demand for superior aesthetics during orthodontic treatment. Plaque in association with fixed appliances can result in clinical problems, such as demineralization of the adjacent enamel and gingival inflammation. To prevent this, meticulous oral hygiene is suggested and often a host of mechanical (toothbrush, inter-dental brush, etc.) and chemical (mouthrinses) adjuncts are recommended to maintain a clean mouth during orthodontic treatment.

Several antimicrobial agents have been incorporated in mouthrinses as adjuncts to daily plaque control and are more beneficial than only mechanical brushing. Chlorhexidine (CHX) mouthrinse, an antimicrobial agent, is considered the gold standard in preventing the dental plaque formation and gingival inflammation due to its antigingivitis effects. It is a cationic composition that can bind to bacterial plaque, enamel hydroxyapatite and mucous membranes. However, CHX has known side effects, like extrinsic tooth and tongue staining when used over longer periods (>4weeks). In recent times in dental clinical practice, there has also been an advanced version of CHX with antidiscolouration system (CHX-ADS). Besides maintaining its antiseptic qualities, CHX-ADS avoids the side effect of staining.

Jurišić and colleagues from Croatia (2018) reported on a trial that sought to investigate the effectiveness of two chlorhexidine mouthrinses on oral hygiene and gingival health status of adolescents wearing two different types of orthodontic brackets. The first null hypothesis was that two mouthrinses show no differences in the effectiveness of reducing gingival signs of inflammation and improving oral hygiene during the period of 18 weeks. The second null hypothesis of the study was that stainless steel and ceramic brackets have no influence on gingival and oral health status.

MATERIALS AND METHODS

Eighty-seven subjects with indications for fixed orthodontic appliance treatment participated in this prospective clinical study. The subjects had to fulfill the following criteria: good general health, no antibiotic intake or use of antibacterial mouthrinses in the previous three months, no periodontal disease (no periodontal probing depth >4 mm; bleeding on probing frequency <20%) and non-smoking. Seven subjects were excluded because they did not meet the inclusion criteria (four used antibiotics at the time and three declined to participate). In total, 80 subjects were included (61 girls, 19 boys; aged 11-18 years, mean age 14.2±1.4 years).

Before the treatment and at every visit, the patients were given oral hygiene instructions. Verbal instruction and physical demonstration were provided on how to carry out effective oral hygiene close to the brackets and ligatures, and how to use dental floss for cleaning spaces around the brackets, between the teeth and under the archwires using a model. All instructions were given by the same experienced investigator. The subjects were instructed to use manual and interdental tooth brushes and to floss twice daily.

A total of 80 subjects considered for standard orthodontic treatment (metallic brackets) were randomly divided into two groups according to bracket types: 40 subjects received metal-stainless steel brackets and 40 subjects received ceramic brackets (3M Unitec) by random choice. All archwires were ligated using stainless steel ligatures. Four weeks after the placement of the fixed orthodontic appliance the subjects from each bracket group were randomly divided into two equal subgroups and were provided with two different mouthrinses for use during the next 14 days. Within each bracket group 20 subjects received a conventional, alcohol-free chlorhexidine solution (0.2% CHX; Parodontax), 20 subjects received a chlorhexidine solution with antidiscoloration system (0.2% CHX-ADS; Curasept ADS 220). Ten millilitres of each mouthrinse was used twice daily. The subjects were instructed to avoid eating and drinking for 30 minutes after mouthrinse usage.

The following parameters were measured: (a) gingival status—using the Gingival Index—Löe and Silness (GI) for each tooth with brackets and (b) oral hygiene status—using the Oral Hygiene Index—simplified (OHI-S) examining standard six tooth surfaces (facial surfaces of the first molars in the right and left maxilla, the lingual surfaces of the first molars in the right and left sides of the mandible; the facial surfaces of the maxillary right central incisor and mandibular left central incisor.

The mean values for OHI-S and GI were calculated. All clinical measurements were performed by the same examiner at three time points: (i) prior to the placement of the fixed orthodontic appliance (t1), (ii) 6 weeks after the placement of the fixed orthodontic appliance (after 14 days of rinsing) (t2), and (iii) 18 weeks after the placement of the fixed orthodontic appliance (t3).
RESULTS
From 87 subjects eligible for the study, 80 met the inclusion criteria (61 girls, 19 boys; aged 11-18 years, mean age 14.2±1.4 years) and participated in the study. Changes in the values of GI and OHI-S were observed, and it was noticed that the changes observed depended on the type of orthodontic brackets and different mouthrinses at definite points of time (0, 6 and 18 weeks) after insertion of the orthodontic appliances.

Significantly lower GI values at second time point for all bracket types and mouthrinses after the usage of the mouthrinse was found (t2; 6 weeks later) (t=2.313; df=78; P=.023). The results of the comparison of the measurements at all three time points in each subgroup showed a decreasing trend for both parameters evaluated in the study at t2 and an increasing trend at t3. In the ceramic brackets group, the mean GI values were significantly lower in the subjects using CHX-ADS mouthrinse (t=2.849; df=38; P=.046).

No significant differences were found between GI and OHI-S values in the ceramic brackets groups using CHX were found. However, between the measurements a decreasing trend at t2 followed by an increasing trend at the t3 were also seen (P>.05). At the same time, GI and OHI-S values in the ceramic brackets groups using CHX-ADS at different time points significantly differed (p < 0.05 at both time intervals)

Overall there was a statistically significant decrease in GI and OHI-S indices in time point t2 (after 6 weeks) and then an increase, although not significant, by time point t3 (18 weeks) for all groups in this investigation. There was no statistically significant difference between the groups having ceramic and metal brackets when these variables were tested alone, and none between mouthrinses alone. Significantly lower GI values were found in subjects wearing ceramic brackets who also used CHX-ADS both in time points t2 and t3.

CONCLUSIONS
Within the limitations of this study the authors concluded that the ceramic orthodontic brackets together with CHX-ADS resulted in improved gingival status.

IMPLICATIONS FOR PRACTICE
Ceramic brackets together with CHX with anti-staining proved to offer superior benefits for gingival health. However, clinicians should note that the sample size was relatively small. Other important factors such as cost were not considered here.

Reference
CPD Questionnaire

This edition is accredited for a total of 3 CEUs: 1 ethical plus 2 general CEUs

GENERAL

Early Childhood Caries experience of children accessing selected immunization facilities in Johannesburg.

1. What is the reported caries prevalence of the children that were studied?
   a. 10%
   b. 32%
   c. 42%
   d. 50%

2. Which one of the following refer to “proximal” factors?
   a. Health systems
   b. Socio-cultural factors
   c. Oral Hygiene
   d. Environmental factors

3. Which one of the following refers to “distal” factors?
   a. Use of oral health service
   b. Diet
   c. Health system
   d. Tobacco

4. The children in Diepsloot had higher levels of caries than those in Vanderbiljpark.
   a. True
   b. False

5. The caregivers in Vanderbiljpark were less educated than those in Diepsloot.
   a. True
   b. False


6. The most important aspect of ensuring success in endodontic surgery is:
   a. Lateral condensation of the endodontic filling material.
   b. placement of a plug of amalgam.
   c. repeated drying of the canal using cotton wool pellets.
   d. an effective apical seal placed in a retrograde technique.

7. Gutta percha may be used effectively:
   a. as a root canal filling if it is combined with a root canal sealant.
   b. as an apical sealant after surgical endodontics if it is thermoplastically adapted to the apex.
   c. as an apical sealant provided it is not extruded beyond the apical foramen.
   d. as root canal filling if mechanical condensation is used.

8. Identify which property of Calcium silicate cement MTA does NOT contribute to its excellence as an apical sealer after endodontic surgery:
   a. an ability to appreciate moisture
   b. its excellent sealing ability
   c. minimum bioactivity
   d. slow setting time, allowing for manipulation.
   e. excellent biocompatibility.

9. Identify the INCORRECT statement. MTA Flow is strongly recommended for root-end filling, pulp capping, pulpotomies, apexification, root resorption and perforation repair because:
   a. the small particle size of less than 10 microns of MTA Flow powder renders a favourable smooth mix.
   b. the gel formation confers resistance to washout
   c. the mixing ratio is constant for all applications
   d. the mix may be accurately applied through a syringe.

Graduate perceptions on dental training to inform dental curriculum from an occupational health perspective

10. Identify the INCORRECT statement. Tacit knowledge is knowledge that is:
    a. hard to quantify
    b. difficult to convey in either verbal or written communication
    c. essentially an inherent skill that need not be taught
    d. hard to pass from one person to another

11. Of the global burden of disease from depression, how much is estimated at present to be due to occupational risk?
    a. 12.3%
    b. 8.0%
    c. 7.8%
    d. 9.4%

Prevalence and aetiological factors of maxillofacial trauma in a rural district hospital in the Eastern Cape.

12. Identify the INCORRECT statement. Most mandibular fractures recorded in this study showed minimal displacement and hence:
    a. treatment by closed reduction was indicated
    b. specialist attention is mandatory
    c. treatment could be delivered at rural hospitals
    d. dentists intending to work in rural areas should undergo training in minor oral surgery

13. The most common aetiological cause of maxilla-facial trauma in this study was:
    a. road traffic accidents
    b. interpersonal violence
    c. falls
    d. animals

Pathology of Candida infection in oral HIV-associated Kaposi sarcoma (oral HIV-KS): a descriptive study. (p 354)

14. Identify the INCORRECT statement:
    a. Only 40.6% of oral HIV-KS showed secondary Candida infection
    b. The age of patients with oral HIV-KS secondarily infected with Candida ranged from 21-63 years
    c. The site most affected by secondary infection was the tongue
    d. Males were much more frequently affected by secondary infection
15. Identify the INCORRECT statement:
   a. Cases with low CD4 counts showed deeper penetration of Candida pseudohyphae.
   b. Cases with low CD4 counts showed reduced intensity of Candida infection.
   c. Many cases with low CD4 counts showed increased presence of secondary Candida infection.
   d. Cases with low CD4 counts did not always have secondary Candida infection.

Etiological factors for dentine hypersensitivity in a Nigerian population
16. Identify the CORRECT statement concerning non carious toothwear lesions:
   a. Enamel erosion involves dissolution by acids of bacterial origin.
   b. Attrition results in wear of teeth on the buccal and lingual surfaces.
   c. Abrasion describes tooth tissue loss caused by extrinsic acids.
   d. Abfraction occurs at the cervical region of teeth, due to eccentric loading.

Maxillo-facial and Oral Radiography 161
18. Thinning of the cortex at the inferior border of the mandible is a radiological sign of osteoporosis?
   a. True
   b. False

Clinical Windows
19. In the Bozbay et al trial, the piezoelectric ultrasonic scaler retained the highest percentage of coronal cementum.
   a. True
   b. False

20. In the Jurišić et al trial, in the ceramic brackets group, the mean Gingival Index values were significantly lower in the subjects using CHX-ADS mouthrinse (Chlorhexidene Antidiscolouration).
   a. True
   b. False

ETHICAL
Toothlessness a moral crisis
21. According to Daniels, Just Societies ought to provide a minimum standard of care for all, which would enable individuals to attain acceptable levels of function.
   a. True
   b. False

22. Identify the CORRECT statement. With regards to oral health,
   a. It is morally just for dental extractions to be the primary and most accessible service in the public service.
   b. Financial considerations are the sole factor determining the policy regarding dental extractions.
   c. The policy of extractions being the primary and most accessible service in the public service is not morally just.
   d. Ethical principles should be discarded in favour of practical solutions regarding extractions being the primary and most accessible service in the public service.

23. Identify the CORRECT statement:
   The philosophical ethics described by Bentham and Mill emphasise that
   a. the consequences of an action determine its moral value.
   b. the effective end result is never moral.
   c. the moral value of an action is determined by the perpetrator.
   d. morality has no relationship to action.

24. It is essentially discriminatory and unfair that extractions are offered to, and accepted by, sections of the South African society.
   a. True
   b. False

25. The ethical principle of non-maleficence does not apply when considering the high extraction rates recorded in the public health service in South Africa.
   a. True
   b. False

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.
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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%.
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It was way back in 1972 that Evelyn Theunissen took up her new position as Dental Assistant to Dr Mervyn Rosenberg. It is now 46 years later and Evelyn continues to work together with Mervyn caring for patients in the Sea Point practice which Mervyn joined ... you guessed it, in 1972! Mervyn had qualified at Wits in 1969, was posted to the Military Hospital in Bloemfontein but was seconded to Ceres which had suffered that enormous earthquake. Mervyn worked for a year for Herman Reinach, who was Chairman of the Earthquake Disaster Committee and needed a dentist to help look after his patients. After a year spent in England, Mervyn settled into the Sea Point practice which has been his commitment ever since. Over all these years, Evelyn has been an exemplary assistant, contributing side by side with Mervyn to the dental care of their patients.

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