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Celebrating the first year of Sefako Makgatho Health Sciences University

The School of Oral Health Sciences has found it fitting to celebrate the first year of the existence of Sefako Makgatho Health Sciences University (SMU) with the publication of a special edition of our most esteemed journal (SADJ). The School is based in and serves largely marginalized societies and with the dynamic political and environmental situation in the country, could not be better situated to finding solutions towards serving the masses of this diverse South African population whose health needs, already demanding, are rapidly escalating. Technology in the health sciences is improving at a fast pace and comes at high costs. The challenge for researchers (scientists/clinicians) is to find and carefully select the type of technology that will best benefit the nation. Research in the School has to be locally relevant and yet be internationally competitive in order for the Institution to improve its esteem in the academic arena.

Articles presented in this edition cover radiological, pathological, trauma, aesthetic, patient satisfaction and educational needs, a spectrum which reflects the diversity of oral health issues within the ambit of the School. The Department of Oral Pathology delivers diagnostic histopathology and clinical pathology services to clinicians of the School of Oral Health Sciences, of the specialist departments of Ear Nose and Throat, Dermatology, Plastic Surgery as well as to peripheral hospitals in Polokwane. Specialists in the Department are actively involved in local outreach programs, several International organisations and were invited to write chapters for the new 2017 WHO Head and Neck issue and to participate in the International Collaboration of Cancer Reporting (ICCR) Dataset for Oral Cancer to be distributed early 2017. The Department has an active research output with various research foci but also acts as a research support unit in-house and on campus. Radiology plays a vital role in serving all clinical disciplines and with the recent full digitization of this Department, more efficiency in patient management and increased research output is expected. We live in a violent society and there is an abundance of trauma treated in the Maxillofacial clinic in our hospital. Aesthetic needs are on the increase as reflected in the number of patients requesting aesthetic rehabilitations and orthodontic treatment. In this modern society, patients demand the best treatment and departments are challenged to offer this with the limited resources available, hence, the importance of regular patient satisfaction surveys. The teaching and training platform cannot be overlooked, leading to the need to improve on didactic methods and to constantly reassess and revise the curriculum to make the training relevant to societal requirements whilst staying on par with local and international norms. SMU is rooted in rich academic soil, sufficiently fertile to enable research to grow and to flourish.

The challenge facing the School henceforth lies in strengthening and empowering the post-graduate offerings through recruitment and retention of skilled academics and increasing the skills of the current personnel. The postgraduate sector is the heart of research output in most institutions and when this sector is fully functional, inputs translate into high research output, excellent service delivery and attraction of good academics and students. There are indeed areas of good progress but the School must identify others that need strengthening and must also seek collaboration with local and international institutions to build capacity and to establish a formidable team of dedicated academics. It is also my view that the School needs to expand its training platform as this will serve as the “fertile ground” for research development through community engagement and service delivery.

I want to thank Edith Dube, Editorial Assistant, Annemie Visser, Graphics Designer, EDoc, Professor Evans, Managing Editor and his team of reviewers for the hard work they put into processing this issue within a short space of time. I also want to thank the Director of the School of Oral Health Professor Lekan Ayo-Yusuf for presenting the idea and seeking permission from the South African Dental Association to publish this edition. A final thank you goes to all academic members of staff for their willingness and hard work in striving successfully to meet tight deadlines.

Dr MPS Sethusa
Chairperson of the School Research Committee

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As with its predecessor, the Medunsa/University of Limpopo, the School of Oral Health Sciences at the Sefako Makgatho Health Sciences University (SMU) continues to address both the under-representation of blacks in the oral health profession and the lack of good oral health care in underserved regions of South Africa. The SMU still trains most of the black dentists in South Africa and places great emphasis on attracting students from rural areas of South Africa, stressing community service and preventive oral health care during undergraduate training. The SMU remains the only one of the five oral health profession training institutions in South Africa offering three Baccalaureus programmes, namely, in Dentistry, Dental Therapy and Oral Hygiene. All undergraduate programs have strong service learning components and one of the papers in this special issue of the SADJ focuses on how students reflect on the value of social accountability. The paper suggested that the students from SMU recognise the importance of social development within the overall context of health promotion rather than only focusing on immediate needs for pain relief, especially in poverty stricken communities.

A significant proportion of our students come from rural areas. These students are funded through provincial bursaries or through the National Student Financial Assistance Scheme (NSFAS) and although it provides them with a golden opportunity for an educated future, it also brings some social and academic challenges. Many of the financially supported students often do not have enough money for food or to buy any prescribed textbooks, which frequently hampers their study and overall academic performance. The SMU have some feeding schemes in place where personnel are able to assist with donations. Experience have shown that, when supported to complete their studies, these students from rural areas are three times more likely than others to return and practice in rural areas, giving back to the community they originated from. It is therefore SMU’s priority to enhance student academic and non-academic support programmes in order to improve the overall student experience on campus as part of the much broader teaching and learning quality enhancement agenda, which would be supported by the newly established Centre for University Teaching and Learning (CUTL). Promoting student diversity in the classroom and providing educational opportunities beyond the classroom is a major initiative at SMU. Students requiring any additional academic or non-academic support are identified early through appointed student guardians and incorporated into the SMU student support system through a well organised referral system. Early interventions correlated well with an increase in academic success rates over the past year.

Since the opening of SMU, novel methods of teaching have been developed. These include expansion of modern simulation facilities and more frequent usage of video-based instructions in Maxillofacial and Oral Surgery following a real-time video link to our operating theatre. This expansion of educational methods also called for academic staff who would not only provide high-level patient care while teaching and performing research, but also staff who can reach students via cutting-edge educational portals. New educational initiatives will continue to be developed through continuous education of lecturers but also through research initiatives focused on the scholarship of teaching and learning. The SMU is committed to contribute to evidence-based policy leadership in South Africa and to provide quality oral health services for all its citizens.

While our primary mission is to produce outstanding oral health professionals, we also recognise our profound responsibility as a public institution to the Gauteng
Province and its residents. Addressing the historical gap in resource allocation to the Medunsa Oral Health Centre as compared with the other oral health training centres in the province is an on-going process.

On the one hand, the location of our dental school allows us to leverage the immediately surrounding poor communities in ways other schools located within cities have been unable to do, which in turn, increases the lustre of a community-oriented SMU degree. On the other hand, our location poses an additional challenge as regards attracting specialists and fee-paying patients for specialist care, limiting related specialist training opportunities. The access to additional funding through the clinical training grant (CTG) from the Department of Higher Education and Training, the Health Professions Training Grant (HPTG) and the National Tertiary Services Grant (NTSG) through the Provincial Gauteng Health Department have been key in addressing some of these challenges in the past year and would remain vital going forward. In our research and educational programmes, we maintain productive collaborative relationships with leading national and international Universities. The school unlike any other dental school in South Africa now has two NRF-rated scientists on staff, demonstrating our resolve to promote research excellence.

I would like to seize this opportunity to call on all MEDUNSA-SMU alumni to join in supporting the School on this exciting journey as SMU keeps its strategic focus on the following vision and mission statements:

**VISION**
- To be the benchmark institution providing holistic health sciences education that meets the health needs of the individual, the family, the community, and the population.

**MISSION**
- Provide high-quality primary health care-oriented health sciences research, education and services.
- Deploy educational approaches that include evidence-based methods for curriculum development and delivery that are rooted in the community.
- Promote interdisciplinary research, education and skills training that recognise the cross-disciplinary nature of holistic health care provision.
- Produce a cadre of health professionals with the transformative leadership capacity to identify, analyse and address the health needs of the individual, the family, the community and the population.
- Create an environment that supports innovation and harnesses the power of new technologies to address the health needs of the community.

We are entering an era in which oral health professionals will have the expertise to manage their patients, communities and the society more professionally and effectively than ever before. It is an honour to lead the Dental School and the Faculty of Health Sciences at SMU at such an exciting time.

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**COMMUNIQUE**

It is the privilege of the Association to host a FESTCHRIFT recognising the Sefako Makgatho University, the institution renamed in honour of a man who made major contributions to society in a variety of fields. The team at the Medunsa Oral Health Centre of the University are congratulated on their commitment and achievement.

The construction of a Festschrift is indeed an architectural triumph of words, an assembly of text, but these are special words and special text, for in combination they build a model of the Institution which encompasses the achievements, the philosophies and the ambience, the very ethos which sustains the Hospital. So it is with considerable satisfaction that the Festschrift has been constructed and is now presented. It is indeed an appropriate climax to the year.

Well done indeed!
The history of the School of Oral Health Sciences of the Sefako Makgatho Health Sciences University (2005 to 2016)

The Sefako Makgatho Health Sciences University, within which the School of Oral Health Sciences is subsumed, is not new, but originates many years back when the University was initially called the Medical University of Southern Africa (Medunsa). The history of the first 25 years of the Faculty of Dentistry, later called the School of Oral Health Sciences when the University was merged with the then University of the North to form the University of Limpopo (UL), has previously been captured in the SADJ (November 2005, Vol. 60 No. 10). This article therefore relates the history of the School from the time of the 2005 merger to date.

The School of Oral Health Sciences in the Faculty of Health Sciences of the University of Limpopo continued under the leadership of Professor T Gugushe to offer both undergraduate and post-graduate programmes. This was a difficult period for the newly established University as the two institutions grappled to merge two different cultures with different fields of interest.

Efforts to streamline different academic calendars, curricula and working environments led to disagreement and dissatisfaction amongst staff and students. The Medunsa campus of the University as it was called then, also watched in despair and absolute stagnation as the Northern campus continued to flourish with new infrastructure development. This lack of corresponding development at Medunsa led in due course to student boycotts when the existing residences became inhabitable due to neglect and because no new residences were provided to meet the increasing number of students.

The Medunsa campus experienced a loss of academic staff to other faculties of health sciences. The School nonetheless worked hard to sustain the stability of its academic programmes, an effort which was justified by successful and repeated achievement of full HPCSA accreditation of its undergraduate programmes.

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2. Tahepo Gugushe: BSc; BDS; DHMS; M.Dent; M.Phil, Advisor to the Interim Vice Chancellor of the University of Sefako Makgatho Health Sciences University, Medunsa, South Africa.
A task team was appointed by the Minister of Higher Education and Training, Dr Blade Nzimande, to investigate the impact of the “troubled” merger between Medunsa and the University of the North to form the University of Limpopo. The report of the task team under the leadership of Professor Malegapuru Makgoba and Dr Max Price was published on 8 July 2011. One of the main recommendations of this report was that “the merger of the University of Limpopo has not been successful and should be undone”. This process resulted in the appointment on 6 November 2013 of an Interim Council by the Minister of Higher Education and Training to prepare for the establishment of a new standalone University which would be situated on the old Medunsa campus. The Interim Council was mandated to provide oversight of all aspects related to the unbundling of the merger.

The establishment of the new University was finally gazetted on 16 May 2014. A comprehensive University to be known as Sefako Makgatho Health Sciences University (SMU), physically located in Ga-Rankuwa, was to be formed, to be managed under an Interim Council for a period not exceeding six months. The Interim Council, with the assistance of the Interim Management, had to manage the day to day activities of the institution as well as ensuring that a permanent Council was constituted, together with all structures as may have been determined by the institutional statute, such as the Senate and its subcommittees. The University had to re-configure its academic structure given its new mandate as a comprehensive University.

The sharp end of the de-merger was that SMU would have control over its own affairs and continue its uniqueness as a purely health sciences University, but the blunt side of it was that in order to be financially sustainable as a standalone institution, it would have to increase its number of students to 10 000. The number of students at the time of the de-merger was approximately 4877. It was agreed that special financial assistance would be granted but the University would have to quickly increase the number of students to achieve financial security.

Prof Lekan Ayo Yusuf was appointed as the Director of the School of Oral Health of Sefako Makgatho University (SMU) on 01-12-2013 and he had to “hit the ground running” as there were many events pending including accreditation visits by the HPSCSA. He had not previously been a member of staff of the institution and consequently faced a steep learning curve of how to run the School, of how to manage an institution in the throes of re-establishing itself and of when to identify and implement changes. The University and the School were at a time of transformation and restructuring following the de-merger and there were many neglected areas which required urgent attention. The management of the Dental Hospital needed attention, the gaping wounds from lost staff needed bandaging, and the fight to retain the School as a standalone entity within the University was raging as some departments considered the School to be too small to be an independent entity.

It is his spirit of serving people and influencing leaders that makes it proper that this institution be named after him. He passed away at the age of 90 on 23 May 1951 and perhaps, as an institution of health, our best acknowledgement of the life and work of Sefako Makgatho should be our endeavour to keep the community healthy up until that venerable age!

Following the formation of the University Council, it became necessary to delegate senior members of staff with institutional experience to assist the newly appointed Acting VC of the University, Professor De Beer. Prof Gugushe was tasked to assist and advise the Acting VC. It soon became clear that the operations of the School of Oral Health were hampered as a result of the dual roles he was playing and it was decided to create the post of Director of the School.

Prof Ayo Yusuf is a prolific researcher who carries an NRF rating and who has vast experience in managing hospitals. It was immediately clear that the School and the University would benefit considerably by his appointment for he was successful in stabilizing staff establishment in various departments, ensured that hospital protocols for the ordering of equipment and dental material were improved, and fostered a culture of research within the School. His ability to learn, search, find problems and solutions did not go unnoticed and he soon became actively involved in the running of the University. His passion for academia has landed him a post as Acting Executive Dean of the University - and once again the Director of the School is serving dual roles! This appointment was supposed to be of short duration but because of the delay in the finalization of the senior executive structures and the appointment of senior executive members of the University, Prof Ayo Yusuf has carried on to date.

The School of Oral Health of SMU is securely positioned to continue training cadres of Oral Health professionals who are well equipped to meet the needs of the South African Community - and beyond. The challenge is to find new programmes which can be implemented to make the School and the University financially sustainable, to identify areas which need enforcement and to continue strengthening the current academic thrust.

This Festschrift makes that statement of commitment.
The role of socio-economic position on satisfaction with oral health services among South African adults: a structural equation model

ABSTRACT
Objective: To investigate how differences in socio-economic position (SEP) influence satisfaction with dental services among South Africans.

Methods: Data collected from a nationally representative sample of the South African population ≥16 years old (n=3,112) included socio-demographics, health insurance enrolment, past-year dental visit and facility type (public or private), satisfaction and reason(s) for dissatisfaction with the dental services received. Using structural equation modelling, a pathway to satisfaction with dental services was tested using a number of model fit statistics.

Result: Of the 15.1% (n=540) who had visited a dentist in the past-year, 54.1% (n=312) were satisfied with the services received. Reasons for dissatisfaction included long waiting time (33.1%), painful procedure (13%) and rude staff (10.4%). Being of higher SEP was associated with reporting using private facility. Those who visited public facilities were more likely to have encountered a long waiting time, which in turn was associated with being more likely to report treatment as having been painful and reporting dissatisfaction. Long waiting times had the greatest direct effect on dental service dissatisfaction ($\beta = -0.31$).

Conclusion: Improving waiting time is likely to be the major factor to help reduce socio-economic disparities in the quality of dental services experienced by South Africans.

INTRODUCTION
Oral health status follows a socio-economic gradient. One of the possible ways in which oral health is influenced by socio-economic position, is the dental attendance patterns. Richard and Ameen (2002) suggested that regular dental attendance, defined as a visit to the dental clinic within a two year period, is associated with better oral health. Regular dental attendance is associated with several factors, one of which is the satisfaction with the dental services. Furthermore, socio-economic position has been shown to predict satisfaction with healthcare in South Africa. The symptomatic use of dental services, particularly due to having a pain-related oral problem, has been associated with significantly less satisfaction with the services received.

The satisfaction of clients is a concern for all organisations. The subject of satisfaction and its associated factors for

ACRONYMS
BHF: Board of Healthcare Funders
CFI: Comparative Fit Index
HSRC: Human Sciences Research Council
NFI: Normed Fit Index
NHl: National Health Insurance
RMSEA: Root Mean Square Error of Approximation
SASAS: South African Social Attitude Survey
SEM: Structural Equation Modelling
dental patients has not been studied extensively in South Africa. The most dominant theory of customer (patient) satisfaction is the disconfirmation theory, which holds that the customers evaluate service satisfaction by comparing their perceptions about services experienced based on their pre-experience expectations to those of the actual services received. The service quality model, which is widely adopted in the marketing literature, proposes a similar view that perceptions about the expected service influence how a consumer will evaluate the outcome of the service experience. For example, the consumer who thinks that the dental services in the public sector are bad, may have his or her evaluation of the outcome of his or her service experience clouded by his or her preconceived judgement.

To further explain the pathway of satisfaction, Zeithaml, Berry and Parasuraman presented a model that represents customer satisfaction as a product of three concepts. These are firstly, the desired (ideal) service, reflecting the level of service the customer wants to receive; secondly, adequate service, which is the standard of service that the customer is willing to accept; and thirdly, the predicted (expected) service, i.e. the level of service the customer believes is likely to be received. The quality of service received between the desired service and the adequate service represents the ‘zone of tolerance’. This determines the level of satisfaction with the actual service received (i.e. if the level of the actual service received falls within the ‘zone of tolerance’ the person is satisfied, but if the level of service received falls below the level of ‘zone of tolerance’ the person is dissatisfied). Two major documented factors affecting the rating level of patient satisfaction with dental services received are the interpersonal relationship/communication and the technical skills.

It is conceivable that the patient’s socio-economic position could influence the zone of tolerance and thus the level of satisfaction with the quality of health services received. An individual’s socio-economic position has an influence on the type of dental facility used, which in turn could influence the levels of both the desired service and the acceptable adequate service for that individual. Most people in possession of a Medical Aid (Private health insurance) in South Africa are likely to be of a higher socio-economic position and are likely to visit private dental facilities which are perceived to offer a higher standard of care. On the other hand, the majority of those of lower socio-economic position use the public/government dental clinics, which are characterised by long queues, overcrowding and are often understaffed. Thus, people may have to wait for long periods of time to receive the necessary attention.

The question therefore is whether merely using a private or public facility is directly or indirectly associated with the level of patient satisfaction with the services received? If there is an indirect effect, how is this mediated? Could it be by the restrictions seen to be associated with the use of public facilities?

Considering that satisfaction with past dental services may be significantly associated with future regular dental attendance, understanding the pathway that leads to patient satisfaction with dental services received may contribute to an improved oral health status by promoting regular dental visits. In particular, the use of the structural equation model would allow us to determine the pivotal pathway to dental patient satisfaction. If the pathway is so identified, application of the information could contribute to an improvement in dental patient satisfaction, especially among those of lower socio-economic position. The aim of this study was therefore to investigate how differences in socio-economic position influence patient satisfaction with dental services received among South African adults.

METHODS

Study design and sample population

This cross-sectional study used a representative sample of South African adults aged 16 years and older who participated in the Human Sciences Research Council’s (HSRC) annual South African Social Attitude Survey (SASAS) during 2010 (n=3,112). The detailed sampling procedure for the SASAS, which was a household survey, has been published previously. Briefly, the SASAS used a multi-stage cluster sampling method to obtain a representative sample of adult South Africans, based on census enumeration areas. The survey procedure was approved by the HSRC’s Research Ethics Committee (No. 6/22/09/10 6).

MEASURES

Comprehensive demographic information obtained through the survey included: participants’ age, gender and current smoking status; a self-rated subjective socio-economic position on a scale of 1 to 10, with 1 representing those who see themselves as being at the bottom of the societal Manoux hierarchy; the area of residence categorised as rural, informal urban, and formal urban; the highest level of education attained categorised as <Grade 12, Grade 12 and >Grade 12 and medical aid (private health insurance) enrolment. The question items used were either adapted from the published literature or as used previously in past South African population surveys. The oral health-related questions included past 12-months dental visits, the type of dental facility attended (public/government or private dental clinic); the satisfaction with the dental services received and, for those who indicated being dissatisfied, the reason(s) for not being satisfied.

DATA ANALYSIS

Using structural equation modelling (SEM), an a priori model tested among past dental attendees hypothesized that a higher social position will be associated with having a medical aid. In turn that would result in a greater likelihood of using a private dental facility and having less waiting time for dental treatment which consequently leads to a higher level of satisfaction with the dental services received. The model was adjusted by removing non-significant pathways (bootstrap standardized estimates) and modified further based on inspection of modification indices. Adequacy of model fit was accessed using chi-square statistics (>0.05), Normed Fit Index (NFI) and Comparative Fit Index (CFI) of >0.9 and Root Mean Square Error of Approximation (RMSEA) ≤ 0.08.

RESULTS

Of the study participants, only 15.1% (n=540) reported a visit to a dentist in the past 12-month period. Of those who had made such a visit, 54.1% (n=312) reported being satisfied with the dental services received. Satisfaction
with the past dental visit was associated with a visit to a private dental facility, being in possession of a medical aid, education levels above Grade 12 and non-smoking (Table 1). Females tended to have a more positive but not statistically significant level of satisfaction whilst age and residence bore no significant relationship to levels of satisfaction (Table 1).

A significant positive correlation between self-rated subjective socio-economic position and educational level \((r=0.43; p<0.001)\) was observed. Those who were dissatisfied with services received were more likely to rate themselves as being of lower socio-economic position (the socio-economic ranking of those satisfied compared with those dissatisfied was 5.64 vs. 4.87; \(p\)-value < 0.001).

The most common reasons for dissatisfaction were long waiting time (33.1%), painful procedure (13%) and rude staff (10.4%) (Table 2). The fourth most common reason for dissatisfaction with dental services received was that the service was too expensive or that there was no value for money (8%), which exclusively applied to those who had visited a private dental facility.

The fit statistics suggest that the final SEM model (Figure 1) obtained fitted the data well \([χ^2(df10)=9.3; p=0.50; NFI=0.99; CFI=1.00; RMSEA=0.00; 0.00-0.04]\).

The path analysis from the structural equation model in Figure 1 demonstrates that there was no direct effect (pathway) of socio-economic position or of the use of private or public facility on the level of satisfaction with dental services. However, a long waiting time before treatment had the greatest direct effect on dental service satisfaction \((β=-0.31)\). In addition, the long waiting time also imposed an indirect effect which was mediated through a greater likelihood of having experienced rude staff and/or painful treatment.

**DISCUSSION**

This study demonstrated that only about half of South African adults who had received dental service in the preceding 12 months were satisfied. Furthermore, those dissatisfied with dental services received were more likely to be of a lower socio-economic position. The three most commonly reported reasons for dissatisfaction were long waiting time (systems level), having had a painful procedure (technical skills) and experience of rude staff (interpersonal/communication). Those who were dissatisfied with dental services due to long waiting times were significantly more likely to have visited a public dental facility (Table 2). Those who were dissatisfied due to the service being too expensive and having no value for money were exclusively and significantly those who had visited a private dental facility (Table 2). This is explicable as public dental facilities are mostly free in South Africa, so expense is unlikely to be an issue.

The path analysis indicated that the pathway to satisfaction with dental services was not directly related to the type of dental facility visited (i.e. private or public) to socio-economic position.

Rather the pathway was mediated positively through possession of medical aid and negatively by long waiting times, rude staff and having had a painful dental treatment. This suggests that the disparities in perceived quality of dental services received can be addressed by attending to the mediating factors identified in this study.

Being enrolled in a Medical Aid had a direct effect on the level of satisfaction with dental services received. Medical Aid membership, found in this study to be associated with being more affluent, may contribute directly to satisfaction with dental services irrespective of the type of dental facility in which the service was delivered. Hall and Dornan (1990), had indeed previously reported that more affluent patients simply receive better treatment from health staff than do less privileged patients, even within the same health care facility. However, being a member of a Medical Aid also had an indirect effect on satisfaction for it is then more likely that the member used a private facility rather than a public facility. Furthermore, being in possession of medical aid may have removed the financial burden of having to pay for the visit, reducing the perception of the treatment being too expensive and hence, also diminishing the likelihood of dissatisfaction.

Those who visited a private facility were significantly more likely to have reported being satisfied with the dental services received compared with those who visited a public/government facility (Table 1). However, the path analysis demonstrates that the effect of dental facility type on reporting satisfaction with dental services received is mainly indirect, through not having experienced a long waiting time \((β=-0.31)\) and, to a lesser extent, not having encountered rude staff \((β=-0.11)\) nor undergone painful treatment \((β=-0.24)\). These observations suggest that long waiting times may be the pivotal factor associated with dissatisfaction with dental services received irrespective of the type of dental facility attended, considering that such long delays influence the other two factors in the path analysis.

The use of a public dental facility as opposed to the use of a private dental facility was associated with a greater likelihood of reporting complaints about rude staff. This...
might be related to the fact that most of the public dental facilities are overburdened with large numbers of patients, all trying to seek care from a limited number of clinical operators who themselves are overworked and could conceivably become frustrated. Those who reported waiting for long periods were also more likely to have reported experiencing rude staff and, interestingly, were also more likely to have reported having had a painful procedure, both factors associated with dissatisfaction with dental services. It could be that the long waiting time might have actually reduced the ‘zone of tolerance’ or level of tolerance to pain. However, the experience of having had painful treatment may also be dependent on the procedure that the person underwent. This factor was not significantly different between those who visited a private, or those who visited a public, facility (Table 2).

Similarly, the long wait may have made the people less tolerant to the attitude of the dental staff and consequently may have perceived the harassed staff as rude. Alternatively, the agitated patients may, in their bid to secure more immediate attention, have in fact provoked the staff who reacted in a manner that may be considered rude.

The National Department of Health recently introduced National Core Standards to improve the quality of care received. The successful enhancement of value and attitudes; and the reduction of waiting times, two of the six standards, hopefully should reduce dissatisfaction with dental care. There will nevertheless be a need for further studies to assess whether the implementation of these National Core Standards actually improve satisfaction with services as may be inferred from the results of this study.

**LIMITATIONS OF THE STUDY**

The cross-sectional study design limits possible inferences on causality. The use of structural equation modelling, however, did provide some possible causal pathways that can be tested in future longitudinal studies.

The respondents were not asked what procedure they had received and how they paid for the procedure, and whether they paid the Board of Health Funders (BHF) rates or not. The recall bias may have influenced the responses of the respondents. Furthermore, there may be other reasons for dissatisfaction which were not captured/included in this study. A large number of study participants indeed selected ‘other’ reasons without specifying what those reasons were, even though they were provided with that option. Although the data were collected in 2010, it is unlikely that the structural elements of the relationship described in this study would have changed to any extent.

**CONCLUSIONS AND RECOMMENDATIONS**

The SEM analysis confirms that there is a relationship between SEP and patient satisfaction with dental services and identifies some of the factors influencing that relationship. Although there is need for further studies on the influence of more service quality attributes, it appears that waiting time influences the ‘zone of tolerance’. Therefore, interventions aimed at improving dental attendance, particularly for people of low-income, should include among other things a reduction in waiting time or perhaps prior information to patients on expected waiting time which can be regularly updated by staff, and in a polite manner. Other interventions could include the use of

**Table 1: Factors associated with satisfaction with dental visits**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% Satisfied</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of facility attended</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>64.4 (224)</td>
<td>0.001</td>
</tr>
<tr>
<td>Public/government</td>
<td>37.0 (88)</td>
<td></td>
</tr>
<tr>
<td><strong>Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>47.7 (44)</td>
<td>0.042</td>
</tr>
<tr>
<td>Informal urban</td>
<td>33.9 (14)</td>
<td></td>
</tr>
<tr>
<td>Formal urban</td>
<td>58.9 (254)</td>
<td></td>
</tr>
<tr>
<td><strong>Medical aid / Private Health insurance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>41.3 (136)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>69.9 (175)</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;Grade 12</td>
<td>47.2 (108)</td>
<td>0.003</td>
</tr>
<tr>
<td>Grade 12</td>
<td>49.2 (98)</td>
<td></td>
</tr>
<tr>
<td>&gt;Grade 12</td>
<td>71.4 (106)</td>
<td></td>
</tr>
<tr>
<td><strong>Age (in years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 – 24</td>
<td>49.4 (48)</td>
<td>0.878</td>
</tr>
<tr>
<td>25 – 34</td>
<td>55.9 (59)</td>
<td></td>
</tr>
<tr>
<td>35 – 44</td>
<td>55.1 (91)</td>
<td></td>
</tr>
<tr>
<td>45 – 54</td>
<td>52.8 (41)</td>
<td></td>
</tr>
<tr>
<td>54 – 64</td>
<td>62.3 (43)</td>
<td></td>
</tr>
<tr>
<td>65 +</td>
<td>52.6 (30)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>49.6 (134)</td>
<td>0.138</td>
</tr>
<tr>
<td>Female</td>
<td>58.4 (178)</td>
<td></td>
</tr>
<tr>
<td><strong>Smoker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>57.0 (260)</td>
<td>0.026</td>
</tr>
<tr>
<td>Yes</td>
<td>40.6 (52)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: Patient satisfaction with dental services and reasons for dissatisfaction by type of facility attended**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (%)</th>
<th>Private (%)</th>
<th>Public/government (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied with dental service received</td>
<td>54.1</td>
<td>64.4</td>
<td>37.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Reason for dissatisfaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long waiting time</td>
<td>33.1</td>
<td>5.9</td>
<td>58.8</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Painful visit</td>
<td>13.0</td>
<td>11.9</td>
<td>14.0</td>
<td>0.67</td>
</tr>
<tr>
<td>Rude staff</td>
<td>10.4</td>
<td>5.8</td>
<td>14.8</td>
<td>0.11</td>
</tr>
<tr>
<td>Expensive / no value for money</td>
<td>8.0</td>
<td>16.5</td>
<td>0</td>
<td>0.002</td>
</tr>
<tr>
<td>Not involved with the treatment</td>
<td>5.0</td>
<td>6.1</td>
<td>3.8</td>
<td>0.69</td>
</tr>
<tr>
<td>Other reasons</td>
<td>16.7</td>
<td>16.1</td>
<td>17.4</td>
<td>0.85</td>
</tr>
</tbody>
</table>
of positive distractions for the people waiting for dental treatment to reduce the boredom of a long wait, and also the training of staff in the dental facility on customer care. Nevertheless, every effort should be put in place to reduce the waiting time for dental treatment such that it remains within the ‘zone of tolerance’.

The findings of this study may also be seen to highlight the potential for the introduction of the National Health Insurance (NHl) to directly improve satisfaction with service received and thus to encourage more regular use of dental services and the promotion of prevention of dental disease. In particular, the findings suggest the need to focus on waiting time as an important performance standard when service agreements are signed with potential National Health Insurance (NHI) service providers, irrespective of whether they are located in a public or a private facility.

Conflict of interests: None declared

References

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Unique multi-action formula, proven to improve the appearance of teeth in **two weeks**

- Helps lift stains
- Helps prevent new stains forming
- Protects against plaque bacteria
- Fluoride helps strengthen teeth

LISTERINE® Advanced White should be used twice daily (10 ml twice daily for 60 seconds) after brushing as an adjunct to mechanical cleaning.
The efficiency of the referral system at Medunsa Oral Health Centre

SUMMARY

Introduction: The functioning of various referral systems in health service delivery at district level have been described.

Aims and objectives: To examine the effectiveness of the elective treatment referral system that operates internally at Medunsa Oral Health Centre. The proportion of emergency and non-emergency patients who consulted at the diagnostic unit and were subsequently referred for elective treatment at clinical units during February 2013 was compared with those who had actually received treatment one year later.

Design: This was a retrospective, comparative cross-sectional study in which existing medical records were reviewed.

Methods: Treatment records of emergency and non-emergency patients who consulted at the diagnostic unit and were subsequently referred to clinical units for elective treatment during February 2013 were reviewed one year later. The service register of the diagnostic unit for the month of February 2013 was also reviewed. Data related to the referral preferences of attending clinicians, demographic characteristics and dates when treatment was actually received was extracted.

Results: Significantly fewer (14.6%) patients of either group were treated than were referred. The average waiting time for treatment was 81.2 days and ranged between 6 and 184.5 days.

Conclusions: The internal referral system that operates at Medunsa Oral Health Centre was shown to be inefficient.

INTRODUCTION AND BACKGROUND

A hierarchical referral system is followed in the public health sector in South Africa. The functioning of various referral systems in service delivery at district level have been described. Very little was found in the literature concerning referral systems and dentistry.

A recent national health care facilities audit found that dental services are lacking across the board at primary health care level in South Africa. High attendance rates were reported where services were available and accessible. However, the range of services offered was often limited to emergency treatment of pain and sepsis.

A referral system operates between Medunsa Oral Health Centre, a dental school and a comprehensive care referral hospital in the outskirts of Pretoria, and dental clinics in the Tshwane health district. The effectiveness of this referral system has however not been examined.

At Medunsa Oral Health Centre new and repeat self-referred and referred patients, not on the hospital appointment system, routinely move between the diagnostic unit, a screening and referral clinic, where experienced dentists examine them and clinical units where dental students under faculty supervision provide treatment or treatment appointments are scheduled.

Emergency patients are triaged based on the severity of their illness, injury or pain and referred to emergency clinics. The attending dentist determines the appropriate treatment and referral options.

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Multiple problems are also assessed. They are however not addressed in emergency appointment -referrals are made to elective clinics at that time. At emergency clinics, the dentist will aim to reduce or stop the pain experienced. Emergency clinics can make referrals to elective clinics. Prosthodontics emergencies are referred to the prosthodontics clinic.

Patients with less urgent problems are referred for general dental care and or for initial assessment in the relevant specialty clinics. They are placed on a waiting list for care and are informed when a booking becomes available.

General dental examinations and care is offered through oral hygiene, minor oral surgery and operative dentistry clinics. This dental service includes routine dental examinations or check-up, oral health advice, scale and polish, extractions, fillings, fissure sealants and root canal treatments.

Referrals for specialist dental services from community oral health/ medical services also pass through the diagnostic unit. Specialist dental care is often provided as part of a treatment plan in combination with other specialty clinics.

The number and configuration of general care and specialty clinics has changed over the years. In the era of the traditional six-year training program - oral hygiene; operative dentistry; orthodontics; prosthodontics; periodontics; maxillofacial and oral surgery, and a combined diagnostic and radiology clinic comprised the clinical units. Following the switch from the traditional six-year to a five-year program, the diagnostic clinic became independent of the radiology clinic and an integrated clinical dentistry clinic was established.

Attempts have been made to establish referral rates for clinical units. This study examines the effectiveness of the elective treatment referral system that operates internally at Medunsa Oral Health Centre. Patient flow between the diagnostic and clinical units was investigated.

OBJECTIVES OF THE STUDY

1. To describe the demographic characteristics of patients who consulted at the diagnostic unit of Medunsa Oral Health Centre during the month of February, 2013
2. To determine and compare the proportions of emergency and non-emergency patients who required elective treatment with those who actually received treatment one year after consultation at the diagnostic unit
3. To determine the average elective treatment waiting time for clinical units
4. To identify patient factors associated with receiving elective treatment using multiple variable logistic regression

MATERIALS AND METHODS

Study design
This was a retrospective, comparative cross-sectional study in which existing medical records were reviewed.

Target population
The sampling frame consisted of treatment records of all patients, not on the hospital appointment system, who consulted at the diagnostic unit of Medunsa Oral Health Centre in February 2013.

Study sample
The ideal sample size was estimated at 323 patient records in nQuery Advisor, Release 7.0 software at the confidence interval of 95% and absolute precision of 5% assuming a referral rate of 30%. This study finally included a sample of 295 patient records.

Sampling method
A random sample of the population was selected. The lottery method of random sampling was used, i.e. patients were assigned numbers, and coupons with serial numbers ranging from 1 to 1209 were then thoroughly mixed in a bowl and 323 were drawn at random (without replacement) to provide the desired sample size.

MEASUREMENTS

Medical records
Treatment records of emergency and non-emergency patients who consulted at the diagnostic unit and were subsequently referred to clinical units for elective treatment during February 2013 were reviewed one year later. The service register of the diagnostic unit for February 2013 was also reviewed. Data related to the referral preferences of attending clinicians, demographic characteristics and dates when treatment was actually received at referral clinics was extracted.

Definition of variables
Age refers to patient age derived from date of birth recorded in the diagnostic unit service register.

Gender refers to sex (general state of being male or female)

Waiting time was defined as the time between the date of consultation at the diagnostic unit and the treatment date at clinical units.

Effectiveness was assessed by determining and comparing the proportions of patients who consulted at the diagnostic unit and were deemed to require and subsequently referred for elective treatment at clinical units of Medunsa Oral Health Centre with those who actually received the treatment.

Emergency patients are those who consulted at the diagnostic unit with an issue involving teeth and supporting tissues that was fixed/treated at the emergency clinics.

Emergency units are clinics where emergency oral and dental treatment is offered. They include the Minor Oral Surgery, Maxillofacial and Oral Surgery, and Care line clinics.

Care line clinic is an emergency clinic where restorative emergencies, dental pain and injuries to teeth and the pulp are treated.

Non-emergency patients are those who consulted at the diagnostic unit with less urgent problems, and were placed on a waiting list for care.

Ethical considerations
Ethical approval for the study was granted by the Ethics
Committee of the Sefako Makgatho Health Sciences University. Permission to conduct the study was granted by the Chief Executive Officer (CEO) of Medunsa Oral Health Centre.

STATISTICAL ANALYSIS / HYPOTHESIS TESTING

Data was captured, coded and cleaned in Microsoft Excel software and then transferred to Statistical Analysis Software (SAS) software for analysis.

Means, frequencies and proportions (percentages) were calculated.

Fisher’s Exact Test (two-sided) was performed to test the statistical significance of the difference in the proportions of patients referred to and treated in clinical units.

A multivariate logistic regression analysis was performed to identify patient factors associated with receiving elective treatment in the study population. The binary outcome of interest was received treatment (Yes/No). The determinants investigated included patient group i.e. emergency or non-emergency, age group, and gender.

RESULTS

Data extracted from a random sample of 295 treatment records was analysed.

Table 1: Demographic characteristics

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Male n (%)</th>
<th>Female n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-13 years</td>
<td>19 (14.6)</td>
<td>12 (7.4)</td>
</tr>
<tr>
<td>14-19 years</td>
<td>8 (6.2)</td>
<td>13 (8.0)</td>
</tr>
<tr>
<td>20-35 years</td>
<td>45 (34.6)</td>
<td>59 (36.2)</td>
</tr>
<tr>
<td>36-45 years</td>
<td>22 (16.9)</td>
<td>17 (10.4)</td>
</tr>
<tr>
<td>46-60 years</td>
<td>22 (16.9)</td>
<td>37 (22.7)</td>
</tr>
<tr>
<td>&gt;60 years</td>
<td>14 (10.8)</td>
<td>25 (15.3)</td>
</tr>
</tbody>
</table>

*Gender and age data missing in two female patients

Females constituted 55.9% of patients in the study sample. Male and female patients in the 20-35 years age group comprised just over a third (35.2%) of the sample. The gender distribution in age groups older than 35 was similar (44.6% male vs 48.4% female)

Table 3: Gender distribution of patients referred to emergency clinics

<table>
<thead>
<tr>
<th>Emergency clinics</th>
<th>Male n (%)</th>
<th>Female n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor Oral Surgery</td>
<td>59 (76.6)</td>
<td>81 (75)</td>
</tr>
<tr>
<td>Maxillofacial &amp; Oral Surgery</td>
<td>4 (5.2)</td>
<td>10 (9.3)</td>
</tr>
<tr>
<td>Care line</td>
<td>14 (18.2)</td>
<td>17 (15.7)</td>
</tr>
<tr>
<td>Total</td>
<td>77 (100)</td>
<td>108 (100)</td>
</tr>
</tbody>
</table>

*Nine (9) patients visited more than one emergency clinic

Just over three quarters of all emergency patients of both sexes visited the Minor Oral Surgery clinic. Few patients of either gender visited the Maxillofacial and Oral Surgery clinic. More males (18.2% vs 15.7%) than females visited the Care line clinic.

Table 4: Frequency of patient groups by numbers of elective referrals

<table>
<thead>
<tr>
<th>Patient groups</th>
<th>Zero</th>
<th>Single</th>
<th>Multiple</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>56</td>
<td>102</td>
<td>18</td>
<td>176</td>
</tr>
<tr>
<td>Non-emergency</td>
<td>6</td>
<td>71</td>
<td>42</td>
<td>119</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>173</td>
<td>60</td>
<td>295</td>
</tr>
</tbody>
</table>

Four out of five (78.9%) study subjects received elective treatment referrals. The majority (58% vs 59.7%) of both patient groups received a single referral. Just over a third (35.3%) of non-emergency patients and a tenth (10.2%) of emergency patients were referred to multiple clinical units.

Table 5: Distribution of elective care referrals among clinical units

<table>
<thead>
<tr>
<th>Clinical units</th>
<th>Referrals n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodontics</td>
<td>53 (17.79)</td>
</tr>
<tr>
<td>Operative Dentistry</td>
<td>113 (37.92)</td>
</tr>
<tr>
<td>Endodontics</td>
<td>5 (1.68)</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>18 (6.04)</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>55 (18.46)</td>
</tr>
<tr>
<td>Oral Hygiene</td>
<td>44 (14.77)</td>
</tr>
<tr>
<td>Integrated Clinical Dentistry</td>
<td>10 (3.36)</td>
</tr>
<tr>
<td>Total</td>
<td>298 (100)</td>
</tr>
</tbody>
</table>

Just less than forty percent (37.92) of all referrals were made to the Operative Dentistry clinic. Similar proportions (17.79% vs 18.46%) were made to Periodontics and Prosthodontics clinics. Fewer patients were referred to Orthodontics (6.04%), Integrated Clinical Dentistry (3.36%) and Endodontics (1.68%) clinics respectively.

More non-emergency patients than emergency patients were referred to Periodontics, Orthodontics, Prosthodontics and Oral Hygiene whereas more emergency patients than non-emergency patients were referred to Operative Dentistry and Endodontics clinics. Equal numbers were referred to the Integrated Clinical Dentistry clinic. There was substantial evidence (p <0.05) to reject the null hypothesis of no difference in the proportions of elective care referrals between emergency and non-emergency patients in the population for Operative Dentistry, Orthodontics, and Prosthodontics clinics. However, there was insufficient evidence (p>0.05) to reject the null hypothesis for

Table 2: Gender distribution of patient groups

<table>
<thead>
<tr>
<th>Patient groups</th>
<th>Male n (%)</th>
<th>Female n (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>76 (43.2)</td>
<td>100 (56.8)</td>
<td>176 (100)</td>
</tr>
<tr>
<td>Non-emergency</td>
<td>54 (45.4)</td>
<td>65 (54.6)</td>
<td>119 (100)</td>
</tr>
<tr>
<td>Total</td>
<td>130 (44.1)</td>
<td>165 (55.9)</td>
<td>295 (100)</td>
</tr>
</tbody>
</table>

Emergency patients comprised 59.7% of study subjects. Female patients constituted 56.8% and 54.6% respectively of emergency and non-emergency patients. However, there is insufficient evidence (p>0.05) to reject the null hypothesis of no gender difference in the proportions of emergency and non-emergency patients.
Periodontics, Endodontics, Oral Hygiene and Integrated Clinical Dentistry clinics.

Fewer patients from either group (14.6%) were treated than were referred during the study period. Elective care was received at a rate of one in thirteen and one in sixteen for emergency and non-emergency patients respectively. There was insufficient evidence (p>0.05) to reject the null hypothesis of no difference in the proportions of patients who received elective care between emergency and non-emergency patients in the population.

More non-emergency patients than emergency patients received treatment at Periodontics, Operative Dentistry, Prosthodontics and Oral Hygiene clinics whereas more emergency patients than non-emergency patients received treatment at Endodontics and Orthodontics clinics. There was substantial evidence (p<0.05) to reject the null hypothesis of no difference in the proportions of patients who received elective treatment between emergency and non-emergency patients in the population at Prosthodontics clinic. However, there was insufficient evidence (p>0.05) to reject the null hypothesis of no difference in the proportions of patients who received elective treatment between emergency and non-emergency patients in the population at all other clinical units.

Table 6: Comparison of elective treatment referrals at different clinics between patient groups

<table>
<thead>
<tr>
<th>Clinics</th>
<th>Patient groups</th>
<th>Total</th>
<th>Fisher's Exact Test (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emergency n (%)</td>
<td>Non-emergency n (%)</td>
<td></td>
</tr>
<tr>
<td>Periodontics</td>
<td>23 (43.4)</td>
<td>30 (56.6)</td>
<td>53</td>
</tr>
<tr>
<td>OpDent</td>
<td>68 (67.5)</td>
<td>45 (42.5)</td>
<td>113</td>
</tr>
<tr>
<td>Endodontics</td>
<td>4 (80)</td>
<td>1 (20)</td>
<td>5</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>5 (27.8)</td>
<td>13 (72.2)</td>
<td>18</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>17 (30.9)</td>
<td>38 (69.1)</td>
<td>55</td>
</tr>
<tr>
<td>Oral Hygiene</td>
<td>18 (40.9)</td>
<td>26 (59.1)</td>
<td>44</td>
</tr>
<tr>
<td>ICD</td>
<td>5 (50)</td>
<td>5 (50)</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 7: Comparison of elective treatment received between patient types

<table>
<thead>
<tr>
<th>Patient groups</th>
<th>Elective care recipients</th>
<th>Total</th>
<th>Fisher's Exact Test (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Emergency</td>
<td>16 (13.3)</td>
<td>104 (86.7)</td>
<td>120 (100)</td>
</tr>
<tr>
<td>Non-emergency</td>
<td>18 (15.9)</td>
<td>95 (84.1)</td>
<td>113 (100)</td>
</tr>
</tbody>
</table>

Table 8: Comparison of elective treatment received at different clinics between patient groups

<table>
<thead>
<tr>
<th>Clinics</th>
<th>Treatment recipients</th>
<th>Total</th>
<th>Fisher's Exact Test (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emergency n (%)</td>
<td>Non-emergency n (%)</td>
<td></td>
</tr>
<tr>
<td>Periodontics</td>
<td>2 (33.3)</td>
<td>4 (66.7)</td>
<td>6 (100)</td>
</tr>
<tr>
<td>Operative Dentistry</td>
<td>7 (46.7)</td>
<td>8 (53.3)</td>
<td>15 (100)</td>
</tr>
<tr>
<td>Endodontics</td>
<td>1 (100)</td>
<td>0 (0)</td>
<td>1 (100)</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>2 (100)</td>
<td>0 (0)</td>
<td>2 (100)</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>3 (21.4)</td>
<td>11 (78.6)</td>
<td>14 (100)</td>
</tr>
<tr>
<td>Oral Hygiene</td>
<td>4 (44.4)</td>
<td>5 (55.6)</td>
<td>9 (100)</td>
</tr>
<tr>
<td>ICD Dentistry</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A total of 16 emergency and 18 non-emergency patients received treatment at multiple clinical units.

Table 9: Average elective treatment waiting time at different clinics

<table>
<thead>
<tr>
<th>Clinics</th>
<th>Median days (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodontics</td>
<td>6 (6 -6)</td>
</tr>
<tr>
<td>Operative Dentistry</td>
<td>68 (17-196)</td>
</tr>
<tr>
<td>Endodontics</td>
<td>25 (25 -25)</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>184.5 (2 -367)</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>35 (2-232)</td>
</tr>
<tr>
<td>Oral Hygiene</td>
<td>21(2-368)</td>
</tr>
<tr>
<td>Integrated Clinical Dentistry</td>
<td>10 (3.36)</td>
</tr>
<tr>
<td>Total</td>
<td>298 (100)</td>
</tr>
</tbody>
</table>

Table 10: Logistic regression analysis of factors associated with receiving elective treatment in the study population

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter estimate</th>
<th>Standard error</th>
<th>Wald Chi-square</th>
<th>p-value</th>
<th>Estimated odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-0.171</td>
<td>0.381</td>
<td>0.201</td>
<td>0.654</td>
<td>0.843</td>
</tr>
<tr>
<td>Age group 1</td>
<td>2.293</td>
<td>1.513</td>
<td>2.296</td>
<td>0.130</td>
<td>9.901</td>
</tr>
<tr>
<td>Age group 2</td>
<td>0.001</td>
<td>0.731</td>
<td>0.000</td>
<td>0.999</td>
<td>1.001</td>
</tr>
<tr>
<td>Age group 3</td>
<td>-0.455</td>
<td>0.892</td>
<td>0.260</td>
<td>0.610</td>
<td>0.635</td>
</tr>
<tr>
<td>Age group 4</td>
<td>-0.557</td>
<td>0.609</td>
<td>0.834</td>
<td>0.361</td>
<td>0.573</td>
</tr>
<tr>
<td>Age group 5</td>
<td>0.031</td>
<td>0.690</td>
<td>0.002</td>
<td>0.964</td>
<td>1.032</td>
</tr>
<tr>
<td>Age group 6</td>
<td>0.154</td>
<td>0.605</td>
<td>0.065</td>
<td>0.799</td>
<td>1.167</td>
</tr>
<tr>
<td>Age group</td>
<td>0.154</td>
<td>0.605</td>
<td>0.065</td>
<td>0.799</td>
<td>1.167</td>
</tr>
<tr>
<td>Patient groups</td>
<td>0.670</td>
<td>0.378</td>
<td>3.140</td>
<td>0.076</td>
<td>1.965</td>
</tr>
</tbody>
</table>
The average time lapse between consultation at the diagnostic unit and receipt of treatment in clinical units was 81.2 days with a range of just under a week (6 days) to longer than six months (184.5 days). The waiting time was relatively short for Periodontics (6 days), Oral Hygiene (21 days), Endodontics (25 days), and Prosthodontics (35 days) intermediate for Operative Dentistry (68 days) and long for Orthodontics (184.5 days).

Analysis codes: Gender (0 = male, 1 = female); Patient groups (0 = non-emergency patient, 1= emergency patient)

There was no indication of an independent relationship (p>0.05) between receiving elective treatment, gender, age group and patient groups in the study population.

**DISCUSSION**

This study set out to investigate the effectiveness of the referral system that operates at Medunsa Oral Health Centre. Comparable studies were not found – the functioning of referral systems at dental schools has not previously been described. A possible explanation for this might be that the inefficiency of dental school clinics is generally recognised: Treatment is provided by students according to their level of training under faculty supervision; Treatment times are longer than would be experienced in private dental practices, and lack of treatment continuity as patients are passed from year to year and from one student provider to another.7

**Demographic characteristics**

The results of this study indicate that more women than men (55.9% female vs. 44.1% male) visited Medunsa Oral Health Centre and that two thirds of the patients were aged 45 years and younger.

The present findings seem to be consistent with other research which found a large female preponderance at dental clinics.7,14 The age structure of the study population is consistent with that described by Lesolang and colleagues.7

**Comparison of the proportions of referred and treated emergency and non-emergency patients**

The current study found that more non-emergency patients than emergency patients were referred for elective treatment. However, few patients of either group received treatment than were referred in all clinical units. The most interesting finding was that an overwhelming majority (78.9%) of the study subjects were deemed to require elective treatment and received referrals, the bulk of which were to the Operative Dentistry clinic.

Considering that Medunsa Oral Health Centre is a comprehensive treatment referral hospital, the finding that more non-emergency patients than emergency patients were referred for elective treatment was not unexpected. It was however, rather disappointing that less than 20% had received care one year later. Otherwise, the study produced results which corroborate the findings of a great deal of the previous work in this field i.e. a large number, 31.8% of emergency patients in the current study, of self-referred patients inappropriately utilising the service for basic curative services i.e. extractions, which could be satisfactorily provided at primary care facilities where available.15 Murray and Pearson contend that self-referred patients potentially affect the workload at the hospital, impact on resource utilisation and are an inefficient use of hospital resources.16

One of the issues that emerge from these findings is that symptomatic dental attendance is common at Medunsa Oral Health Centre. An implication of this is that the referral system that operates between Medunsa Oral Health Centre and dental clinics in the Tshwane health district is not effective – 31.8% of emergency patients bypassed it. Further work is required to investigate this referral system. Factors such as accessibility, acceptability, efficiency and effectiveness have been identified as influential in the use of a referral system.7,13

The large discrepancy between the proportions of patients who received treatment than were referred in all clinical units suggests Medunsa Oral Health Centre’s internal referral system is ineffective. The reason for this is not clear but treatment provided by students is widely recognised to be inefficient due to such limitations as lengthy waits for instructors and materials, lack of auxiliary staff, poor scheduling systems and general “red tape” built into the teaching system.7,13 There are, however, other possible explanations.

The large number of patients who require general dental care observed in this study reflects the high levels of untreated dental caries reported in studies of dental caries prevalence in South Africa.20, 21

**Average waiting time for treatment in the clinical units**

The results of this study show that the average waiting time for treatment in clinical units at Medunsa Oral Health Centre was 81.2 days and ranged between 6 and 184.5 days. It was the shortest for Periodontics (6 days) and longest for Orthodontics (184.5 days).

The average waiting time observed in the current study was significantly higher than the maximum waiting time of 45.8 days that was reported to be acceptable to patients in the City of Turku in Finland.22 Timely access is an important determinant of patient satisfaction.23 Long waiting times have been associated with reduced use of dental services.24

A possible explanation for the long waiting time for treatment may be failure by patients to keep appointments and cancelled appointments. The rate of non-attended dental appointments at Medunsa Oral Health Centre has not been established. A non-attendance rate of 35% has recently been reported at a remote rural dental training facility in Australia.25

Very little was found in the literature on the subject of waiting time for non-emergency dental treatment. Previous research has tended to examine either waiting time for consultation in the equivalent of a diagnostic unit in the current study26 or waiting time for dental treatment with sedation or general anaesthesia.27,28 Further studies on the current topic in populations seeking treatment at dental schools are therefore recommended. Research questions that could be asked include the acceptable waiting time for elective dental care.

The long waiting time for Orthodontics might be related to necessary waiting times to allow the jaw to develop fully.20
It is however difficult to explain the small number of patients treated in relation to the relatively short waiting time for treatment at the periodontics clinic.

Factors associated with receiving elective care

The multivariable analyses of the current study did not find any association between receiving elective curative treatment and gender, age group and patient group.

This finding has previously not been described. Further studies, which take these variables into account, will need to be undertaken. A significant gender difference in the receipt of preventive treatment was however identified at the bivariate level in a dental school patient population in Wisconsin, USA.31

Limitations of the study

A potential threat to the internal validity of this study was the large number of significance test which were carried out. This increases the type 1 error rate, which leads to spurious conclusions.

Another potential threat was the loss to follow up of 8.7% (28/323) of the study sample.

CONCLUSION

The internal referral system that operates at Medunsa Oral Health Centre was assessed as inefficient in the present study.

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Conflict of interest: None declared.

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8. Medical University of Southern Africa. Faculty of Dentistry Calendar Volume III 2002.
9. University of Limpopo (Medunsa Campus), Faculty of Dentistry Calendar Volume III 2006.
Comparing repeat and first visit patients’ satisfaction with service quality at Medunsa Oral Health Centre

SUMMARY
Introduction: The SERVQUAL model is commonly used in medical centres to assess patient satisfaction with service quality.

Aims and objectives: This study examines patient satisfaction with their experience at Medunsa Oral Health Centre. Satisfaction rates of first time and repeat patients were determined and compared using SERVQUAL dimensions. Factors associated with patient satisfaction were identified using a multiple variable logistic regression model.

Design: This was a comparative cross-sectional descriptive study.

Methods: A pretested routinely used standardised SERVQUAL questionnaire was used to collect data from study participants at Medunsa Oral Health Centre. It consisted of 16 questions which rated mainly positive statements of six dimensions of service quality using a five response categories Likert scale. The categories were strongly agree, agree, unsure, disagree and strongly disagree and the scale was anchored from -2 through to 2. The benchmark score for an overall satisfied patient was 16 out of a total possible score of 32.

Results: Two-thirds of both patient groups were satisfied overall. Differences in satisfaction rates for all service quality dimensions were not statistically significant. Access, empathy, reliability, and tangible exerted a significant influence.

Conclusions: Patient satisfaction with service quality was high - no differences were found between study groups.
includes two additional dimensions, access and general satisfaction, associated with patient satisfaction. This standardized questionnaire, which surveys expectations and perception in one questionnaire arranged under the five SERVQUAL domains plus access and general satisfaction, is used routinely within the Department of Health. \(^4\) It is administered annually to all consenting patients at Medunsa Oral Health Centre, a dental school and referral hospital, in Garankuwa on the outskirts of Pretoria as they exit the hospital.

The Department of Health in Gauteng reports average service quality satisfaction scores for entire patient populations at public dental hospitals - subgroups, first time and repeat users, are however surveyed. Conflicting results have been reported in patient subgroups among general hospital patients. A literature search yielded no studies that focus on satisfaction rates between first time and repeat users of dental hospitals. This study sought to test whether there were differences in satisfaction rates between new and repeat patients, not on the hospital appointment system, at Medunsa Oral Health Centre to indirectly check for continued improvement in service quality. These patients are routinely screened at the diagnostic unit and subsequently referred to appropriate clinical units for further evaluation and treatment.

OBJECTIVES OF THE STUDY
1. To describe the demographic characteristics of first time and repeat patients who consulted at the diagnostic unit between October 2014 and May 2015.
2. To determine and compare overall and individual quality dimension satisfaction rates between first time and repeat patients.
3. To identify factors associated with patient satisfaction using multiple variable logistic regression.

MATERIALS AND METHODS

Study design.
This was a comparative cross-sectional descriptive study.

Target population
The study population consisted of patients who were not on the hospital appointment system, who consulted at the diagnostic unit between October 2014 and May 2015.

Study sample
A total of ninety one patients in each group of repeat and first time patients were required in nQuery Advisor, Release 7.0 software for a two-sided chi-square test to have an 80% chance of detecting a difference of 20% in satisfaction rate at the 5% level of significance. A response rate of 70% was obtained from a sample of 275 patients. This study finally included a sample of 194 patients i.e. 97 patients in each group.

Sampling method
A systematic random sample was selected i.e. the first patient in either study group, identified by hospital registration number, was chosen at random and then every third patient was selected to participate in the study.

MEASUREMENTS

Client Satisfaction Survey Questionnaire
A Health Systems Trust Client Satisfaction Survey Questionnaire updated for the Gauteng Provincial Health Department was used to collect data from study participants. \(^10\) For a more detailed discussion of the validity and reliability of this questionnaire see Smith and Engelbrecht. \(^4\) Patients – first time or repeat, or their parent/guardian in the case of minors, completed the pre-tested questionnaire themselves or were assisted by the research team on exit from the hospital following service at respective referral clinical units. They received the questionnaire following consultation at the diagnostic unit. It consisted of 16 questions which rated mainly positive statements of six dimensions of service quality using a five response categories Likert scale. The categories were strongly agree, agree, unsure, disagree and strongly disagree and the scale was anchored from -2 through to 2. A respondent whose score equalled or was greater than the number of statements for a particular dimension was deemed satisfied with that dimension. A respondent whose score was less than the number of statements for a particular dimension was deemed not satisfied with that dimension. The benchmark score for an overall satisfied patient was 16 out of a total possible score of 32.

Definition of variables
SERVQUAL is a quality management framework used to measure quality in the service sector. \(^6\)

Age refers to patient age derived from date of birth recorded in the diagnostic unit service register.

Gender refers to sex (general state of being male or female)

Patient group refers to whether the patient is a first time or repeat user of the health facility.

A satisfied patient was defined as one with a score equal to or greater than the number of statements relating to a particular dimension of service quality.

An overall satisfied patient was defined as one with an aggregate score equal to or greater than 16 out of a possible total score of 32

Access measures the level of satisfaction with how reachable/available health services are. Respondents were asked to respond to the following statements:
- It takes more than 30 minutes to get to the hospital
- It costs more than R20, 00 to get to the hospital
- The outpatient/casualty department has convenient hours of opening

Empathy measures the ability to care and display compassion towards clients. Respondents were asked to respond to the following statements:
- The nurse who welcomed me listened to my problems
- The doctor who treated me was polite
- My privacy was respected by all the staff

Reliability measures the ability to accurately perform the service offered. Respondents were asked to respond to the following statements:
- I had to wait a long time to get my folder
- The doctor explained to me what was wrong with me
- If I received medicines/pills I did not have to wait long for them
Tangible (facilities) refers to equipment, physical surroundings. Respondents were asked to respond to the following statements:

- The hospital is in good condition
- The hospital is clean
- There was a bench for me to sit on while I waited
- The toilets are clean

General satisfaction measures the level of satisfaction with overall services rendered within the health facility.

Respondents were asked to respond to the following statements:

- I was pleased with the way I was treated at the hospital
- Next time I am ill I will come back here

Responsiveness measures the willingness to assist clients. Respondents were asked to respond to the following statement:

- The person who gave me my folder was helpful

Ethical considerations

Only patients who provided informed consent were enrolled. All data collection and analysis and reporting was done without any personal identifiers. Patients had the opportunity to refuse participation at any time without any repercussion. Ethical approval for the study was granted by the Ethics Committee of the Sefako Makgatho Health Sciences University. Permission to conduct the study was granted by the Chief Executive Officer (CEO) of Medunsa Oral Health Centre.

STATISTICAL ANALYSIS/HYPOTHESIS TESTING

Collected data were subjected to uni-variate, bi-variate and multi-variate analysis in Statistical Analysis Software (SAS) software. Frequencies and proportions were calculated.

The reliability co-efficient of the questionnaire was calculated using Cronbach’s alpha.

Chi-squared test was performed to test the statistical significance of the difference in the proportions of satisfied repeat and first time patients.

A multi-variable logistic regression analysis was performed to identify determinants of overall patient satisfaction. The binary outcome of interest was overall patient satisfaction. The determinant included patient group i.e. repeat or first time, age, gender, and the six dimensions of service quality i.e. access, empathy, reliability, tangible, general satisfaction, and responsiveness.

RESULTS

Data of a systematic random sample of 194 first time and repeat patients was analysed. A response rate of 70% was obtained.

### Table 1: Distribution by age and gender

<table>
<thead>
<tr>
<th>Age groups</th>
<th>First time patients</th>
<th></th>
<th></th>
<th>Repeat patients</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males n(%)</td>
<td>Females n(%)</td>
<td>Total n(%)</td>
<td>Males n(%)</td>
<td>Females n(%)</td>
<td>Total n(%)</td>
</tr>
<tr>
<td>&lt;18</td>
<td>5 (55.6)</td>
<td>4 (44.4)</td>
<td>9 (100)</td>
<td>2 (20)</td>
<td>8 (80)</td>
<td>10 (100)</td>
</tr>
<tr>
<td>18-24</td>
<td>5 (33.3)</td>
<td>10 (66.7)</td>
<td>15 (100)</td>
<td>7 (43.8)</td>
<td>9 (56.2)</td>
<td>16 (100)</td>
</tr>
<tr>
<td>25-34</td>
<td>14 (50)</td>
<td>14 (50)</td>
<td>28 (100)</td>
<td>13 (48.1)</td>
<td>14 (51.9)</td>
<td>27 (100)</td>
</tr>
<tr>
<td>35-44</td>
<td>9 (52.9)</td>
<td>8 (47.1)</td>
<td>17 (100)</td>
<td>6 (35.3)</td>
<td>11 (64.7)</td>
<td>17 (100)</td>
</tr>
<tr>
<td>45-54</td>
<td>5 (27.8)</td>
<td>13 (72.2)</td>
<td>18 (100)</td>
<td>3 (37.5)</td>
<td>5 (62.5)</td>
<td>8 (100)</td>
</tr>
<tr>
<td>55-64</td>
<td>1 (25)</td>
<td>3 (75)</td>
<td>4 (100)</td>
<td>9 (60)</td>
<td>6 (40)</td>
<td>15 (100)</td>
</tr>
<tr>
<td>65+</td>
<td>1 (16.7)</td>
<td>5 (83.3)</td>
<td>6 (100)</td>
<td>2 (50)</td>
<td>2 (50)</td>
<td>4 (100)</td>
</tr>
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</table>

### Table 2: Reliability coefficient of quality dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>0.493</td>
</tr>
<tr>
<td>Empathy</td>
<td>0.703</td>
</tr>
<tr>
<td>Reliability</td>
<td>0.163</td>
</tr>
<tr>
<td>Tangible</td>
<td>0.674</td>
</tr>
<tr>
<td>General satisfaction</td>
<td>0.520</td>
</tr>
</tbody>
</table>

Demographic characteristics

Children younger than 18 years; patients in the 25-34 age group, and adults older than sixty four years constituted 9.8%, 28.4% and 5.2% of the entire sample size respectively. The gender distribution between first time (41.2% males vs.58.8% females) and repeat (43.3% males vs. 56.7% females) patients was similar.

Just over two-thirds (68%, 70.1%, and 69.1%) of both patient groups and the entire sample were satisfied overall. More than half (56.7%) of the entire sample size were not satisfied with access. Eight percent more (47.4% vs. 39.2%) first time patients were satisfied with access compared with repeat patients.

Just less than a third (31.4%) of the entire sample was satisfied with the reliability of the service. Seven percent more (72.2% vs. 65%) first time patients were satisfied with the reliability of the service.

An overwhelming majority of both patient groups and the entire sample were otherwise satisfied with the remainder of service quality dimensions.

Differences in satisfaction rates between first and repeat patients for all service quality dimensions were not statistically significant (p>0.05).

### Identity of factors associated with patient satisfaction

The results indicated that access, empathy, reliability, and tangible were independently associated with overall patient satisfaction.

Patients who were satisfied with access had 0.062 times the odds of being satisfied overall as those not satisfied with access, after adjusting for empathy, reliability, tangible, general satisfaction, responsiveness, gender, patient group
and age. In other words, the odds of being satisfied overall in these patients decreased by 94%.

Patients who were satisfied with staff empathy had 0.037 times the odds of being satisfied overall as those not satisfied with empathy, after adjusting for access, reliability, tangible, general satisfaction, responsiveness, gender, patient group and age. In other words, the odds of being satisfied overall in these patients decreased by 96%.

Patients who were satisfied with the reliability of the service had 0.191 times the odds of being satisfied overall as those not satisfied with reliability, after adjusting for access, empathy, tangible, general satisfaction, responsiveness, gender, patient group and age. In other words, the odds of being satisfied overall in these patients decreased by 81%.

Patients who were satisfied with the facilities (tangible) had 0.022 times the odds of being satisfied overall as those not satisfied with facilities, after adjusting for access, empathy, reliability, general satisfaction, responsiveness, gender, patient group and age. In other words, the odds of being satisfied overall in these patients decreased by 98%.

In contrast, there was no indication of an independent relationship between general satisfaction, responsiveness, patient group, and age.

We had insufficient evidence to reject the null hypothesis of no association between gender and overall satisfaction in the population at the 5% level. However, as the p value is only just greater than 0.05, there may be an indication of an independent relationship between gender and overall satisfaction. The confidence interval includes values for the odds ratio as high as 5.517.

**DISCUSSION**

This study set out to test whether there were differences in satisfaction rates between new and repeat patients at Medunsa Oral Health Centre.

Patient satisfaction surveys are conducted annually at public hospitals in Gauteng. The results of the current study are discussed with reference to the

<table>
<thead>
<tr>
<th>Table 3: Satisfaction rates between new and repeat patients by quality dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient groups</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>First time</td>
</tr>
<tr>
<td>Repeat</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time</td>
<td>46 (47.4)</td>
<td>51 (52.6)</td>
</tr>
<tr>
<td>Repeat</td>
<td>38 (39.2)</td>
<td>59 (60.8)</td>
</tr>
<tr>
<td>Total</td>
<td>84 (43.3)</td>
<td>110 (56.7)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Empathy</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time</td>
<td>84 (86.6)</td>
<td>13 (13.4)</td>
</tr>
<tr>
<td>Repeat</td>
<td>89 (91.8)</td>
<td>8 (8.2)</td>
</tr>
<tr>
<td>Total</td>
<td>173 (89.2)</td>
<td>21 (10.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reliability</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time</td>
<td>27 (27.8)</td>
<td>70 (72.2)</td>
</tr>
<tr>
<td>Repeat</td>
<td>34 (35)</td>
<td>63 (65)</td>
</tr>
<tr>
<td>Total</td>
<td>61 (31.4)</td>
<td>133 (68.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tangible</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time</td>
<td>83 (85.6)</td>
<td>14 (14.4)</td>
</tr>
<tr>
<td>Repeat</td>
<td>89 (91.8)</td>
<td>8 (8.2)</td>
</tr>
<tr>
<td>Total</td>
<td>172 (88.7)</td>
<td>22 (11.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General satisfaction</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time</td>
<td>91 (93.8)</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Repeat</td>
<td>91 (93.8)</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Total</td>
<td>182 (93.8)</td>
<td>12 (6.2)</td>
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<table>
<thead>
<tr>
<th>Responsiveness</th>
<th>Satisfied n (%)</th>
<th>Not satisfied n (%)</th>
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<tbody>
<tr>
<td>First time</td>
<td>91 (93.8)</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Repeat</td>
<td>91 (93.8)</td>
<td>6 (6.2)</td>
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<tr>
<td>Total</td>
<td>182 (93.8)</td>
<td>12 (6.2)</td>
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<tr>
<th>Table 4: Logistic regression analysis of overall patient satisfaction in the study population</th>
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<tbody>
<tr>
<td>Variable</td>
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</tr>
<tr>
<td>Intercept</td>
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<tr>
<td>Access</td>
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<tr>
<td>Empathy</td>
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<tr>
<td>Reliability</td>
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<tr>
<td>Tangible (facilities)</td>
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<tr>
<td>General satisfaction</td>
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<tr>
<td>Responsiveness</td>
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<tr>
<td>Gender</td>
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<tr>
<td>Patient group</td>
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<tr>
<td>Age</td>
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</table>
Report of the 2008 survey was not available. Comparisons are made with results for dental hospitals. Differences in summary measures used to analyse results made it difficult to compare the results. The current study used percentiles whereas the previous study used averages to analyse client responses.

The satisfaction rates for dental hospitals surveyed in 2008 were calculated using a method defined in the reference study - an average score of 2 meant 100% satisfaction by all clients, a score of 1 meant a 50% satisfaction level and a score of 0 meant patients were neither satisfied nor unsatisfied. The results indicate that dental hospital patient populations are less satisfied with access and reliability of the services, more so at Pretoria and Wits dental hospitals.

The results of the current study compare favourably with those of the previous study for all quality dimensions except reliability.

Demographic characteristics
The results of this study indicate that the groups were similar in terms of age and gender distribution. More women than men visited the clinic. Relatively few children visited the hospital.

The present findings seem to be consistent with other research which found a large number of female patients at dental clinics. One unanticipated finding was the low number of children patients considering that the study period included school holidays.

Reliability of the questionnaire
In this study, Cronbach’s alpha scores less than 0.7 were obtained for the majority of the quality dimensions. These findings are rather disappointing since the commonly-accepted rule of thumb is that for research purposes alpha should be more than 0.7 to 0.8. They are however consistent with those found by Adebayo and colleagues in Nigeria.

The alpha scores obtained in the 2008 survey were not available for comparison. They would have been higher than those achieved in the current study as the questionnaire was administered by a field work team who were conversant in the languages widely spoken by the study population.

Comparison of the satisfaction rates between first time and repeat patients
The current study found that just over two-thirds of both patient groups were satisfied overall. Satisfaction rates for empathy, tangible, general satisfaction, and responsiveness were high and broadly similar between the study groups. However, the satisfaction rates for access and reliability were appreciably low in both study groups. The differences in satisfaction rates for all service quality dimensions between the study groups were not statistically significant (p>0.05).

These results are consistent with those observed at dental hospitals across Gauteng in the previous study. These findings suggest that access and reliability exert a significant influence in dental patient perception of service quality.

The differences in satisfaction rates for reliability observed at Medunsa Oral Health Centre between the previous and current study can be explained by differences in the way the variable was treated in the analysis. In the previous study responses to the question - If I received medicines/pills I did not have to wait long for them – were excluded from analysis.

A possible explanation for the improved satisfaction rates for empathy, tangible, general satisfaction, and responsiveness obtained in the current study might be that the management of the facility continues to improve the service quality in response to the findings of annual surveys. However, with a response rate of 70% and the exclusion of patients on the hospital appointment system, caution must be applied, as the findings might not be generalizable to all patients who consult at Medunsa Oral Health Centre.

This study has been unable to demonstrate that first time users tend to give a higher satisfaction rating than repeat users as reported by Huang and colleagues in emergency medical services. The present findings are however consistent with the study which found no difference in satisfaction between first time users and repeat users in a study of clinics in the UK.

Factors associated with patient satisfaction
In the current study access, empathy, reliability, and tangible were independently associated with overall patient satisfaction. In contrast, there was no indication of an independent relationship between general satisfaction, responsiveness, patient group, gender and age.

This finding supports previous research of patient satisfaction in dental school clinics which identified access, empathy, equipment and physical surroundings of the service as important determinants of satisfaction. In contrast to earlier findings by John and colleagues, responsiveness was not independently associated with patient satisfaction in the current study.

The age and gender findings of the current study are consistent with those of Adeniyi and colleagues who found no statistically significant association with overall satisfaction score. These variables are however inconsistently associated with ratings of satisfaction.

Limitations of the study
Within group i.e. first time or repeat patients, comparisons were not carried out.

The potential threats to the internal validity of the study were those arising from non-response bias and the lack of reliability of the questionnaire – a response rate of 70% was obtained and the questionnaire was not translated from original language into local languages – this could have improved the reliability of the questionnaire.

CONCLUSION
In the present study, patient satisfaction with service quality at Medunsa Oral Health Centre was high and no differences were found between first and repeat patients.

Acknowledgements: The authors would like to extend their appreciation to the Health Systems Trust for granting them permission to use the Client Satisfaction Survey Questionnaire.
Conflict of interest: None declared

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16. Arain M, Nicholls J, Campbell M. Patients’ experience and satisfaction with GP led walk-in centres in the UK; a cross sectional study, BMC Health Services Research 2013;13:142
Piloting the Community Service Attitudes Scale in a South African context with matching qualitative data

AcRONYMS

CSAS: Community Service Attitudes Scale
SL: Service learning

ABSTRACT

Introduction: There is a need to measure the social accountability of dental students following service learning (SL) exposure.

Objectives: To pilot the Community Service Attitudes Scale (cSAS) and to test its reliability in a South African context while matching cSAS findings with students’ perceptions of their SL experience.

Methods: Final year dental students at Sefako Makgatho University anonymously completed a modified version of the CSAS and submitted written reflections before and after SL exposure. Students also participated in two focus group discussions after exposure. Before and after CSAS data were statistically compared using t-tests. Qualitative data from the focus groups and reflective essays were matched against the findings of the CSAS.

Results: Students (n=41, 76% CSAS response rate) generally displayed positive attitudes towards communities in need, both before and after exposure (no statistical difference). The CSAS internal consistency was excellent ($\alpha = 0.96$). Qualitative findings suggested a need for stakeholders’ involvement in the procurement of SL resources and in meeting community needs. There was tension between SL and quota-driven dental training.

Conclusion: The CSAS showed good reliability and appears a useful tool to measure social accountability in South Africa. The qualitative findings need further investigation.

INTRODUCTION

Service learning has become an integral part of dental education.1 Service learning (SL) is included in undergraduate curricula to develop the social awareness and responsibility of students by exposing them to communities in need.2 It has been proposed that the alignment of academic objectives with a SL experience, followed by structured reflection, brings about critical, deep and long-lasting learning that embraces community dynamics.3 It also fosters social responsibility which will help influence and shape public policy in future. Thus, dental graduates are expected to become advocates for needy communities.3

The effect of SL on the attitudes of dental students has been measured on several occasions.4-6 The majority of studies, mostly conducted in developed countries, suggested positive effects on students’ attitudes towards SL4,6 while at least one reported no changes in students’ attitudes following exposure to SL.5

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<table>
<thead>
<tr>
<th>Phase</th>
<th>Domain</th>
<th>Question</th>
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<tr>
<td></td>
<td></td>
<td><strong>Awareness</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1a Community groups need your help</td>
</tr>
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<td></td>
<td></td>
<td>1b There are people in the community who need help</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1c There are needs in the community.</td>
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<td></td>
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<td>1d There are people who have needs which are not being met.</td>
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<tr>
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<td><strong>Action</strong></td>
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<td></td>
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<td>2a Volunteer work at community agencies helps solve social problems.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2b Volunteers at community agencies make a difference, if only a small difference</td>
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<tr>
<td></td>
<td></td>
<td>2c University student volunteers can help improve the local community quality of life.</td>
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<td></td>
<td></td>
<td>2d Volunteering in community projects can greatly enhance the community’s resources.</td>
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<tr>
<td></td>
<td></td>
<td>2e The more people who help, the better things will get.</td>
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<td><strong>Ability</strong></td>
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<td>3a Contributing my skills will make the community a better place.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3b My contribution to the community will make a real difference.</td>
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<td></td>
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<td>3c I can make a difference in the community.</td>
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<td><strong>Connectedness</strong></td>
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<td>4a I am responsible for doing something about improving the community.</td>
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<td></td>
<td></td>
<td>4b It is my responsibility to take some real measures to help others in need.</td>
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<td></td>
<td></td>
<td>4c It is important to me to have a sense of contribution and helpfulness through participating in community service.</td>
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<td></td>
<td></td>
<td>4d It is important to me to gain an increased sense of responsibility from participating in community service.</td>
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<td></td>
<td></td>
<td>4e I feel an obligation to contribute to the community.</td>
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<td></td>
<td></td>
<td>4f Other people deserve my help.</td>
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<td></td>
<td></td>
<td><strong>Moral obligation</strong></td>
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<td></td>
<td></td>
<td>5a It is important to help people in general.</td>
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<tr>
<td></td>
<td></td>
<td>5b Improving community is important to maintaining a quality society.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5c Our community needs good volunteers.</td>
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<tr>
<td></td>
<td></td>
<td>5d All communities need good volunteers.</td>
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<td></td>
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<td>5e It is important to provide a useful service to the community through community service.</td>
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<td><strong>Empathy</strong></td>
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<td>6a When I meet people who are having a difficult time, I wonder how I would feel if I were in their shoes.</td>
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<td>6b I feel bad that some community members are suffering from a lack of resources.</td>
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<td></td>
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<td>6c I feel bad about the disparity among community members.</td>
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<td><strong>Importance</strong></td>
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<td>7a Lack of participation in community service will cause severe damage to our society.</td>
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<td></td>
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<td>7b Without community service, today’s disadvantaged citizens have no hope.</td>
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<td></td>
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<td>7c Community service is necessary to making our communities better.</td>
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<td></td>
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<td>7d It is critical that citizens become involved in helping their communities.</td>
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<td></td>
<td></td>
<td>7e Community service is a crucial component of the solution to community problems.</td>
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<td><strong>Personal costs</strong></td>
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<td>8a I would have less time for my school work.</td>
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<td>8b I would have less energy.</td>
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<td></td>
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<td>8c I would have less time to work.</td>
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<td></td>
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<td>8d I would have less free time.</td>
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<td></td>
<td></td>
<td>8e I would have less time to spend on other social interactions.</td>
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<tr>
<td></td>
<td></td>
<td><strong>Personal benefit</strong></td>
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<td></td>
<td></td>
<td>9a I would be contributing to the betterment of the community.</td>
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<td></td>
<td></td>
<td>9b I would experience personal satisfaction knowing that I am helping others.</td>
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<tr>
<td></td>
<td></td>
<td>9c I would be meeting other people who enjoy community service</td>
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<td></td>
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<td>9d I would be developing new skills.</td>
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<td></td>
<td></td>
<td>9e I would make valuable contacts for my professional career.</td>
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<td></td>
<td></td>
<td>9f I would gain valuable work experience.</td>
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<td></td>
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<td><strong>Helping behaviour</strong></td>
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<td></td>
<td></td>
<td>10a I want to do this (service-learning) activity.</td>
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<td></td>
<td></td>
<td>10b I will participate in a community service project in the future.</td>
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<td></td>
<td></td>
<td>10c Would you seek out an opportunity to do community service in the future?</td>
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Figure 1: CSAS questions per phase and domain
Notably, the effects of SL have been investigated only a few times in an African context. Evidence from the University of the Witwatersrand in South Africa suggests that there was an increase in social responsibility and personal growth following participation in community projects. Although such studies provide valuable insights in terms of the effects of SL in local contexts, most of their measurement tools lack conceptual rigour and comparability.

The Community Service Attitudes Scale (CSAS) is an alternative questionnaire that could provide standardisation and conceptual rigour. The CSAS is a validated questionnaire based on Schwartz’s Model of Helping Behaviour that measures changes in social awareness and responsibility in four phases. Phase One is the “activation” step whereby participants in SL become aware of the needs in society and the need for action, in the context of their own abilities and feelings of connectedness to the problem. In the Second Phase, the “obligation” step, the participants feel empathetic and sense a moral obligation to react to this need. During Phase Three, the “defence” step, participants assess their stance towards reacting to the need, partly based on the perceived importance of the problem and partly based on personal impact (personal cost and personal benefit). Finally in Phase Four, participants express intentions to respond with action (helping behaviour) to address the need.

The CSAS has not been used extensively in dental education but appears to be a suitable tool for comparative studies in different settings and to measure change over time. The reliability (internal consistency) and construct validity of the CSAS have been tested in a developed world setting and appear to be of good quality. The CSAS has however not been used or tested in a developing world context. It is highly conceivable that dental students who grew up in an African setting are most likely to possess high levels of awareness of poverty and inequality, which may have influenced their value systems and helping behaviour. A need therefore exists to test and pilot the CSAS in an African setting before it is used on a large scale to evaluate the effects of SL.

The primary objective of the study was thus to apply the CSAS in a South African context and to test the internal consistency of the questionnaire. The secondary objective was to match the CSAS findings with student perceptions of their SL experience.

METHODS

Ethical approval was obtained from Sefako Makgatho Health Sciences University (SMU); previously called the Medical University of Southern Africa (MEDUNSA).

Data collection and statistical analysis – Quantitative component

Final year dental students (2014) at the Sefako Makgatho Health Sciences University, South Africa, reported their demographic information (age, race, gender and level of education) and their preferred sector of employment after qualification.

The students anonymously completed a modified version of the CSAS before and after their experience in exposure to community service. The questions of the CSAS were organised according to the phases and domains of Schwartz’s Model of Helping Behaviour (Figure 1). Since Questions 8a-e were negatively framed, the values obtained from this domain were reversed for the purpose of the statistical analysis.

Reliability (internal consistency) analyses were conducted by means of the Cronbach Alpha statistic on domain, phase and questionnaire levels. A Cronbach Alpha coefficient of 0.7 was considered to be an indicator of acceptable internal consistency (data quality).

A t-test was used to analyse the responses to pre- and post-exposure questionnaires on question and domain levels. Because of the multiple tests conducted during the analyses, a p-value less than 0.001 was considered to be statistically significant.

Data collection – Qualitative component

Two focus group discussions were conducted during the eight-week SL rotations. The primary researcher (PMG) conducted the focus group discussions directly after students returned from their community engagement experience in their randomly allocated groups. No attempt was made to influence the demographic composition of the groups. Each focus group discussion comprised ten.

Figure 2: Custom-designed open-ended questions for focus group discussions
participants. The set of questions displayed in Figure 2 was used for the two interview sessions. A tape recorder was used to capture all discussions; and information was stored on audio tapes. Transcription of the information was done to paper, and the data later transferred into Microsoft Word.

Pre and post-exposure reflective essays were also used as an additional source of qualitative data. After the focus group discussions, the students were requested to write a reflective essay at home. The Department of Community Dentistry, School of Oral Health Sciences (SOHS) had adapted a reflective template (Figure 3) from Gibbs (1988), which was used as a guide for writing the essays.

Quotations extracted from the transcribed focus group discussions and reflective essays were combined and subsequently organized according to the domains (Figure 1) of the CSAS that served as the qualitative theme. The original coding and data extraction was done by the primary researcher (PMG) and controlled by the second author of this article (TCP).

**RESULTS**

Forty one (76%) of the 54 final year students completed both the pre- and post-exposure questionnaires. Most (90.2%) respondents were Black African students and 45% were male. The majority (53.7%) were 26-30 years of age, while 26.8% were 21-25 years old. The remainder of students were older. At least 60.9% possessed a tertiary qualification. More than half of the students (53.7%) had expressed a desire to work in the public sector after qualification. Three quarters (75.6%) of the students had not previously been exposed to community projects.

**CSAS results**

Both pre- and post-exposure responses were positive towards community service (Table 1) except for those regarding “personal cost”, which were somewhat neutral. No statistical differences (t-test) could be found between before and after scores on a question or domain level although the data showed a small decline for all the indicators.

The Cronbach Alpha analyses (Table 1) consistently rendered coefficients of more than 0.70 on a domain and phase level, with a coefficient for the entire questionnaire of 0.96.

**Focus group discussion and reflective essay results**

The qualitative results are displayed below by means of a selection of illustrative quotes, arranged according to phases and domains of the CSAS (Figure 1).

| Table 1: Mean pre- and post-exposure CSAS domain and internal consistency scores |
|--------------------------|-------------|-------------|---------------|----------------|-------------|----------------|------------|
| Phase                   | Domain      | Pre-exposure score |                      | Post-exposure score |                      | Pre-post difference | Cronbach Alpha Coefficient |
|                         |             | n | Mean | Standard deviation | n | Mean | Standard deviation | t-Test (P) |               |                     |
| Activation step         | Awareness   | 41 | 6.44 | 1.11 | 41 | 6.15 | 1.53 | ns* | 0.93   |
|                         | Action      | 41 | 5.65 | 0.96 | 41 | 5.49 | 1.39 | ns  | 0.76 |
|                         | Ability     | 41 | 6.17 | 1.10 | 41 | 5.78 | 1.46 | ns  | 0.90 |
|                         | Connectedness | 41 | 5.86 | 1.01 | 41 | 5.23 | 1.36 | ns  | 0.82 |
| Obligation step         | Moral obligation | 41 | 6.09 | 1.06 | 41 | 5.73 | 1.40 | ns  | 0.88 |
|                         | Empathy     | 41 | 5.93 | 1.27 | 40 | 5.63 | 1.48 | ns  | 0.89 |
| Defense step            | Importance  | 41 | 5.95 | 1.31 | 40 | 5.65 | 1.46 | ns  | 0.94 |
|                         | Personal costs | 41 | 3.91 | 1.45 | 40 | 3.60 | 1.61 | ns  | 0.73 |
|                         | Personal benefit | 41 | 6.18 | 0.98 | 41 | 5.76 | 1.27 | ns  | 0.88 |
| Response step           | Helping behaviour | 41 | 5.97 | 1.25 | 39 | 5.30 | 1.70 | ns  | 0.93 |

*ns=not significant
Activation step: Students’ perceptions of community needs (Phase 1)

The following are illustrative quotes that indicate students’ “awareness” of community needs:

“I am informed by my social background. That is why I can identify with most patients’ social circumstances.”

“Here at the school they may have an ideal patient but out there patients have limitations.”

“Local people are poor in the real sense …”

“Things are the way that they are due to lack of knowledge of patients.”

“... as a result they get substandard treatment, extractions and maybe restorations if they are lucky. There are no extensive services.”

The following are illustrative quotes that show student awareness of the “need for action” to assist communities in need:

“Yes, we do have the knowledge but there needs to be action for things to happen and change to be effected.”

“SL needs stakeholder action.”

“There are definitely possibilities out there; let us move out of this confinement of the dental walls ... The government must assist. Proposals can be drafted for expansion of this programme. Government departments must be involved, not only theoretically.”

The following are illustrative quotes indicative of students’ perceptions of their “ability to make a difference” and factors that impede their making a difference.

“SL is different, we unleash our abilities of patient management and to run the clinic.”

“Out there we do reach out to the impoverished communities but impeded by the old, long-broken equipment.”

“... how do we start when there are no materials, and instruments are old and broken?”

“I feel that politicians fail our communities so much. We have good SL models of how to do things in communities but have no resources to undertake those activities. I wonder where this saga is going to end?”

The following quotes illustrate students’ “connectedness” with communities in need:

“I am from poverty myself, so I can contribute positively in any destitute community.”

“You want to stay out there in the community for SL and feel that you are contributing to improve lives.”

“I want to see myself helping the patient from beginning to the end: follow-up to see everything is okay eventually. I want to be happy to have assisted the patient.”

Obligation step: Students’ normative appraisal of their stand towards community service (Phase 2)

The following are illustrative quotes that indicate the students’ sense of “moral obligation” to react to the needs of poor communities:

“There is a lot to be done because patients come here with caries and go back with the same, but out there you make sure you do not send the patient home the same way they came.”

“People are treated looking at their poor backgrounds. We must treat people first and not the background.”

The following quotes illustrate the “empathy” of students with communities in need:

“Most of them do not know what else we do as dental practitioners except for tooth extraction. It hurts to see this…”

“Local people are poor in the real sense and sending them back home without treatment is like committing some murder.”

“When we visit the Baghdad community they ask us if we are going to build houses for them. You can see that going there just for oral health is a drop in an ocean. Our appearance there gives them false hopes.”

“When you’re the outsider without understanding the person situation, I always judged how can one let a disease spread and get worse without seeking treatment. Looking at what the communities are going through I now understand the dilemma. One must think of where the next meal is coming from before anything.”

Defense step: Students’ reassessment of their stand towards community service (Phase 3)

The following is an illustrative quote that indicates students’ sense of the “importance of community service”:

“The war against community problems will not be won easily if things remain the way they are.”

The following quotes show the students’ perceptions of “personal cost” in the context of their participation in SL:

“BDS is quite a stressful course; strenuous with superficial information. It is a too congested programme. It feels like an initiation school more than academic.”

“Presently we are chasing clinical quota so badly... we are forever faced with circumstances beyond our control. It (SL) puts pressure on students.”

“Presently we do not have a choice but to swallow everything that is thrown at us. We lack time for introspection.”

The following quote shows the students’ perceptions of “personal benefit” in the context of their participation in SL:

“In SL you do introspection as an individual.”

“There is an opportunity for growth with SL because we are more relaxed and learn at our pace, unlike at MOHC (School).”

“... at SL that is where you see growth and progress into becoming a doctor, undisturbed.”: “You perfect your skills unimpeded; you engage with community members. You actually manage to get a patient to trust you.”

“This where I truly found myself as opposed to the training inside the school.”

“Stereotypes are cleared, time to reflect positively and learn from it, and independent decision-making. I feel confident and independent.”

“It was a great opportunity for us to treat so many people in need. I see improvement in professionalism and principles of inter-professional care.”

Response step: Students’ intentions to help communities in future (Phase 4)

The following quotes illustrate students’ “intentions to help communities in future”:

“Most definitely, I will serve the impoverished communities.”

“Well, I will do community service at the rural area of my choice with no coercion from the department because I like it.”
“If management cooperates with me, I will do something where I am going. There is so much harvest out there.”

“I am waiting for the day when we will be treating patients at their own homes; doing all the necessary dental procedures and checking on all other problems that they have, transporting them to and from the local health facility, to improve their quality of life.”

“We can start with key groups like pension services, churches, and mother and child clinic. Know people and organise the clinic to address their needs. We can start inside and out; by writing a business plan and presenting it to the community leaders, apply the knowledge gained throughout the years of dental training.”

**DISCUSSION**

This pilot is the first study to apply the CSAS in a South African context to measure change in attitude towards community service in a cohort of dental students before a larger scale application at a later stage. Qualitative data was also collected to gain a sense of student perceptions about community service in a South African context. For the first time it was shown that SL in an African context may not have had a positive effect on students’ attitude towards underserved communities. In fact, a small decline was observed albeit statistically insignificant. Such a finding was only made once before in a developed world setting.²

Using the phases of the CSAS as conceptual guide, these somewhat surprising results can be explained as follows:

**Activation step**

The quantitative results suggest that students displayed positive attitudes during the activation step in the domains of “Awareness”, “Action”, “Ability” and “Connectedness”.

The qualitative results supported the quantitative findings indicating that some of the students were already aware of the social problems and inequality through their life experience even before they engaged in SL. The post-exposure qualitative data shows that although the students felt that action is necessary, consistent with the multi-sectoral approach to primary health care, they sensed that other key stakeholders will have to make substantial contributions to make real differences. Public health facilities and equipment are often under-resourced in developing world contexts such as South Africa.¹³ The qualitative results also indicate that students are aware that their role as oral health care providers will be limited when they are not empowered with the necessary resources to deal with the problems, hence their call for key stakeholders to come to the party. Therefore, it is conceivable that community exposure would not necessarily improve student attitudes any further in this South African context unless the SL experience is making a meaningful difference to the community with support of adequate resources. Both the quantitative and qualitative findings showed that the students appeared to have a sense that they have the ability to make a difference and indeed expressed personal connectedness to community problems.

**Obligation step**

The above-mentioned findings in the Activation step may have influenced the normative assessment of the situation by students and their assessment of the importance of community engagement before the SL took place. The pre- and post-exposure quantitative findings suggest that the students felt morally obliged to do community service and that they displayed empathy in their behaviour. The post-exposure quantitative results did not produce many expressions of moral obligation but there was plenty of empathy towards the needs and shortcomings of the communities they visited.

**Defense step**

It is therefore not surprising that students regarded community service as important in the Defense step of the CSAS.

The slightly more negative assessment of “personal cost” compared with the other domains appeared to be logical given the time pressures of an undergraduate dental curriculum. The qualitative data indeed shows the pressures the students have to absorb when dealing with achieving minimum procedural quotas and having to participate in SL at the same time. It appears as if students felt that the quota-driven discipline-based teaching and learning¹⁴ takes preference despite their own assessment of a need for community service and patient-centred care. The results of the study show a clear conflict between students’ normative assessment of the need for learning in the community and what is happening during their hospital-based training.¹⁵ Despite this ethical conflict, the quantitative and qualitative results suggest that the majority of students, to a large extent, realised the personal benefits of SL.

**Response step**

Again the above-mentioned appraisal informs the students’ positive attitudes, in terms of helping behaviour, that were observed during the study.

**Limitations and strengths of the study**

A major limitation of this small scale study is the use of a single cohort as source of quantitative information. The purpose of the study was however to test the CSAS in a South African context before large scale deployment. The results have shown that reliable information can be obtained from the CSAS in a South African context.

The strength of the study is the matching of the quantitative results with qualitative findings to gain some sense of different quantitative observations.

**CONCLUSIONS**

The results of this study suggest that the reliability (internal consistency) of the CSAS was considered good within the South African context.

The quantitative results suggested that the effects of SL may be distinctly positively influenced by other key stakeholder involvement in the procurement of resources to enable broader service delivery to communities in need. This issue needs further exploration and clarification. Moreover, the apparent ethical tension between quota-driven clinical training and SL also needs to be further elucidated.

The promising results from the current and previous studies⁴ combined with the conceptual rigour⁵ of the instrument makes the CSAS an attractive tool for comparative studies in the field of SL to measure social accountability in an educational setting.
Conflict of Interest: None declared

References

Refusal of potentially life-saving dental care: Antithetical conflict of ethical principles

CASE PRESENTATION
Mrs Pea, a recently widowed 63 year old patient visited the dental hospital complaining of pain and swelling below the tongue. This pensioner has no immediate family except her 55 year old nephew, a nomadic truck driver living about 500 kms away. The attending dental specialist on the occasion of her visit was concerned that Mrs Pea looked unkempt, neglected and insecure. Clinical and radiographic examinations were undertaken, and she was diagnosed as suffering Ludwig’s angina, originating from carious teeth 37 and 38. The infection was bilateral but confined to the submandibular area. Mrs Pea was informed of the seriousness of the condition, and the need for immediate intervention was emphasised. The benefits and risks of the required treatment were discussed with her, yet she refused surgical intervention (including extractions) but requested alternative management instead. Throughout the consultation, Mrs Pea was attentive, interacted well with the specialist, sought clarification and demonstrated clear understanding of the intervention as suggested. Mental examination of the patient indicated that she was indeed fully competent. Anticipating that the condition could worsen, the specialist prescribed antibiotics and advised the patient to come back if and when her condition changed. She was then discharged, and all events of the day were recorded for future reference.

A few days later, Mrs Pea was wheeled into the Maxillo-facial Clinic; she had a running intravenous line which had been inserted at the referring hospital. Her condition had deteriorated; the infection had spread to other fascial spaces and she was struggling to breathe. The specialists on duty reiterated the advisability of the treatment modality previously recommended and informed her of the risks and benefits of treatment or refusal of care. Still Mrs Pea was adamant that she did not need the treatment as suggested. Her nephew, who was present, reported to the specialists that despite his relentless persuasion, her aunt was unlikely to accept treatment as she suffered from severe dental phobia and intense anxiety about dental treatment.

Confronted with this dilemma, the specialists requested an opinion from an ethicist on how to resolve this predicament. Ethical questions raised pertaining to this clinical predicament included the following: Whether Mrs Pea’s decision to refuse potentially life-saving care was rational, given her emotional state? To what extent was dental phobia impacting on her ability to give valid informed consent? Could doctors impose paternalistic medical authority in view of her questionable mental state, and institute the prescribed dental treatment?

DISCUSSION
Patient with dental phobia – understating the moral context of autonomy
Central to this dilemma is the adversative conflict between three fundamental ethical obligations. Therefore, resolving this case requires reconciliation of these principles:
(i) beneficence or duty to promote the wellbeing of the patient,
(ii) non-maleficence or duty to protect the patient from harm and
(iii) autonomy or duty to respect the wishes and preferences of a competent patient.1-4

Historically, the decisions of doctors were not to be challenged, and the opinions of patients were largely disregarded. The doctors “know best” mentality entrenched this power asymmetry in decision-making in the medical profession. For a variety of reasons, medical paternalism remains established and perpetuated in clinical care.5,6 Patients are still not accorded sufficient opportunity and space to influence the course of their treatment and care. Fortunately, the chasm that pervades patient-doctor relationship has been greatly reduced in the past few decades.6 Increasingly, the
autonomy of the patient is receiving considerable recognition in clinical practice, attributable in part to the teaching of bioethics and ethics in medical schools, and also to the rising risk and cost of litigation.7

According to the World Medical Association’s Declaration on the Rights of Patients: “the patient has the right to self-determination, to make free decisions regarding himself/herself. The physician will inform the patient of the consequences of his or her decision. A mentally competent adult patient has the right to give or withhold consent to any diagnostic procedure or therapeutic.” This means that competent patients could refuse treatment even if it could result in disability or death.

Decisions by patients to depart from beneficial medical recommendations challenges the professional values, ethos and the foundational rationale for medical care. The refusal of a patient to accept a suggested course of treatment fundamentally contradicts the obligation of the doctor to beneficence and non-maleficence and favours autonomy. In such instances doctors should be concerned about a patient’s detrimental and “irrational” behaviour in the light of available and appropriate treatment. Doctors are thus obligated to investigate and identify the cause of “irrational” behaviour as a prerequisite to management of the patient.

The notion of irrationality presupposes that an objective assessment of decisional capacity has been undertaken, and that the patient was found to be inadequate in essential functional areas. A plethora of mental status assessments proceeding from simple to complex formulations have been developed to provide objective patient assessment.8-10 Using these tools, all tenets of informed consent, viz. information, comprehension, voluntariness and decision making, including the ability to communicate choice, can be evaluated to determine the patient’s mental state. There is consensus that medical conditions associated with increased risks of serious morbidity and mortality require stringent tests of competence, as associated decisions by patients and doctors could have grave consequences.11 First, if competent patients are wrongly diagnosed, then doctors could paternalistically impose their preferred treatment without the valid consent of the patient. Secondly, if incompetent patients are erroneously diagnosed as competent, they may not receive the therapy, however appropriate, that they, in their incompetence, do not accept. This ethical obligation to respect an irrational decision could lead to unwarranted harm to the patient. When patients refuse treatment the doctors need to understand the basis of this decision. Since the burden of proof lies with the doctor, it is imperative that the determining cause and the appropriateness of refusal of care by the patient is thoroughly examined and appraised.12

The consensus is that stressful clinical circumstances may severely impair the ability of the patient to process the information provided.11-15 Schwartz-Arad et al. found that patients with phobia demonstrated a superior understanding of information provided by doctors.16 These patients are not naive, but extremely sensitive to threatening information, hence their increased priority and attention to detail about their condition and their improved comprehension. This heightened attention to detail equally heightens the perception that clinical procedures are painful, and raises the levels of fear. Phobic patients display irrational perceptions of clinical events, which may “impair functioning of the mind” and may place the cognitive capacity in question.14,15 Phobia may affect the manner in which the patient recalls, comprehends, views and believes that the risks and benefits of treatment apply to their own situations.11,12

Dental phobia necessarily diminish voluntariness, as it exposes patients to situations that reduces their possibilities to act freely and without coercion.15,16 The characteristic avoidance of routine dental care in favour of urgent symptomatic treatment, denies these patients sufficient time to reflect on clinical information provided.15,16 In emergency situations, patients are unable to reflect on their needs and cannot articulate their preferences in good time, thereby compromising autonomous decision making or validity of consent.

Evaluating Mrs Pea’s situation
Blind respect of autonomy is problematic when a cognitively competent patient fails to utilize information provided to reach rational decisions. Patients experiencing emotional episodes, in the majority of cases, are unable to process information and to make sound decisions about their care.17 Mrs Pea refused dental treatment and was set on going home. Her decision to reject treatment is attributed to extreme fear of dental care, leading to a self-perpetuating cycle of avoidance of dental care. Her dental history indicates procrastination and a lethargy in seeking dental treatment when clinical options are available. According to the attending specialists it is reasonable to conclude that Mrs Pea received adequate information, and understood the risks and benefits associated with the intervention. We further recognise that her psychological state might have heightened an appreciation of her medical situation and the proposed treatment. As a result of her amplified perception of clinical events, it is reasonable to conclude that Mrs Pea’s ability to apply all available information to her situation was severely impacted by her phobia, hence her “irrational” stance and inability to recognise that refusal of treatment could end her life. Additionally, the urgent and serious nature of her condition did not present sufficient time to apply her mind to the situation in reaching a rational decision. Such circumstances are not conducive to free and voluntary consent. Structural barriers such as a lack of communication by the practitioner accompanied by an inadequacy in his/her affective abilities to manage Mrs Pea’s situation further compromised the ability of the patient to provide valid consent. We can conclude that, given her state of mind, Mrs Pea was not able to give free and voluntary informed consent.

Managing patients with dental phobia: implications for dental professionals
Obtaining informed consent from patients with dental phobia is achievable but challenging, especially for inexperienced clinicians. It is prudent for doctors to refer patients for objective mental examination if decisions they take about their treatment are deemed “irrational”. If the assessment outcomes indicate that the patient is indeed mentally incompetent, then legally appointed guardians should be involved in the implementation of proposed treatment. In cases where the patient is declared mentally competent
despite their perceived “irrational” decision making; the following practical measures are suggested:

Clinicians should investigate the underlying determinants of irrational behaviour, as, for example, in this case, dental phobia is implicated. Factors like culture, socio-demographic and environment are reported as contributors to perceived irrational patient behaviour. Dental phobia can be exacerbated by unfavourable stimuli in the clinical surroundings. Therefore creative measures should be sought to convey necessary information to patients without triggering undesirable patient reactions. The use of well-structured leaflets have been proven effective in communicating information and increasing knowledge of patients. In addition, undertaking patient consultation in secluded spaces, away from clinical areas, may assist in alleviating the intensity of phobia. Flexibility is necessary when seeking consent from irrational patients; doctors ought to acknowledge expressed fears and misconceptions, and find innovative ways to manage them. Good rapport and working relationship between patients and doctors can make or break the consent process.

CONCLUSION

Dental phobia impacts negatively on valid informed consent, which is a legal and ethical requirement for clinical management of patients. Creative ways of dealing with anxiety should be explored to enable their patients to make informed decisions about their care, including refusal of treatment. Health systems could advantageously be re-engineered to minimise structural barriers to informed consent.

References
15. Armfield JM, Stewart JF, Spencer AJ. The vicious cycle of dental fear: exploring the interplay between oral health, serv-
Styloid process elongation according to age and gender: a radiological study

SUMMARY
The aim of the study was to investigate the ossification patterns and types of elongated styloid process (ESP) in relation to age and gender in patients attending the Medunsa Oral Health Centre at Sefako Makgatho Health Sciences University. Out of the 102 panoramic images evaluated, 40.2% and 59.8% were male and female patients respectively. Type I ESP was the most frequent type (59.1%), followed by Type III (24.8%), Type II (9.4%) and Type IV (7.7%). The Type A calcified outline pattern of ossification was the most common (48.9%), followed by Type D (28.9%), Type C (14.1%) and Type B (8.1%).

Panoramic images are vital in evaluating ESP seen as incidental findings and dental practitioners need to be aware of its variations.

INTRODUCTION
The styloid process (SP) can be seen on both sides of a panoramic radiograph as a slender bony projection extending inferior and slightly mesially just beneath the external auditory meatus. It gives rise to two ligaments, the stylohyoid and the stylomandibular ligament and provides attachment for three muscles, the styloglossus, stylohyoid and stylopharyngeus which act together during normal oropharyngeal functions. The apex of the styloid process is continuous with the stylohyoid ligament which is attached to the lesser horn of the hyoid bone. The apex is situated between the internal and external carotid arteries, the clinical significance of which will be explained.

The styloid process arises from the second branchial arch, Reicher’s cartilage. There are two cartilage centres from which the SP develops, first the tympanohyal one which is present at birth. It becomes calcified and only attached to the temporal bone in the first year of life. The second cartilage centre which appears after birth is termed “stylohyal”. The two centres normally fuse at puberty. Radiologically, absence of fusion is indicated by a radiolucent line which can be mistaken for a fracture line. Terms used in the literature such as “stylohyoid chain”, “stylohyoid complex” and “stylohyoid apparatus” all refer to the anatomical configuration of the styloid process together with its stylohyoid ligament and the lesser horn of the hyoid bone at which the ligament is inserted. These terms are often used interchangeably. The normal length of the SP in an adult varies from 20-30mm and is considered elongated when it measures more than 30mm. Components of the stylohyoid chain may undergo ossification, in particular the stylohyoid ligament (SHL). When ossification occurs, the styloid process appears elongated and is referred to as an “elongated stylohyoid process”. The term elongated styloid process (ESP) was first described by Watt Eagle, an Otolaryngologist in 1937 who also found that the ESP may produce head and neck pain and other symptoms, known collectively as Eagle’s Syndrome.

This is a fairly rare condition. The exact aetiology of ossified and elongated SP is unknown. It is important for clinicians and radiologists to have a sound knowledge of the normal anatomy and to be aware of abnormalities of the styloid process. Depending on the size, shape and orientation, an ESP may cause a stroke due to the compression of the carotid artery. Since stroke is among the top four causes of death in South Africa and the top ten leading causes of disability internationally, it was decided to investigate the ossification patterns and types of ESP and its relation to age and gender in patients attending the
Medunsa Oral Health Centre at Sefako Makgatho Health Sciences University. The ESP was detected as an incidental finding on panoramic radiographs of patients who consulted for dental care at the Institution.

MATERIALS AND METHODS

This study was a retrospective, descriptive cross sectional study in which measurements were performed on archived radiographic images. Ethical approval for the study was granted by the Ethics Committee of the Sefako Makgatho Health Sciences University. The study population consisted of routinely taken panoramic radiographic images of adult patients who had visited the Oral Health Centre of Sefako Makgatho Health Sciences University between January 2013 and December 2014. The panoramic radiographs had been taken with a digital panoramic system (SIRONA Orthophoss XG5) using digital sensors under standard exposure factors as recommended by the manufacturer. A total of 147 images were archived. Accurate measurements were performed for a convenient sample of 69% (102/147) of diagnostically acceptable images of patients with styloid process/processes of a length greater than 30mm. The radiographic images were stored on Dicom Carestream software. Measurements of the lengths of styloid processes were performed on diagnostically acceptable images from the tympanic plate to the tip of the styloid process by two experienced calibrated radiologists as described by Ilguy and colleagues (2005). The types of appearance of the styloid process elongation seen in this study were classified using the numerical method described by Langlais et al (1986) with modifications reported in other studies. Type I: Uninterrupted integrity of styloid process (> 30mm) (Figure 1); Type II: Styloid process joined to the mineralized stylomandibular or stylohyoid ligament by a single pseudo articulation (Figures 2a and b); Type III: Segmented styloid process containing multiple segmented pseudo articulations (Figure 3) and Type IV describes elongation of styloid process due to distant ossification and is derived from a variant published by Reddy et al, as a modification of the “H” and “J” patterns described by MacDonald-Jankowski which were presented as a possible classification.

The patterns of styloid process ossification were also recorded, classified using Langlais’ system which differentiates the calcified ESP’s into Types A to D.

Radiographic Modified Langlais et al classification of patterns of ossification of elongated styloid processes (Figures 5-8)

**Type A:** Calcified outline of styloid process (Figure 5);
**Type B:** Partially calcified styloid process with discontinuous radiolucent core (Figure 6);
**Type C:** Nodular appearance of styloid process with varying degrees of central radiolucency (Figure 7) and
**Type D:** Completely calcified styloid process with no evidence of a radiolucent interior structure (Figure 8).
Data of demographic characteristics was extracted. The variables for which data were available included age and gender. Data was coded and cleaned in Microsoft Excel software and then transferred to SAS software (SAS Institute Inc, Cary, NC, USA) for statistical analysis.

RESULTS
A total of 147 panoramic images had styloid processes measuring more than 30mm, however only 102 images were of acceptable diagnostic quality with a total number of 149 elongated styloid processes. Forty one (40.2%) patients were males and 61 (59.8%) were females. Table 1 showed that the male patients most affected by eSP were in the age group 18-29 years. The 50-59 age group of males showed the least number of eSPs while the majority of the female patients with eSP were in the older age groups i.e. 24% for 50-59 years and 21% for 60 years and older. Type I eSP occurred most frequently for both male and female patients, whereas type IV eSP showed the least occurrence (Table 2). Type I ESP occurred most frequently in all age groups (59.1%), followed by type III, type II and type IV (Table 3). The calcified outline pattern of ossification occurred the most frequently in both genders (48.9%), followed by the distant ossification pattern (28.9%) and nodular pattern (14.1%). The partially calcified pattern was the least common (8.1%) (Table 4).

Table 1: Demographics

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<th>Age Group</th>
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<tr>
<td>30-39</td>
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<td>40-49</td>
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<td>14</td>
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</tr>
<tr>
<td>50-59</td>
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</tr>
<tr>
<td>&gt;60</td>
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<td>13</td>
<td>19</td>
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<tr>
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<td>41 (40.2%)</td>
<td>61 (59.8%)</td>
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Table 2: Types of elongation and gender

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<th>Type III</th>
<th>Type IV</th>
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<td>Male</td>
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<td>22 (21.6%)</td>
<td>4 (3.9%)</td>
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<td>Female</td>
<td>59 (56.9%)</td>
<td>8 (7.8%)</td>
<td>15 (14.7%)</td>
<td>6 (5.9%)</td>
<td>88 (59.1%)</td>
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Table 3: Type of elongation and age group

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<tr>
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Table 4: Ossification pattern and gender

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<td>12</td>
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<td>Percentage</td>
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Table 5: Ossification pattern and age

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<th>Type C</th>
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DISCUSSION
Elongated styloid process is a term used by Eagle, an Otorhinolaryngologist, in an article published in 1937 to describe SP longer than 30mm on lateral skull radiographs of dentomaxillofacial and ear-nose-throat patients. Panoramic radiography, lateral oblique and cone-beam computed tomography are other imaging modalities used by several authors to diagnose ESP. Panoramic images were used in this study for diagnosis of ESP types and patterns of ossification. The elongated styloid processes in this study were reported as incidental findings, the
panoramic radiographs were requested for other indications, which was in accord with Alpoz et al.14

In the present study females were more commonly affected than males (59.8 and 40.2% respectively), which was in accordance with other studies conducted in Turkey, Brazil and Japan,12-15 however some studies have found males to be more commonly affected.16-19 Type I elongation was found to be the most common in the present study which was in accord with studies done by various authors.2,3,16,19

The present study also found that the calcified outline pattern of ossification was the most common, and several studies had the same findings.2,9,19 Most of Type I ESP showed a calcified outline, however a study conducted by Reddy et al.3 in India found Type I in most patients to be completely calcified (Type D ossification pattern). In a Turkish population the most frequent type and pattern of ossification was Type II and Type B.20

CONCLUSION

In the population sample studied, Type I with calcified outline ESP was observed the most frequently.

ESP is often an incidental finding and awareness of the styloid process variations by Dental Professionals is important.

Conflict of interests: None declared.

References

Bacteriology and management of orofacial infections in a Maxillofacial and Oral Surgery Clinic, South Africa

ABSTRACT

Introduction: The widespread use of antibiotics in clinical medicine has contributed to a significant decline in the morbidity and mortality attributable to orofacial infection. However, there are indications of global variations in the microbiology, sensitivity to antibiotics and clinical outcomes, which have not been studied locally.

Aim of the study: To investigate the bacteriology and antimicrobial sensitivity of microorganisms causing orofacial infections amongst patients attending a local Maxillofacial and Oral Surgery clinic, in order to inform an appropriate antibiotic therapy regimen.

Methodology: Study design and setting: A retrospective record-based survey conducted at the Medunsa Oral Health Centre, Sefako Makgatho Health Sciences University, South Africa.

Data collection: Demographic details, clinical information and laboratory data (identified microorganisms and antibiotic sensitivity), were acquired from files dating between March 2011 and June 2015.

Results: In total 122 pathogens had been successfully cultured from 127 patient specimens. The profile of microorganisms was predominately aerobic, with Streptococcus viridans, Coagulase negative Staphylococcus and Staphylococcus aureus comprising the majority. All responded favourably to first line antibiotics. Penicillin, clindamycin and gentamycin were the most effective antimicrobials.

Conclusion: Penicillin remains the drug of choice in treating orofacial infections. The current study discourages the indiscriminate use of metronidazole.

Keywords: orofacial infections, bacteriology, sensitivity testing

INTRODUCTION

Orofacial infections are common conditions that originate in the oral cavity and the face with the propensity to spread to adjacent tissues. While largely odontogenic in origin, the infections could arise from other structures of the face and oral cavity. The spectrum includes periapical infections, which if untreated may spread to fascial spaces and in severe cases may result in Ludwig’s angina and widespread necrotizing fasciitis. Streptococcus spp and Staphylococcus spp have been largely implicated as causative agents.

Antibiotic therapy has resulted in significant reductions in the morbidity and mortality associated with orofacial infections. Despite this success, an increasing resistance to antimicrobial agents is reported, because of the indiscriminate use of antibiotics and the evolution of micro-organisms.

Prescribing successful antimicrobial therapy is a function of clinical experience and the availability of scientific evidence. Hence pragmatic and rational approaches to the selection of antibiotics should be encouraged when dealing with infections in order to limit development of anti-microbial resistance. The current regimen used at the Department of Maxillofacial and Oral Surgery, Medunsa Oral Health Centre, Sefako Makgatho Health Sciences University is based on international recommendations and has not been derived from local data to support clinical practice.
This study was therefore carried out to characterize the micro-organisms involved in orofacial infections and to provide evidence to inform the development of antimicrobial therapy regimens to treat pathogenic micro-organisms in the Department of Maxillofacial and Oral Surgery.

**METHODOLOGY**

**Study design and setting:**
This study was completed by means of a descriptive, retrospective survey of patient records. Ethical approval was given by Medunsa Research and Ethics Committee Clearance certificate number MREC/D/301/2013.

**Participants**
Records of patients treated at Medunsa Oral Health Centre (MOHC) for orofacial infections from March 2011 to June 2014 were reviewed. Inclusion criteria required that the records contained the surgeon’s clinical data as well as information from the National Health Laboratory Services (NHLS) database which recorded the classification of micro-organisms and details of the antimicrobial sensitivity tests. From the clinical records information was acquired including age and gender of the patient, site of infection, history of antibiotic use and history of treatment for the orofacial infection. All case records meeting the inclusion criteria were used for this study.

**Laboratory procedures**
Bacterial culture and microscopic identification were performed by calibrated microbiologists in the National Health Laboratory Services (NHLS), Sefako Makgatho Health Sciences University. All the specimens submitted to this centre were sourced and handled according to the NHLS (SOP’s) standard operating procedures and Good Clinical Practice Guidelines. Aspiration sites were cleaned with alcohol. Sufficient amounts of pathological matter were aspirated from these sites and stored in the appropriate storage medium. The specimens were delivered within an hour of collection to the NHLS for analysis.

Antimicrobial sensitivity testing was also conducted by the NHLS to determine the susceptibility of *Streptococcus viridans*, Coagulase negative *Staphylococcus aureus* and *Staphylococcus aureus* to commonly prescribed first line antibiotics such as, penicillin, erythromycin, gentamycin, metronidazole, and second line drugs such as cloxacillin. First line therapy or primary treatment refers to treatment regimens that are generally accepted by the medical establishment for initial treatment of a given condition. These regimens are standard of care and are the first choice of treatment. Second-line antibiotics are drugs used when the first line regimen does not work adequately.

**Data collection**
Two calibrated researchers independently abstracted data from the clinical records and NHLS printouts. Data were captured electronically in a specially designed spreadsheet prior to statistical data analysis.

**Data analysis**
Data were analyzed using a Statistical Package for Social Sciences Inc. (IBM SPSS ver. 23.0, for Windows, Chicago, Illinois, USA). Initial analyses included inter and intra-observer reliability testing using Cohen’s Kappa test. All variables were subjected to appropriate descriptive and analytical statistical analyses. Pearson’s Chi-Square tests and odds ratios were calculated to test the associations between categorical variables. All tests were carried out at α = 0.05.

**RESULTS**
Demographics and clinical characteristics of participants (Table 1)
The study comprised 127 files in which were recorded details of patients who had suffered orofacial infections. Males constituted 73 (57.9%) of the sample. The mean age and standard deviation (SD) of the sample were 38.62 (SD: 16.23) years and age ranged from 3 to 78 years. On admission, 82 (64.8%) patients had presented with acute infections (lasting a week or less), and 90 (71.9%) had had no previous history of antibiotic use related to orofacial infection (Table 1).

<table>
<thead>
<tr>
<th>Variable category</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>73 (57.9)</td>
</tr>
<tr>
<td>Female</td>
<td>53 (42.1)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
</tr>
<tr>
<td>≤ 40</td>
<td>77 (61.1)</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>49 (38.9)</td>
</tr>
<tr>
<td>Duration of Infection</td>
<td></td>
</tr>
<tr>
<td>≤ 1 week</td>
<td>82 (64.6)</td>
</tr>
<tr>
<td>&gt; 1 week</td>
<td>45 (35.4)</td>
</tr>
<tr>
<td>History of Antibiotic Use</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37 (29.1)</td>
</tr>
<tr>
<td>No</td>
<td>90 (71.9)</td>
</tr>
<tr>
<td>Previous dentofacial surgery</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>12 (9.5)</td>
</tr>
<tr>
<td>No</td>
<td>113 (90.4)</td>
</tr>
</tbody>
</table>

**Distribution of spaces involved in orofacial infections**
Orofacial infections originated mainly from the submandibular area, 57.5% (73), submental infections 15.0% (19), and intra-oral abscesses, 8.7% (11). Ludwig’s angina occurred in 7 cases (5.5%). The hard palate, lip, occipitum, ear, and temporals and other tissues were also infected in a minority of cases. (Figure 1)

**Profile of microbial isolates**
A total of 122 strains of microorganisms were isolated from the specimens. Of the isolates, four species of bacteria constituted 77.1% (94) of all microorganism cultured. Prominent aerobic organisms isolated included *Streptococcus viridans*, 36.1% (44); Coagulase negative *staphylococcus aureus* 23% (26); *Staphylococcus aureus* 14.0% (17); and *Klebsiella pneumoniae* 5.7% (7). Strains of *candida albicans* were also positively identified (Table 2).
Gentamycin, Metronidazole and the second line drug, selected in this study. No resistance was reported for *Staphylococcus aureus* Gentamycin, but significant episodes of resistance to erythromycin (Table 3).

Profile of Microbiological organisms isolated

<table>
<thead>
<tr>
<th>Bacterial strains</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus Viridans</td>
<td>44 (36.1)</td>
</tr>
<tr>
<td>Coagulase Negative Staphylococcus Aureus</td>
<td>26 (21.3)</td>
</tr>
<tr>
<td>Staphylococcus Aureus</td>
<td>17 (14.0)</td>
</tr>
<tr>
<td>Klebsiella Pneumoniae</td>
<td>7 (5.7)</td>
</tr>
<tr>
<td>Enterobacter spp</td>
<td>5 (4.1)</td>
</tr>
<tr>
<td>Staphylococcus Epidermidis</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Pseudomonas spp</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Candida Albicans (Fungal)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Streptococcus Mitis and Oralis</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Others</td>
<td>11 (8.8)</td>
</tr>
<tr>
<td>Total</td>
<td>122 (100)</td>
</tr>
</tbody>
</table>

**Antimicrobial sensitivity test**

*Streptococcus viridans* was completely sensitive to Clindamycin, Gentamycin and Cefotaxime, and highly responsive to the use of commonly prescribed penicillin and erythromycin (Table 3). *Staphylococcus aureus* showed relatively high susceptibility to the first line of antibiotics selected in this study. No resistance was reported for Gentamycin, Metronidazole and the second line drug, cloxicillin (Table 4). Coagulase negative *staphylococcus aureus* showed complete sensitivity to Clindamycin, and Gentamycin, but significant episodes of resistance to penicillin and erythromycin were encountered (Table 5).

**DISCUSSION**

This study used clinical records in the investigation of the prevalence of microorganisms associated with orofacial infections in patients presenting at a local clinic and assessed the recorded sensitivity of common organisms to antibiotic therapies. In this study, more males than females presented with orofacial infections, a finding similar to previous studies. The mean age of our participants was 38.62 years, slightly lower than the average of 40 years reported in some studies.

The relevant literature records that the facial spaces most commonly affected by orofacial infection include the submandibular, lateral pharyngeal, buccal, and submental spaces, in descending order of involvement for both multi- space and single space infections. In terms of single space involvement most studies concur that the submandibular space is the most commonly involved site, followed by buccal and canine spaces. Whilst the current study also identified the submandibular space as the most frequent site of involvement, the results differ in terms of the occurrence of infection in all other spaces. The predominance of submandibular space infections is attributed to the presence of carious mandibular molars. Bacteria isolated in the current study consisted of aerobic organisms. Low counts of anaerobic organisms could be attributed to the acute nature of infections managed in this clinic, and a history of no previous antibiotic use in 71.9% of the patients. Mixed infections mature over time, resulting in an overgrowth of anaerobes in the later stages of the infection. These findings are not consistent with most of the published literature, which predominantly indicates anaerobic colonization in orofacial infections.

**Streptococcus viridans**, *Coagulase negative staphylococcus aureus*, *Staphylococcus aureus* and *Klebsiella pneumonia* remain the most frequently isolated pathogenic microorganisms in orofacial infections in the current study. Many researchers have demonstrated similar findings in orofacial infections of odontogenic origin. The high levels of *staphylococcus* could reflect actual colonization or the introduction of *staphylococcus* from the skin during treatment. A positive culture of *Candida albicans* in our study corroborates reported findings that this oral commensal may be a significant opportunistic micro-organism in the oral cavity.

Based on our findings, penicillin remains the treatment of choice for orofacial infections in the local context. Erythromycin, clindamycin and gentamycin have been shown to be effective antimicrobials against *Streptococcus viridans*, *Coagulase negative staphylococcus aureus*, *Staphylococcus aureus*, and *Klebsiella pneumonia*. Cloxicillin, is the most effective second line of antibiotics for these bacteria. Similar results have been reported in the literature. Our study, supported by convincing literature, casts question on the common use of erythromycin, when safer non-β-lactams are available. Similarly, both the current study results and other published works do not advocate the use of metronidazole as the drug of first choice in most orofacial infections.

These findings demonstrate that in the majority of patients, routine bacteriological sampling provides no added therapeutic value. Most orofacial infections respond favourably to first line antimicrobials and can be successfully managed without...
additional laboratory investigations. However, in patients with acute resistance, further investigations should be undertaken to isolate the micro-organisms and to determine the most appropriate antimicrobial therapy for management of orofacial infections.

Limitations of the study
A retrospective, record based study design and the small sample size could have a negative effect on the validity and generalization of the results. Despite these limitations, this study provides a sound contribution to the existing body of knowledge and supports current clinical practice.

CONCLUSION
Streptococcus viridans is the most frequently isolated pathogen from orofacial infections and responds to first line antibiotics especially penicillin. Powerful second line drugs remain an alternative in resistant infections.

Recommendations
We recommend stringent bacteriological sampling in patients with complicated orofacial infections and responds to first line antibiotics especially penicillin. Powerful second line drugs remain an alternative in resistant infections.

References
Trends in the seasonal variation of dry socket at Meduna Oral Health Centre

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SR Mthethwa,† BF Mabhoza†

INTRODUCTION AND BACKGROUND

Dry socket, a common painful complication of dental extraction, with an onset varying between one to four days after tooth extraction, is well-researched.†‡ A Medline database search covering the period from 1966 to 2007 conducted by Noroozi and Philbert (2009) using the term “dry socket” produced 317 records of original research and reviews in the English language.† A few dozen more studies have since been conducted – the latest published in May 2016.†

Several terms have been used in referring to dry socket, amongst these being: alveolar osteitis, localised osteitis, postoperative alveolitis, alveolalgia, alveolitis sicca dolorosa, septic socket, necrotic socket, localized osteomyelitis, and fibrinolytic alveolitis.†‡ A recent review found twice as many clinical definitions of dry socket.† Blum’s definition is gaining wide acceptance – “postoperative pain in and around the extraction site, which increases in severity at any time between one and three days after the extraction, accompanied by a partially or totally disintegrated blood clot within the alveolar socket, with or without halitosis”.†

Localised fibrinolysis occurring within the socket and subsequently leading to loss of the blood clot is believed to underlie the pathogenesis of dry socket.†‡ The occurrence of dry socket has been the subject of several studies.†‡3,6,10 The incidence has been established for large and small patient groups mainly over study periods less than a year and has been reported to range between 1% and 4% for all routine non-surgical dental extractions and between 5% and 38% for removal of impacted mandibular third molars.†‡3,4,7,13 The incidence of dry socket for routine dental extractions at Medunsa Oral Health Centre, a dental school and referral hospital in Garankuwa on the outskirts of Pretoria, was reported in a prospective study conducted over an eight-month period, to be 2%.†

The prophylactic and symptomatic management of dry socket has been thoroughly reviewed - the management guidelines were found to be based on expert opinions and clinical experience although the level of evidence for effectiveness of most guidelines was found to be low to moderate.5,15

SUMMARY

Introduction: The multifactorial aetiology of dry socket is firmly established. A probable seasonal variation was recently explored - the results indicated a significantly lower risk in spring.

Aims and objectives: This study sought to further explore the hypothesis of seasonal variation by describing trends in the occurrence of dry socket over three years at Medunsa Oral Health Centre.

Design: This was a repeated cross sectional analytical study in which existing medical records were reviewed.

Methods: Treatment records of 13615 adult patients who underwent routine tooth/teeth extraction(s) between January 2010 and December 2012 were reviewed. Data related to demographic characteristics, date of extraction, and diagnosis of dry socket were acquired. Dry socket odds were calculated. A Chi-squared test for trend was performed.

Results: Females accounted for 66.4% of the dry socket cases. The mean age of the occurrence of dry socket was 36 years (SD 11 years). The risk for dry socket was lowest during spring (September – November) throughout the years 2010 to 2012. Statistically significant seasonal variation was found in the years 2010 and 2011. Other significant risk factors included younger age and female gender.

Conclusions: The findings suggest a seasonal variation in the risk of dry socket.

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The multifactorial aetiology of dry socket is firmly established, with numerous risk factors having been identified. Common amongst these are female gender, young adult, lower molars, traumatic extractions and smoking. Additional risk factors which have been implicated include pericoronitis and high pre- and post-operative bacterial counts seen in patients with poor oral hygiene and inadequate irrigation. The possibility of a seasonal variation in the incidence of dry socket has also long been suspected. This hypothesis was recently explored in a retrospective review of the records of patients spanning a period of one year at Medunsa Oral Health Centre. The results indicated a significantly lower risk in spring (September – November).

The current study sought to further explore over a longer study period the hypothesis of seasonal variation of the incidence of dry socket at Medunsa Oral Health Centre.

**OBJECTIVES OF THE STUDY**
To determine period prevalences and describe trends in the seasonally related occurrence of dry socket over three years, 2010 to 2012.

To evaluate the independent effects of gender, age, and season on the incidence of dry socket using logistic regression.

**MATERIALS AND METHODS**

**Study design**
This was a repeated cross sectional analytical study in which existing medical records were reviewed. Data was collected from three different time periods: between January 2010 and December 2010; between January 2011 and December 2011, and between January 2012 and December 2012 to enable the assessment of trends over time.

**Study population**
The target population consisted of the treatment records of adult (18 years and older) patients who underwent routine non-surgical tooth/teeth extraction(s) at the Minor Oral Surgery clinic of Medunsa Oral Health Centre between January 2010 and December 2012. A total of 13615 records made up the population.

**Study sample**
Every available record was studied.

**MEASUREMENTS**

**Medical records**
Treatment records of 13615 adult patients who underwent routine non-surgical tooth/teeth extraction(s) at the Minor Oral Surgery clinic of Medunsa Oral Health Centre between January 2010 and December 2012 were reviewed. Data related to demographic characteristics, date of tooth/teeth extraction(s), and presence/absence of a diagnosis of dry socket were acquired and then captured in Microsoft Excel software.

**Definition of variables**
Age and Gender refer to patient age and sex as recorded in treatment records.

Seasons of diagnosis were determined according to Southern Hemisphere seasonal calendar: December – February (summer); March – May (autumn); June – August (winter); September – November (spring).

Blum’s definition was used to identify the symptoms recorded in the patient files as indicative of “dry socket”.

**Ethical considerations**
Ethical approval for the study was granted by the Ethics Committee of the Sefako Makgatho Health Sciences University. Permission to conduct the study was granted by the Chief Executive Officer (CEO) of Medunsa Oral Health Centre.

**STATISTICAL ANALYSIS/HYPOTHESIS TESTING**
Data was coded and cleaned in Microsoft Excel software and was then transferred to Statistical Analysis Software (SAS) software for analysis.

Means, frequencies and proportions (percentages) were calculated. Analysis of Variance (ANOVA) was performed to determine whether the mean age differed in any patient groups.

The Chi-squared test (two-sided) was performed to test for statistical significance of the gender difference in dry socket occurrence and for the association between dry socket and seasonal variation.

A multivariable logistic regression analysis was performed to identify patient factors associated with dry socket in the study population. The binary outcome of interest was dry socket (Present/Absent). The determinants investigated included season, age, and gender. The estimated odds for dry socket for each season were compared to the data for winter. The deviances (-2log likelihood values) of two models, either excluding or including season, were compared to assess the significance of season. The chosen significance level of the tests was a p-value less than 0.05.

**RESULTS**
Data extracted from the study population of 13615 treatment records were analysed.

The mean ages of patients in the three groups in the population ranged between 40.19 and 42.82. There was substantial evidence (p < 0.001) that at least one group mean in the population differed from others. Pairwise post-hoc comparisons of the mean ages of patients in the three groups were all statistically significant. A significantly higher proportion of female patients had tooth/teeth extraction(s) (53.3% female vs 46.7% male: p < 0.001).

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean (SD)</th>
<th>p-value</th>
<th>Gender</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>2010</td>
<td>41.10 (14.664)</td>
<td>&lt; 0.001</td>
<td>2261 (50.8)</td>
<td>2194 (49.2)</td>
</tr>
<tr>
<td>2011</td>
<td>40.19 (14.796)</td>
<td>&lt; 0.001</td>
<td>2456 (55.6)</td>
<td>1962 (44.4)</td>
</tr>
<tr>
<td>2012</td>
<td>42.82 (14.538)</td>
<td>&lt; 0.001</td>
<td>2534 (53.4)</td>
<td>2208 (46.6)</td>
</tr>
</tbody>
</table>
The prevalence of dry socket was highest in Autumn and lowest in Spring throughout the years 2010 to 2012. There was strong evidence ($p=0.003$ and $0.030$ respectively) of seasonal variation in the incidence of diagnoses of dry socket over the years 2010 and 2011. However, there was insufficient evidence ($p=0.117$) to reject the null hypothesis that the proportions of patients diagnosed with dry socket were equal for all seasons in the year 2012.

The results of this study indicated that the Spring season and older age were independently associated with lower odds, while the female gender was independently associated with higher odds of dry socket diagnosis.

Patients who had tooth/teeth extraction(s) in Spring had $0.604$ times the odds of having dry socket as those who had tooth/teeth extraction(s) in Winter after adjusting for age and gender. In other words, the odds of developing dry socket in these patients in Spring were decreased by $40\%$.

Female patients had $1.801$ times the odds of having dry socket as male patients after adjusting for age and season. In other words, the odds of developing dry socket in these patients in Spring were decreased by $80\%$.

The incidence of dry socket decreased with age. For every year older than 18 years the odds were decreased by $2.8\%$ after adjusting for season and gender.

The relationship between season and the occurrence of dry socket was significant.

**DISCUSSION**

This study set out to describe trends in the occurrence of dry socket over a three year period at Medunsa Oral Health Centre in order to explore the hypothesis of a possible seasonal variation in the development of this condition.
Differences in the age composition of the study population could be attributed to sampling differences, in particular the results of this study confirmed those of previous studies. The means and gender of patients studied over the three years in the current study. 14 results suggest that the prevalence of dry socket to range between 0.5-5% following routine extraction. 1,3,6,25 The risk of dry socket between every other season compared with winter. This finding suggests that the association between the occurrence of dry socket and seasonal occurrence was not due to chance. These results however, need to be interpreted with caution as the association between the occurrence of dry socket and seasonal occurrence observed in this study may be due to measurement bias and confounding problems. For instance, the seasonal variation could also just be a reflection of seasonal differences in patient load that could conceivably influence how much time and thus care is spent on each extraction and thus the possibility of a traumatic extraction. Indeed, traumatic extractions have been associated with increased risk for dry socket. In addition the data in this study showed the patient load during Spring was consistently lower than the numbers seen in Winter (see Table 5).

Measurement bias could have arisen from inter-observer variation as an indeterminate number of clinicians were involved in the diagnosis of dry socket and possibly used non-standardized diagnostic criteria. It can be however be argued that the diagnostic criteria used in this study are highly sensitive since they are contained in most definitions used in the literature for the clinical assessment of the condition.

Many of the other relevant confounding variables i.e. site of extraction, traumatic extractions, smoking, pericoronitis, high pre and postoperative bacterial counts seen in patients with poor oral hygiene and inadequate irrigation, were not adjusted for in the multivariable regression model as data were not available.

It is difficult to explain the seasonal variation in the occurrence of dry socket, but it might be related to tea

### Table 7: Results from multivariate Logistic regression analysis of factors associated with dry socket.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter estimate</th>
<th>Standard error</th>
<th>Wald Chi-square</th>
<th>p-value</th>
<th>Estimated odds ratio</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.349</td>
<td>0.151</td>
<td>240.782</td>
<td>0.000</td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td>Season:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autumn (1)</td>
<td>0.170</td>
<td>0.112</td>
<td>2.922</td>
<td>0.130</td>
<td>1.185</td>
<td>0.951-1.477</td>
</tr>
<tr>
<td>Spring (2)</td>
<td>-0.505</td>
<td>0.136</td>
<td>13.807</td>
<td>0.000</td>
<td>0.604</td>
<td>0.462-0.788</td>
</tr>
<tr>
<td>Summer (3)</td>
<td>-0.203</td>
<td>0.123</td>
<td>2.739</td>
<td>0.098</td>
<td>0.816</td>
<td>0.641-1.038</td>
</tr>
<tr>
<td>Winter (0)</td>
<td>Data used as Reference values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Demographic characteristics

The results also showed that more women than men had a tooth or teeth extracted. This observation might be a reflection of higher attendance by females, which would be consistent with other research which found a large number of female patients at dental clinics. Indeed, the current study indicates that there were differences in the mean ages and gender of patients studied over the three years.

### Trends in the prevalence of dry socket

The results of this study confirmed those of previous studies, indicating the frequency of dry socket to range between 0.5-5% following routine extraction. These results differed from those published in 2008 (Singh and Bouckaert 2008), which estimated the incidence of dry socket at this facility to be only 2%. This variation could be attributed to sampling differences, in particular differences in the age composition of the study populations. The ages of patients in the previous study included children below 18 years (12-79 years with a mean age of 36 years throughout the years 2010 to 2012 which is also consistent with previous reports that dry socket occurs most frequently between 20 and 40 years of age. 6,16,25

The results of this study found strong evidence of seasonal variation in the years 2010 and 2011. However, no significant seasonal differences in the occurrence of dry socket were seen in 2012.

The most pertinent finding was the reduced risk of dry socket associated with the spring season as asserted by statistical tests of significance applied individually to each extraction and thus the possibility of a traumatic extraction. Indeed, traumatic extractions have been associated with increased risk for dry socket. In addition the data in this study showed the patient load during Spring was consistently lower than the numbers seen in Winter.

### Table 8: Assessing the significance of season in the model

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables included</th>
<th>-2log likelihood</th>
<th>Degrees of freedom of the model</th>
<th>Number of parameters fitted in the model, including the intercept</th>
<th>Test statistic (4415.197 - 4386.737)</th>
<th>Degrees of freedom of test statistic</th>
<th>Chi-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age and gender</td>
<td>4415.197</td>
<td>2</td>
<td>3</td>
<td>28.46</td>
<td>4</td>
<td>*p&lt; 0.05</td>
</tr>
<tr>
<td>2</td>
<td>Age, gender and 3 dummy variables for season</td>
<td>4386.737</td>
<td>5</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p value was read off a table of a Chi-squared distribution derived using Microsoft Excel version 5.023
consumption patterns. Oldewage Theron and colleagues (2002) reported that tea was the third most consumed beverage in summer and the first most consumed beverage in winter.\textsuperscript{26} Hot tea may interfere with the healing process through loosening the scab that is forming over the socket. However, more research on this topic needs to be undertaken before the association between seasonal occurrence and dry socket is more clearly understood.

**Factors associated with dry socket**

In the current study the Spring season and older age were independently associated with a lower occurrence of dry socket, while being of female gender was independently associated with a higher occurrence of dry socket.

These results are consistent with those of other studies as they relate to gender.\textsuperscript{4,6,16} One of the issues that emerge from these findings is that the risk of dry socket decreased by 2.8% for every year older than 18 years. This finding suggests that older age played a protective role in the occurrence of dry socket in the current study. The association between dry socket and seasonal variation has not previously been described.\textsuperscript{20}

**Limitations of the study**

Data were not available for many of the relevant confounding variables.

A potential threat to the internal validity of this study was the large number of tests of statistical significance which can be reached. Accepting these limitations, the strength of this study nevertheless was the large sample size and the fact that it covered a three year period.

**CONCLUSION**

The current study findings, while preliminary, suggest a seasonal variation in the risk of incurring dry socket.

**Conflict of interest:** None declared.

**References**

Mandibular third molar and angle fractures: a meta-analysis

Objective: To use a quantitative systematic review of available, credible literature to enable an estimation of the risk of mandibular angle fracture in the presence of mandibular third molars (M3s).

Methods: Data were obtained through a systematic search of PubMed, Embase, and a thorough hand search of eligible references. Papers were included with: (i) acceptable methodological rigor; (ii) complete and accurate data. Details were recorded on the presence of third molars among the reported cases with or without angle fractures. Two calibrated researchers used a specially designed data abstraction form to independently populate information from the selected studies. Comprehensive Meta-Analysis software ver. 3.3.070 was used to calculate relative risk (RR) as the estimate of risk in this study.

Results: Nineteen (19) retrospective cohort studies were analysed, comprising of 9888 patients with 3254 mandibular angle fractures. In the presence of mandibular third molars, the risk of mandibular angle fractures increases by 44% when compared with the risk in the absence of third molars.

Conclusion: The presence of mandibular third molars increases the risk of mandibular angle fracture. Clinicians should be discerning in identifying patients at increased risk, or those likely to benefit from appropriate prophylactic removal of wisdom teeth.

Keywords: mandibular fracture, third molar, meta-analysis

INTRODUCTION

The influence of the presence of mandibular third molars on the occurrence of angle fractures is imprecisely estimated, despite boundless research on this subject. This dearth of conclusive evidence has resulted in the inability of science to resolve the debate over whether there is ethical justification for prophylactic removal of asymptomatic mandibular third molars.1 Approximately half of all mandibular fractures affect the angle.2,3 This anatomical site is associated with the eruption of mandibular third molars, leading to the hypothesis that these teeth play a role in angle fractures.4,5 Significant consensus holds that the third molars act as space occupying organs, resulting in a weakening of the mandible, thereby contributing to an increased risk of fractures. The removal of wisdom teeth allows for bone deposition in the socket, resulting in a reduction in the occurrence of angle fractures.6 Epidemiological findings show that there is an increased risk of mandibular angle fractures among males, 30 years and younger.4,7 Other risk factors include: type of trauma, nature and direction of force and characteristics of the aetiological agent. Physical activities like contact sport events may involve low intensity impact, which if applied to the weakened mandibular angle could result in fractures. Automotive accidents, in contrast, may transfer high intensity force directly to the lesioned areas of the mandible, leading to a greater incidence of fractures.5

The quality of currently available literature on the relevance of third molars in mandibular angle fractures has been challenged in recent times. To date, no prospective cohort study has been conducted to ascertain the extent of temporal causality of fracture due to the presence of third molars. Methodological difficulties and ethical considerations do not justify such prospective research, hence the need to collate available evidence to reach conclusions. A recently published meta-analysis of retrospective cohort studies estimated a three times higher risk of angle fractures in the presence of third molars.6 While this result repeats previous findings reported in the literature, serious
concerns persist regarding the validity of the conclusions, attributed to a significant degree of heterogeneity among included studies, and weak design factors.5,6

Understanding the role of third molars in mandibular fractures is paramount as this evidence could provide insight to the clinical approach and management of patients at “risk”. Furthermore, research findings add value to the longstanding question about the prophylactic removal of asymptomatic wisdom teeth in the prevention of mandibular angle fractures.

Using available published literature, this study sought to estimate the relative risk of mandibular angle fracture in patients presenting with or without M3s.

METHODOLOGY

a. Search strategy and identification of studies
(i) Electronic databases, namely PubMed and Embase, were searched during the month of June 2016. General text terms and medical English keywords “angle fracture” or “mandibular angle fracture”, “third molar” or “wisdom teeth”, were used to locate articles that had been published between 1966 and 2016. The search was limited to original articles, reviews and meta-analyses. Gray literature, conference proceedings and other obscure publications were not considered for the purpose of this study. Instead, Cochrane reviews and references of retrieved studies were used to generate additional literature.

(ii) The inclusion criteria for this meta-analysis were based on the following study design properties: (a) Cohort studies: providing information on the incidence of fractures among cohort (presence of third molars) and controls (absence of third molars); (b) Case-control studies reporting the prevalence of third molars among cases (patients with mandibular fractures) and control (without mandibular fractures); (c) Cases (series): cumulated cases of patients with mandibular fractures, and diagnosis of third molars. (d) English language studies with complete and accurate information. Studies were excluded from this meta-analysis based on the following factors: (a) non-English; (b) inaccurate and incomplete data for quantitative analysis.

The principal researcher reviewed the titles and abstracts of retrieved studies in an initial determination of their inclusion into the meta-analysis. The final decision for inclusion was ratified by two more authors, and in case of disagreement, a full article was interrogated in order to reach a conclusion.

b. Appraisal and selection of studies
Full articles were thoroughly reviewed by two authors using a predetermined quality assessment tool. The components of each article were assigned a score of 1 to 3 with 1= poor; 2=moderate, and 3=good. Study characteristics, namely: study design; methodological rigor; how validity and reliability were addressed; sample size and completeness of data were scored. Articles achieving a cumulative score of 10 or more were included in the analysis.

c. Data collection and analysis
A Data abstraction form was used to collect information on (i) mandibular third molars (impacted or not), (ii) mandibular angle fractures, (iii) sample size, (iv) publication date and other related information. Collected data allowed for a computation of relative risk, with a 95% confidence for all studies and subgroups.

Cochran’s test of homogeneity was undertaken based on inverse variance weights. Data from individual studies were pooled to estimate overall effect size. Subgroup analyses were undertaken to establish group differences with respect to the outcomes of interest. Two groups were created based firstly on sample size differences (more and less than 300 participants) and the second on assessed outcomes (angle fractures only; angle and condylar fracture). Comprehensive Meta-Analysis software ver. 3.3.070 was used for computation of the overall and subgroup magnitude of risk. Publication bias was assessed through funnel plots.

RESULTS

Results from all conducted searches were merged and duplicates removed, resulting in 91 abstracts and titles that were assessed for eligibility. Fifty three (53) studies were excluded and 38 full articles evaluated as eligible for inclusion into the systematic review. Of these, seven studies were excluded as they did not address the research question; five studies did not report the use of controls or comparisons5-12, two were meta-analyses5-6, two provided incomplete and non-extractable data8,13; one study had a data base used in a previous analysis8,14 other studies had sample sizes considered too small.15,16 A total of nineteen studies were included in the final analysis (Table 1).

Table 1: Study characteristics

<table>
<thead>
<tr>
<th>Author</th>
<th>Date</th>
<th>Setting</th>
<th>Follow-up</th>
<th>Cases</th>
<th>Controls</th>
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<td>Iida4</td>
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<td>Germany</td>
<td>1997-2001</td>
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<td>China</td>
<td>1991-2005</td>
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<td>India</td>
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<tr>
<td>Thangavelu19</td>
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<td>2014</td>
<td>Canada</td>
<td>2007-2012</td>
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<td>Gaddipati15</td>
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</table>
Most of the studies selected were from Asia (India and China), North America, with a few from Europe and Africa. All studies incorporated in this systematic review were retrospective cohort studies, with no prospective cohort study, or case control studies being eligible for inclusion in the meta-analysis. Based on the descriptive analysis, 3254 cases of angle fractures were reported from 9888 patients, whose records were collected over study periods ranging from a few months to 10 years. The mean (sd) age of the patients was 28.91 (2.27), and proportionally more males than females (82%:18%) had been enrolled.

Statistical tests of heterogeneity revealed significant variability across studies and subgroups (Cochran Q, df, p, I² = 179,18,0.00, 89.49). Based on this finding, the random effects model was adopted over the fixed effects model as the most appropriate estimate of the overall measure of risk. The overall relative risk for this meta-analysis was 1.44 (95% CI = 1.31 to 1.57). Subgroup analyses by sample size and outcome groups did not yield significantly different estimations of risk (Table 2). The researchers conclude that there is a 44% increase in the risk of mandibular angle fractures in patients with mandibular third molars, than in those without.

DISCUSSION
Validity of study findings - Role of chance, bias and confounding
This sample represents the largest number of studies included in a meta-analysis to date, with significantly more studies (n=19) from 11 countries being included in the final analysis. Chance or random error can be excluded as a possible explanation for the findings, because the study can be regarded as providing an unbiased and comprehensive estimation of risk.

The funnel plot clearly indicates the paucity of negative studies in published literature. Such studies, if included in the meta-analysis, would attenuate the overall relative risk of 1.44 towards 1.00, thereby providing an alternative explanation of the association between third molars and mandibular fractures. On the contrary, the overwhelming absence of negative studies could indicate a true cause and effect relationship between angle fractures and third molars, and not a systematic error. Equally the effect of non-English or grey publications can be assumed to be negligible (Figure 1).

Subgroup analysis, according to the study outcome, indicates that there is a quantitative interaction between third molars and condylar and angle fractures. This is evidenced by a different yet positive magnitude of association between the two groups. The overall estimate, RR (95% CI) for two outcomes group versus one outcome group were 1.67 (95% CI = 1.37 to 1.98) and 1.33 (95% CI = 1.21 to 1.43).
### Table 3: Subgroup analysis - measures of overall effect by outcome group

<table>
<thead>
<tr>
<th>Group by Ca</th>
<th>Study name</th>
<th>Risk ratio</th>
<th>Lower limit</th>
<th>Upper limit</th>
<th>Z-Value</th>
<th>p-Value</th>
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<td>1.477</td>
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</tr>
<tr>
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### Table 4: Subgroup analysis - measures of overall effect by sample size

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<th>Lower limit</th>
<th>Upper limit</th>
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<th>p-Value</th>
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</table>
Comparison of study findings

The majority of studies included in this meta-analysis report a mean sample age of 30 years or less, a statistic close to the average age of 29.81 in the current study. A preponderance of the studies reviewed highlight that over six times more males to females were treated for mandibular fractures. In corroborating this study, this record showed that a preponderance of males were treated (82% to 18% females). These findings indicate the influence of age and gender in the epidemiology of mandibular fracture. It is hypothesized that male gender and youth predispose patients to risky behaviour resulting in an increase in cases of trauma.1-6

This meta-analysis study confirms a 1.44 times increased risk of mandibular fractures in the presence of third molars. This outcome is qualitatively similar, but quantitatively different in magnitude to the risk estimates in published meta-analyses and retrospective cohort studies. Bezerra et al8,9 found the relative risk to be 1.94, Hanson,9 2.4, and Syed,10 2.28, respectively. These results support the hypothesis that third molars reduce the resistance of the mandibular angle to fractures. While the relative risk of 1.44 is low compared with 1.94 and 2.4, we believe that this finding is more precise, providing better evidence due to the comparatively larger sample size.

The relative risk of mandibular angle to condylar fractures is 1.67 in the presence of third molars, while comparison with ‘no fracture’ gives a risk ratio of 1.33. This translates into a 34% reduction in the risk of mandibular angle fracture given the presence of condylar fractures and vice versa. Therefore, as the risk of angle fractures increases, there is a concomitant decrease in the likelihood of condylar fractures in the same patients.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this meta-analysis, we conclude that the presence of third molars increases the risk of mandibular angle fracture. We further note that the study did not assess the specific effects of the various types of impactions on the outcomes. Future studies should be well designed to provide valid evidence which could assist clinicians in making decisions about the management of third molars in populations at risk of fractures.

IMPLICATIONS FOR CLINICAL PRACTICE

This study provides consolidated evidence that the presence of mandibular third molars increases the risk of angle fractures. At the same time, these findings cannot be regarded as conclusive evidence in support of prophylactic removal of pathology free or impacted third molars. The low incidence (1-2%) of mandibular angle fractures as a result of the removal of third molars makes justification of these extractions very difficult, especially on grounds of possible future risk.25 Unfortunately, between 18% and 60% of patients undergo extraction of third molars for no valid reasons.26 Many clinicians still rely on untested beliefs, biases and unverifiable anecdote. In mitigation of this established practice, clinicians have to seek adequate consent from patients, given the greater risks than benefits of this elective procedure. Patients need to be made aware of the risks, and be part of decision-making. It is important for dentists to be discerning before referring patients for prophylactic removal of third molars. Evidence profiles patients who might benefit from removal of asymptomatic third molars to have the following characteristics: - (i) younger than 30 years of age; (ii) male gender; (iii) comorbidities such as osteoporosis and related bone density disorders; (iv) history of trauma especially facial fractures, and (v) high risk activities, such as contact sports, physical work, and strenuous recreation. Dentists should take thorough medical and dental histories in order to evaluate the degree of risk of mandibular angle fracture and refer appropriately.

References

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Clinical and radiological features of 90 odontomas diagnosed in the Oral Health Centre at Sefako Makgatho Health Sciences University

SUMMARY
This paper presents the variations in the clinical and radiological appearances of 90 odontomas diagnosed during routine radiographic examination in a population sample attending an African Dental Hospital. The majority occurred in males (1.4:1) and compound odontomas were more common than the complex type (3.2:1). The most frequent sites recorded were the anterior maxilla for the compound type and the posterior mandible for the complex type. The majority were associated with impacted permanent teeth (57.7%) followed by retention of deciduous teeth (16.6%), displacement of adjacent teeth (11.1%), expansion of the cortical plates (8.9%) and congenitally missing teeth (3.3%). More than 50% of the lesions presented with a radiolucent rim. Early removal is important in order to maintain the chronology of tooth development and to prevent extensive and costly intervention at a later stage.

Odontomas are exclusive to the tooth bearing areas of the jaws and are the most common benign odontogenic tumours. They develop from primordial odontogenic tissue. Due to their composition being a combination of odontogenic epithelium and odontogenic ectomesenchyme, odontomas are categorised in the mixed group in the 2005 World Health Organization classification of odontogenic tumours. Two types are recognised. Complex odontomas are described as malformations in which the dental tissues are arranged more or less in a disorderly pattern with little or no resemblance to normal teeth on radiographs. The compound type presents with normal dental tissues arranged in an orderly pattern giving rise to multiple small tooth-like structures called odontoids or denticles. Histologically, enamel, dentin, cementum and sometimes pulp tissue are present and although the individual tissue types may appear normal, their microanatomical arrangement is abnormal. Due to their limited growth potential, odontomas are not true neoplasms but rather are developmental dental malformations behaving similarly to hamartomas.

The aim of the present study was to analyse the clinical and radiographic features of odontomas diagnosed in an African population sample and to compare the findings with those of other studies.

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Figure 1: Gender distribution in decades. The dark bars represent males and the light bars females.
MATERIALS AND METHODS

The records of the Unit Maxillofacial and Oral Radiology in the School of Oral Health, SMU were reviewed for odontomas diagnosed between 2013 and 2016 on digital dental radiographs. The unit serves mainly an urban and peri-urban Black population sample in the northern part of South Africa. All panoramic radiographs had been acquired by Sirona extraoral Orthophoss machines and digital software tools (Kodak Carestream) had been used for determining the actual sizes of the lesions. The diagnoses had been made on digital images and all surgically removed lesions had been submitted for microscopic examination. The names and hospital numbers of the patients were not recorded in this study and only the demographic data and radiological appearances were transferred to the data collection sheet to guarantee patient anonymity. The radiographic parameters that were recorded included the actual size, type (compound and complex), border, internal structure and influence on adjacent structures. The sizes were reflected in millimetres, margins were defined as the edge or periphery of the lesion with or without a radiolucent soft tissue capsule. The influence on adjacent structures included the effects on the bone and the teeth in the vicinity of the lesion. The differential diagnoses were recorded and elaborated on where relevant. Approval for the study was formally obtained from the research and ethics committees of the hosting University (Certificate number: SMUREC/D/31/2016:PG).

RESULTS

A total of 90 odontomas were diagnosed during the study period. All images were retrieved from the archives of the Unit of Maxillofacial and Oral Radiology at SMU. Radiographs of diagnostic quality were available in all cases.

Thirty four compound, seventeen complex and one mixed odontoma occurred in males, while thirty four compound and four complex odontomas occurred in females. The distribution of the odontomas with relation to their anatomical site, radiological features and the distribution of associated impacted teeth are presented in Tables 1 to 3 respectively. The effects on adjacent structures were impaction of permanent teeth (52 cases, 57.7% of the sample), retention of deciduous teeth (15 cases, 16.6%), displacement of roots and/or teeth (10 cases, 11.1%), and congenitally missing teeth (3 cases, 3.3%). Resorption of tooth roots was not seen and expansion occurred in 8 cases (8.9%). Figure 1 shows the gender distribution and Figure 2 the distribution of complex and compound odontomas in the respective decades of life. Two images of typical compound and complex odontomas are shown in Figures 3 and 4 respectively. Figure 5 shows

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Figure 2: Distribution of radiological subtypes in decades. The blue bars represent compound odontomas, orange bars complex odontomas and the purple bar the single case of mixed complex-compound odontoma.

Figure 3: Panoramic radiograph of a compound odontoma in the right mandible. Note the retained primary tooth, displacement of the root of 42 and impacted 43.
an edentulous mandible with a compound odontoma and Figure 6 presents a coronal CBCT section through a compound odontoma in the right maxilla. Pathological reports were available on 19 cases. The majority of patients were lost for follow-up and surgical removal.

**DISCUSSION**

Papers on odontomas generally appear in the literature as either case reports or as contributions to studies on larger series of odontogenic tumours. Few studies focus on odontomas only. These include 104 cases reported from Brazil, 61 cases from Spain, 63 cases from Korea, 7160- and 22 cases from Turkey, 8,9 134 cases from Denmark 10 and 39 odontomas in Japanese children. 11 The only comprehensive clinico-pathological study on the African continent featured 19 cases reported from Libya in 2013. 12

All cases in the present study had single lesions. Reports on multiple odontomas are rare with less than 20 cases recorded in the literature. 13,14

In the present study all lesions were diagnosed and subclassified accurately on radiographs and microscopic examination did not provide additional diagnostic information other than recording the presence of the different types of dental tissues. Compound odontomas were more than three times as common as the complex type, supporting the findings of most other reports. 5,8,10,15 In fact only two studies were found which recorded a prevalence for the complex type odontomas. 8,16 The tumours develop during childhood and adolescence and are most commonly diagnosed in the second decade of life. 12 The ages of our patients at the time of diagnosis ranged between 6 and 81 years, with most odontomas (70%) found in the second and third decade (42.2% were diagnosed in the third decade and 27.8% in the second decade of life). The mean age at diagnosis was 28 years which is in accord with other studies. 5,9

Variations in the gender distribution of odontomas are reported in the literature. Some studies show an equal gender distribution, 7,12,17 others a predilection for females, 5,6,8,18 while still others support the male predilection found in the present study. 7,12 In some studies the compound variety affects the genders equally, 12 while White and Pharoah 1 found that the majority of complex odontomas occur in women. The equal gender predilection of compound odontomas found in the sample accords with the findings of the Libyan report. 12 In the present study, a significantly higher occurrence of complex odontomas was found in males when compared with females. This is contrary to White and Pharoah 1 who found that 60% of complex odontomas occur in women. In our study, females presented with significantly more compound odontomas (89.5%) than complex odontomas (10.5%) and males with more compound odontomas (65.4%) than the complex type (32.7%). Overall, 38.8% of all odontomas in the present study were located in the anterior region of the jaws, 62% occurred in the maxilla and 38% in the mandible. Significantly more compound odontomas (75.6%) were diagnosed than the complex type, with only one mixed odontoma in the maxillary molar region. The least frequent location for complex odontoma was the anterior region of both the maxilla and mandible.

Most odontomas are reported as incidental findings on radiographs taken for other indications such as delayed eruption of one or more permanent teeth or the retention of a deciduous tooth. 5,7,12 Odontomas are characterized by their slow growth and non-aggressive behaviour. They enlarge during the normal development phase of the dentition and cease to grow after maturation of the associated corresponding teeth. 1,2 If odontomas are not surgically removed, they will persist and may cause complications such as pain and tenderness in the associated area, particularly in denture wearers. 20 In rare cases, eruption of the odontoma takes place 20,21 resulting in trauma or infection and pain. Unerupted permanent teeth, supernumerary teeth or retained deciduous teeth are most commonly
associated with odontomas.\textsuperscript{10,11} Philpensen et al., (1997) reported that an unerupted permanent tooth without a primary precursor is a clinical indication for the presence of an odontoma.\textsuperscript{10} In 88.7% of cases in the present study, odontomas affected adjacent teeth. It has been reported that 37-78% of all eruption disorders in the dentition are caused by odontomas.\textsuperscript{22}

The most common effect on adjacent structures in this study, which occurred in 52 cases (57.7%), was impaction of an associated permanent tooth. This confirms the studies by Hidalgo-Sanchez et al. (2008) and Maeda (1987) who reported comparable findings.\textsuperscript{23,24} More impacted teeth were found in the maxilla (71.1%) than in the mandible (28.9%). The most frequently permanent teeth which were prevented from eruption by compound odontomas, were the maxillary incisors and canines. Complex odontomas caused impactions predominantly in the mandibular molars, a finding which corresponds with the literature. Retention of an associated dentinal cavity tooth was found in 16.6%, tooth displacement in 11.1% and congenital absence of a tooth in 3.3% of the total sample. Resorption of the roots of adjacent teeth was not present.

CBCT (3D Imaging with Cone Beam Computed Tomography) was the technique of choice to determine the borders of the lesions, expansion, thinning of the cortical bone, and perforation. Expansion of bone adjacent to the lesion was clinically observed and then confirmed on CBCT images in 8 cases (8.8%) and was predominantly associated with compound odontomas located in the mandible (5 cases). It is reported that large complex odontomas may also cause expansion of the cortical boundary\textsuperscript{1} which occurred in three cases in our study. No perforation of the cortical bone was detected on CBCT images in our sample. Radiologically the majority of odontomas in the present study were mixed radiolucent-radiopaque lesions surrounded by a radiolucent rim, as described in the literature.\textsuperscript{22} Only 15 cases presented with irregular borders. A lesser degree of radiopacity was noted for odontomas associated with the primary dentition.

The odontomas were treated by surgical excision and no recurrences had been reported up to the conclusion of the study. The small percentage of cases on which a pathology report was available indicates that either the specimen was discarded after removal, or patients refrained from returning for the removal due to the asymptomatic nature of the lesion. However, removal of the lesion is essential in preventing impaction and malpositioning of adjacent teeth.

CONCLUSION

Most odontomas in the present study were asymptomatic and were diagnosed as incidental findings during radiographic examination. The compound type occurred more frequently in the anterior maxilla and was more common than the complex type. The complex odontoma occurred more frequently in the posterior mandible. Early detection and excision are curative and prevent complications which may be detrimental to the development of the dentition.

References

Immune-mediated response of bone in osteomyelitis – fundamental concepts

ABSTRACT
Advancement of knowledge on the role of the immune system in bone metabolism has uncovered a dynamic interdisciplinary research field labelled “osteoimmunology”. The immune system provides stem cells for bone remodelling and elaborates cytokines under both physiological- and pathological circumstances which map the local response of bone cells and alter the phenotypic expression of bone. This manuscript provides an overview of the interaction between the immune system and bone in the different stages of osteomyelitis and correlates the inductive patterns with the radiologic appearances.

Keywords: osteoimmunology, immune regulatory mediators, bone remodelling, osteomyelitis

INTRODUCTION
Bone formation is a complex and precisely regulated process initiated with the differentiation of mesenchymal cells into osteoblasts that are responsible for secretion of the organic bone matrix and the mineralization thereof. Upon completion of bone formation, a continuous process of bone remodelling is responsible for preserving bone mass, repair of fractures and maintaining calcium and phosphorous homeostasis. The seemingly inert skeleton displays an impressive restructuring capacity, with approximately 10% of the mass of the adult skeleton being replaced every year. In the jaws, the flexibility of the remodelling process renders alveolar bone highly adaptable and make possible several clinical interventions such as orthodontic tooth movement, the integration of dental implants and the replacement of resorbed bone. Remodelling of mature bone is initiated by osteoclast-mediated resorption coupled with osteoblast-mediated bone formation. The successive sequence of bone resorption and bone formation and the observation that under physiological circumstances the bone mass remains constant, is proof of a delicate regulatory balance between these two opposing processes. This balance is mediated in a supportive metabolic environment by a delicately controlled release of chemical mediators, also known as cytokines, by the bone cells involved in the remodelling process (Figure 1).

The importance of the immune system in bone metabolism is illustrated by the rapidly expanding interdisciplinary field of osteoimmunology. During physiological bone remodelling the immune system not only provides stem cells, but also elaborate cytokines that regulate the activities of osteoclasts and osteoblasts through binding to specific receptors on the cell surfaces. However, the release of inflammatory cytokines and an influx of immune cells during the course of osteomyelitis overwhelms the physiological cell signalling patterns and results in the induction of bone changes. These changes manifest on radiographs and signify the different clinical patterns of osteomyelitis. This manuscript aims to provide an overview of the interaction between the immune system and bone during the course of osteomyelitis and provides insight into the bone changes seen on radiographs in the different patterns of the disease.

Figure 1: Osteoclasts (white arrows) in resorptive facets and osteoblasts (black arrows) involved in bone deposition. The balance between these processes is dependent on the elaboration of cytokines which govern the activities of these two cell types (H&E stain X400).
BONE REACTION IN ACUTE OSTEOMYELITIS

Acute osteomyelitis is characterised radiographically as an area of poorly demarcated bone loss at the site of inflammation. The resorptive process is initiated by the attraction of neutrophils and monocytes, the mainstay of the innate immune response, to the site of inflammation. Osteoclasts which are responsible for bone resorption differentiate from a pool of predestined osteoclast precursors which circulate in the blood as monocytes and are attracted to bone by a complex interaction of cytokines, the details of which fall outside the scope of this paper.\(^1\)

Osteoclasts are retained within bone by a chemokine known as stromal-derived factor-1 (SDF-1).\(^4\) Depending on the cytokines elaborated in bone, monocytes may also differentiate into macrophages (the cells responsible for phagocytosis of necrotic bacteria and tissue debris at the site of inflammation).\(^5\) The common ancestry of osteoclasts and macrophages illustrates the close relationship between the immune system and bone.

During normal bone remodelling, macrophage-colony-stimulating factor (M-CSF) promotes the expression of receptor activator of nuclear factor \(\kappa\) \(\beta\) (RANK) receptors on dedicated monocytes\(^6\) which are important receptor sites for the activation of the pre-osteoclasts. Osteoblasts release RANKL (RANK ligand) which activates osteoclasts through binding to the RANK receptors on their cell surfaces. The action of RANKL is antagonised by osteoprotegerin (OPG), a cytokine produced by osteoblasts which acts as a decoy receptor for RANKL.\(^7\) This finely tuned control of bone resorption by osteoblasts is important for calcium and phosphate homeostasis whilst maintaining the integrity of the skeleton.

The attraction of leukocytes and macrophages to a site of osteomyelitis and subsequent elaboration of several osteoclastogenic cytokines by the inflammatory cells, amongst others RANKL produced by activated macrophages, several interleukins (IL's) released by leukocytes\(^10\) and tumour necrosis factor \(\alpha\) (TNF \(\alpha\))\(^11\) have a profound stimulatory influence on osteoclasts, resulting in accelerated bone resorption. Microscopically this catabolic shift manifests as an increase in the number of active osteoclasts which are large, multinucleated cells that attach to the bone surface via an integrin vitronectin receptor, \(\alphaV\beta3.\)\(^12\) The active osteoclasts display specialised ruffled cytoplasmic borders which enlarge their contact area with bone. \(\text{H}^+\)-and \(\text{Cl}^-\) ions are secreted across the ruffled borders in the contact zones with bone and the hydrochloric acid formed creates an acidic environment which is responsible for demineralization of the inorganic fraction of bone. Proteolytic enzymes such as tartrate resistant acid phosphatase (TRAP) and cathepsin K are released which degrade the organic matrix.\(^13\) The result is rapid bone resorption which manifests as a poorly demarcated radiolucency (Figures 2a and 2b).

BONE REACTION IN CHRONIC OSTEOMYELITIS

After neutralization of most of the antigens by the innate immune response and the short life span of neutrophils, the nature of the inflammatory reaction in osteomyelitis changes and cells of the adaptive immune response (lymphocytes and plasma cells) appear. Osteoclasts are active for approximately three weeks\(^14\) and thereafter progressively undergo apoptosis and become less abundant. The ingrowth of granulation tissue rich in blood vessels, which is mediated by the release VEGF (vascular endothelial growth factor),\(^15\) provides a source of undifferentiated mesenchymal cells which are predestined to differentiate into osteoblasts.\(^16\) Several transcription factors together with bone morphogenic proteins (BMP) belonging to the transforming growth factor beta (TGF\(\beta\)) superfamily are essential in the differentiation of mesenchymal cells to the osteoblast lineage.\(^17\) Of particular interest in the context of bone formation stimulated by immune cells is the elaboration of prostaglandin E2 which binds to receptors on the cell surfaces of osteoblasts and stimulate their activity.\(^18\) The changes in the cell composition at a site of persistent inflammation and the subsequent changes in the cytokines released contribute to the creation of the new bone.

Figure 2a: Periapical radiograph of a maxillary central incisor with a periapical acute osteomyelitis demonstrating the results of osteoclast activity: destruction of bone manifesting as a poorly defined radiolucency with concomitant external root resorption.

Figure 2b: Leucocytes (collected in top left corner) releasing cytokines (black arrow) that stimulate an osteoclast (white arrow) which is located in a resorptive facet. The net effect is the bone resorption demonstrated in Figure 2a (H&E stain X400).
of an environment favourable for bone formation. It therefore comes as no surprise that the sites of chronic osteomyelitis in the jaw bone manifest as radiopacities (Figures 3a and 3b). In children, the elaboration of bone inductive cytokines at a site of chronic inflammation and in the presence of anabolic hormones such as human growth hormone (HGH) and insulin-like-growth-factor-1 (IGF-1) stimulates a periosteal bone reaction (Figure 4). This reactive process manifests with an “onion-skin appearance” radiologically and is designated as chronic osteitis with proliferative periostitis.

Figure 3a: Persistent chronic inflammation induce osteoblast-activity with bone formation resulting in a typical focal chronic sclerosing osteomyelitis (arrow, cropped panoramic radiograph of a partially erupted 48 with periocronitis).

Figure 3b: Inflammatory cells (white star) release chemical mediators (delicate black arrows) that stimulate the deposition of dense bone by osteoblasts (bold arrows). Note the dense bone characterised by reversal cemental lines which is responsible for the radiodense appearance of the lesion demonstrated in Figure 3a (Silver stain, X200).

Figure 4: Micrograph of chronic osteitits with a proliferative periostitis in a 14 year old child. Note the laminar layers of bone formed on the periosteal surface of the mandible (white arrows) adjacent to a site of chronic inflammation (white star indicates the buccal cortical plate, H&E stain, X200).

CONCLUSION

Mapping of the cytokines released during the course of osteomyelitis provides an explanation for the reaction of bone and the subsequent radiologic changes of the disease. The characterization of cell receptors governing the inflammatory induced bone changes provide lucrative commercial opportunities for the manufacturing of patented drugs and auto antibodies which can either limit bone resorption or stimulate bone formation, thereby facilitating an enhanced clinical outcome for patients with osteomyelitis. Injectable biodegradable microspheres coated by osteoinductive cytokines have already been shown to decrease post infection healing time of bone. Further advances in this rapidly developing field of manipulating bone health is certain to impact in the near future on the management of osteomyelitis of the jaw bones.

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ABSTRACT
The epithelial microstructural configuration of the paired palatine tonsils is adapted to optimize lympho-epithelial symbiosis at the first point of contact with an antigen introduced to the pharynx through breathing or swallowing. The loosely arranged reticulated nature of the epithelium of the tonsillar crypt and vesicular transcytosis of live bacteria and viruses across receptor cells contribute to the early pathogenesis of specific neoplastic- and infective diseases which are discussed in the manuscript.

Key words: tonsillar-epithelium, tonsillar-crypt, immunity, M-cells, oncogenesis, epithelial-lymphoid symbiosis, tonsillar-disease.

INTRODUCTION
The paired palatine tonsils are situated between the palatoglossal- and palatopharyngeal arches and form part of a group of oropharyngeal lymphoid tissue collectively known as Waldeyer’s ring. Other components of this lymphoid ring are located on the posterior surface of the tongue (lingual tonsils), roof of the pharynx (pharyngeal tonsils or adenoids) and tubal tonsils which are found posterior to the openings of the Eustachian tubes on the lateral pharyngeal wall. Waldeyer’s ring of lymphoid tissue is also functionally referred to as “mucosa-associated lymphoid tissue” or MALT and is the first line of adaptive defence against inhaled or ingested antigens. The epithelial surfaces of the tonsils are modified to provide a large contact area for the capturing and presentation of antigens to the associated B- and T lymphoid stem cell populations. Induction of a sub population of B- memory cells with a capacity to produce antigen-specific secretory antibodies on demand and the establishment of a directed lineage of functional T cells, form important components of the adaptive immune protection of the respiratory system and digestive tract.

MATERIALS AND METHODS
Haematoxylin and eosin stained sections of tonsils previously removed during routine tonsillectomies were retrieved from the files of Oral Pathology at Sefako Makgatho Health Sciences University. The sections were screened by an Oral Pathologist and 15 cases with reactive lymphoid hyperplasia were selected. Sections were prepared from the archived blocks and stained with the immunoperoxidase technique for S100 protein, low- and high molecular weight cytokeratin, Ki 67 and IgA. The sections were viewed under a light microscope with a fluorescence attachment and digital camera.

RESULTS AND DISCUSSION
Surface epithelium
The palatine tonsil is covered by 15-20 layers of either flattened non-keratinised- or parakeratinised squamous epithelium resting on a basement membrane. A layer of fibrous connective tissue separates the surface epithelium from the underlying connective tissue, while a membrane of fibrous connective tissue separates the epithelium from the underlying lamina propria. The surface of the tonsil is covered by stratified squamous epithelium which is composed of five types of cells: keratinocytes, basal cells, granular cells, spinous cells and clear cells. The surface epithelium is modified to provide a large contact area for the capturing and presentation of antigens to the associated B- and T lymphoid stem cell populations.

ACRONYMS
MALT: mucosa-associated lymphoid tissue
HPV: human papilloma virus

MALT in Waldeyer’s ring is well-organized and is in close contact with a specialized epithelial surface. The palatinal and lingual tonsils are covered by stratified squamous epithelium and the tubal- and pharyngeal tonsils by pseudo stratified columnar ciliated epithelium with goblet cells. Although the palatine- and tubal tonsils have several crypts, the lingual tonsil has only one and the columnar epithelium covering the pharyngeal tonsils is folded with no true crypts. Variations in the micro-structural arrangement of the epithelium play a significant role in the early pathogenesis of specific disease processes originating in the tonsillar epithelium.

This manuscript provides a functional description of the epithelium and highlights micro-anatomical factors which impact on the early pathogenesis of selected disease states originating in the palatine tonsils.
from the lymphoid component. Selected surface epithelial cells express both cell surface glycoprotein CD44 and nerve growth factor receptor NGFR (or CD271), fulfilling the requirement that stem cells should have a potential for prolonged growth.\(^3\) Dendritic cells migrate in the intercellular spaces and play a key role in antigen recognition. CD8+ T-cells are increased in the surface epithelium in recurrent tonsillitis when compared with idiopathic tonsillar hypertrophy.\(^4\) The thickness of the covering epithelium and the dense junctions provide a barrier protecting basally located stem cells against external irritants such as tobacco and infection by human papilloma virus (HPV).\(^5\)

There must be alterations to the basally located stem cell population to allow for any advancement of the pathogeneses associated with these and other irritants. Small ulcers resulting from surface abrasions may however breach this protection (Figure 1).

Examination of serial sections indicated that the development of tonsillar crypts is dynamic and initiated in the surface epithelium. Crypt formation of the surface epithelium followed upon a localized immune reaction with increased mitotic activity (Figure 2), invagination of epithelium and formation of a crypt. The crypt epithelium ultimately reticulates and induction of MALT close to the crypt results in the establishment of a functional crypt. Through the formation of a crypt the efficiency of antigen presentation to the underlying lymphoid component is facilitated.

**Crypt epithelium**

The main function of a tonsillar crypt is to initiate the first step of the adaptive immune reaction. This is achieved by capturing and then transferring an antigen from the tonsillar crypt to the MALT. In order to facilitate this function, the crypt is lined by reticulated epithelium intermingled with lymphoid cells and alternated by patches of squamous epithelium resembling surface epithelium (Figure 3).

The number of crypts in a palatine tonsil correlates with the extent and reactivity of the lymphoid component. Enlargement and branching of crypts increase significantly the contact area between the epithelial and lymphoid components. The degree of reticulation increases upon antigenic stimulation. When extensively challenged the junction between the intermingled epithelial- and lymphoid component becomes difficult to visualize on sections stained with haematoxylin and eosin (Figure 3). Stains for cytokeratin are helpful in distinguishing the epithelial cells from the lymphoid component (Figure 4).
The epithelium rests on a porous basement membrane which consists of a rich fibre network composed of specific collagen types which maintain intimate contact between the stationary epithelial cells and the migratory lymphoid cell population. Macromolecules in the basement membrane contribute to the immunological events which follow upon contact with an antigen. Unlike surface epithelium, close contact is established between the stationary epithelial cells lining a crypt, mobile components of MALT and endothelial lined capillaries. Capillary endothelium is frequently in direct contact with the reticulated epithelial cells and high endothelial lined venules extend into the reticulated epithelium, particularly in extensively reticulated areas where the venules often reach the surface of the crypt.

Microfold cells (M-cells) are specialized epithelial cells within the crypt lining which act as the gateway for antigens to the immune system. They are also located in other sites such as in Peyer’s patches in gut associated lymphoid tissue (GALT). M-cells are adapted structurally and functionally for the transepithelial passage and presentation of foreign antigens to lymphoid cells in close proximity to the crypt. They are difficult to demonstrate microscopically in the tonsils on routine stained sections but may be visualized on scanning electron micrographs as microvillous cells in small pore-microcrypts between the epithelial cells lining the crypts. The microvilli are oriented towards the crypt lumen and are responsible for endocytosis of antigens which bind to specific receptors on the M-cell surface. A recent study proposed class II β-tubulin as a novel marker for tonsillar M-cells. Following endocytosis, vesicular transcytosis occurs through the M-cell cytoplasm and the antigen is presented to dendritic cells, macrophages, and T-and B lymphocytes closely associated with the invaginated surfaces on the M-cells which are exposed to the lymphoid component (Figure 5).

A direct targeted immune response is then induced. This step completes the trans-epithelial cycle of MALT immune activation. The final outcomes are activation of B- and T cells in the lymphoid component of the tonsil through presentation of the antigen by follicular dendritic cells to the lymphoid stem cell populations in and around the lymphoid follicles (Figure 6).

Production of secretory immunoglobulins facilitate mucosal immunity and the seeding of lymphoid cells (via their close association with the high venules) to systemic sites. Here they exert their specific and directed immunological actions against the antigen which was originally presented via the trans-epithelial route of the tonsillar crypt. The sleeve of plasma cells around capillaries form finger-like projections between the crypt epithelium of a reactive tonsil. Not only do they shed immunoglobulins into the crypt for local protection, but also into circulation for systemic distribution (Figure 7).

**Micro anatomical determinants of selected diseases**

Antigens and some microorganisms are transported intact and alive across the M-cells. These cells are therefore important vectors for the presentation of active bacteria (such as Mycobacterium tuberculosis) and viruses (such as Epstein Barr virus) which primarily target cells of the lymphoid cell lineages. Multiplication in the tonsillar lymphoid cells and seeding to distant sites can subsequently occur. Human
immunodeficiency virus infection (HIV) reduces the number of follicular dendritic cells and impacts on the efficiency of antigen transfer between the M-cell and the MALT stem cell populations. Highly active anti-retroviral therapy (HAART) restores the lymphoid dendritic cell population within months. It has recently been demonstrated that the tonsillar crypt epithelium is an important site for Enterovirus 71 replication, the causative agent of hand foot and mouth disease and a rare form of fatal encephalomyelitis in humans. In acute tonsillitis, which is caused by a wide range of viruses (adenovirus, influenza virus, respiratory syncytial virus and others) or bacteria (*beta-haemolytic streptococci, staphylococcus* and others), the protective immune response is overwhelmed by the infection and although most cases there is uneventful healing, serious complications such as a cellulitis or pharyngeal abscess could follow. The necrotic debris in the crypts of the palate- and lingual-tonsils may undergo dystrophic calcification with the formation of a tonsillolith. With chronic irritation the antigen presentation role of an intact crypt is neutralized due to the replacement of the specialized crypt lining by squamous epithelial cells (Figure 8).

Epithelial basement membrane proteins serve as primary receptors for HPV, the most prevalent sexually transmitted infection. Due to the loosely-arranged syncytial nature of the epithelium, which by virtue of its functional adaptation exposes parts of the basement membrane to the external environment, the tonsillar crypt is the preferred site in the oropharynx for HPV infection. It is estimated that 8.5% of normal tonsils contain HPV DNA, either types 6 and 11 or the high risk type 16. Local immune recognition of HPV is suppressed by the virus. HPV 16 viral oncprotein E7 reduces e-cadherin dependant dendritic cell adhesion to epithelial cells, the virus supresses dendritic cell migration to epithelium and suspends the release of pro-inflammatory cytokines by HPV infected epithelial cells. Viral integration in the crypt stem cell population secures a constant shedding of viral particles through release of HPV into the crypt as infected cells lyse. Carcinomas induced by high risk HPV type 16 are more likely to develop through infection and transformation of the CD44 and nerve growth factor receptor (NGFR) positive stem cells within a crypt than in the other epithelial surfaces of the pharynx where the stem cell population is protected by the multilayered nature of the epithelium. A recent (2010) summary of malignant histopathological transformation is available. HPV associated tonsillar cancer develops after more than a decade of exposure to high risk HPV's which are biologically characterized by HPV's E6 and E7 proteins that bind to- and inactivate tumour suppressor protein p53 and retinoblastoma protein (pRB), with a resultant upregulation of p16, leading to malignant transformation of HPV infected cells.

**CONCLUSION**

Characterization of the molecular nature of the receptors on the apical surface of M-cells and an understanding of the lympho-epithelial symbiosis in the tonsillar crypt are important fields of research for the pharmaceutical manipulation of the trans-mucosal route of infectious agents. Furthermore, probing of the receptor classes on the microvillous surface of M-cells could potentially improve the efficiency of parenterally administered vaccines.

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**References**

Oral mucosal ulceration - a clinician’s guide to diagnosis and treatment

ABSTRACT
Oral mucosal ulceration is a common clinical complaint. Ulceration is often debilitating and affects patients from a wide age group. The clinician confronted with such a patient often feels overwhelmed by the different diagnostic possibilities. Given the wide spectrum of conditions encountered, it is striking that the common use of antibiotics and antifungals to treat oral ulceration, is largely inappropriate. This overview provides general dental practitioners (GDP’s) and other general healthcare workers with a broad classification of commonly encountered mucosal ulcerative lesions, a practical approach to reach a diagnosis and basic treatment strategies for each condition.

Keywords: Oral, ulceration, vesicle, immune mediated, treatment

Oral mucosal ulceration is a common clinical complaint encountered by medical and oral health care providers. Ulceration involves a breach in the epithelial covering (Figure 1) of mucosa exposing the underlying lamina propria while erosions represent an incomplete breach of the epithelial covering and appears as erythematous patches. Lesions are often debilitating, hampering nutrition and affecting quality of life. The clinician confronted with such a patient often feels overwhelmed, resulting in a kind of shotgun treatment approach that favours the inappropriate use of antibiotics. The aim of this review is to provide the general dentist with a workable classification of more commonly encountered mucosal ulcerative lesions with basic treatment strategies for each.

Classification of oral mucosal ulceration may be according to the (i) clinical features, (ii) microscopic features or (iii) pathogenesis (traumatic, metabolic, dermatological, allergic, immunological, infectious, and neoplastic) but classification according to (iv) the clinical presence or absence of preceding fluid-filled vesicles/ bullae will form the basis for the discussion in this review (Figure 2). Secondary information such as systemic signs and symptoms, location, duration and number (single or multiple) of ulcerations are supplied for each condition to guide the clinician to a more focused differential diagnosis. Vesicles (depending on the size they are also termed bleb, bulla or blister) are the clinical manifestation of separation of either epithelial cell layers

ACRONYMS
ACE: angiotensin-converting enzyme inhibitors
EM: Erythema Multiforme
HS: Herpes Simplex Virus
SLE/DLE: Lupus Erythematosus
MMP: Mucous Membrane Pemphigoid
NUG: Necrotising Ulcerative Gingivitis
NSAIDs: Nonsteroidal Anti-Inflammatory Drugs
NUG: Necrotising Ulcerative Gingivitis
OLP: Oral Lichen Planus
OLCL: Oral Lichenoid Contact Lesion
OLDR: Oral Lichenoid Drug Reaction
OSCC: Oral squamous cell carcinoma
PV: Pemphigus Vulgaris
TB: Tuberculosis
RAS: Recurrent Apthous Stomatitis
HHV-3: Varicella Zoster Virus
from each other or from the underlying lamina propria that subsequently become filled with fluid. The final diagnosis of oral mucosal ulcerations is usually dependent on performing a biopsy and submitting the tissue to a pathologist for histological diagnosis. Special investigations in the form of stains and immunofluorescence are often necessary and the pathologist will employ these as necessary.

Topical corticosteroids in the management of oral ulcerative conditions

The anti-inflammatory and immunosuppressive properties of corticosteroids render them ideal for the management of especially immune mediated oral ulcerative conditions. Side effects of systemic corticosteroids make them less favourable as primary treatment options and topical steroids are often good alternatives. Kenalog in Orabase® (triamcinolone acetonide 0.1%) was often the agent of choice but since its discontinuation alternatives have to be considered (Table 1).

The potency of the topical steroid, frequency and vehicle of application should be tailored to each individual case and response to treatment. Generally, widely distributed ulceration may be more effectively treated with a corticosteroid rinse, single lesions with the local application of an ointment, and oropharyngeal lesions with a steroid inhaler. Ointments are not adhesive to the oral mucosa but may be combined with either orabase or denture adhesives. Topical corticosteroids are considered in the following clinical settings: (i) as short course to speed up recovery e.g. recurrent aphthous stomatitis (RAS), erythema multiforme and drug induced ulceration; (ii) sporadic use in conditions with chronic, often cyclical clinical course i.e. oral lichen planus (OLP), severe RAS and mucous membrane pemphigoid (MMP); (iii) maintenance therapy following a short course of systemic corticosteroids i.e. severe OLP; (iv) concurrently with systemic immunosuppressive therapy to reduce the dosages thereof i.e. pemphigus vulgaris.

ULCERS PRECEDED BY VESICLES (VESICULO-ULCERATIVE LESIONS)

Patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective, patients may present with or without intact vesicles preceding the ulcers. Vesicles are often lost due to functional oral activity, remaining only in protected areas of the mouth or in diseases with thick-roofed sub-epithelial vesicles i.e. MMP. Irrespective,
patients frequently provide a history of “blisters” preceding the ulcers or previous episodes of ulcers and that, together with the specific mucosal region affected provide mandatory information to formulate a correct diagnosis. Generally, lesions in this category that presents with an acute onset are likely of viral origin, while lesions with a chronic or relapsing course more likely immune mediated.

I Infections: Vesiculo-ulcerative lesions of viral origin
Preceding systemic signs and symptoms are typically present.

Herpes Simplex Virus (HSV)
The most common to affect the oral mucosa, primary HSV-1 infection mostly affects children presenting either as asymptomatic infection or with mucosal vesicles followed by painful ulceration affecting both keratinised and non-keratinised mucosa. Adults with primary infection suffer symptomatic herpetic pharyngotonsillitis initiated as vesicles that rapidly break down into painful shallow ulcerations. Serological investigations at this stage demonstrate absence of HSV-1 immunity. Primary infection normally runs a self-limiting course but initiation of acyclovir suspension within 72 hours of onset (15mg/kg, 5 times/day for 7 days) reduces symptoms with shorter duration of the ulcers and decreased viral shedding. The later in life primary infection occurs, the greater the need for antiviral therapy, with 1g valacyclovir given twice daily for adults. Recurrent infections follow the dermatome of the ganglion in which the virus established latency after the primary infection. Recurrences in the form of herpes labialis are most commonly initiated by various factors including, but not limited to, stress, UV exposure or dental local anaesthetic. Initial prodromal stinging or burning is followed by a cluster of approximately five small fluid-filled vesicles on erythematous mucosa that ruptures to leave painful shallow ulcers which coalesce and crusts. Despite low bioavailability of the active metabolite and multiple applications needed, herpes labials is effectively treated by 5% acyclovir or 1% penciclovir cream when initiated within the prodromal stages. Systemic antiviral agents with significant anti-HSV action (acyclovir, valacyclovir, famcyclovir) may be used early in recurrence, although results are conflicting. Addition of corticosteroids to the topical formulation of antiviral agents significantly decreases the ulcerations but adds no benefit to the resolution time.

Herpangina (Hand-Foot-Mouth Disease)
Caused by coxsackievirus, echoviruses, and other enteroviruses, typically affects children below 10 years. Two to six red macules or vesicles is followed by self-limiting ulcerations, approximately 5mm in diameter, on the anterior tonsillar pillars, soft palate, uvula, and/or tonsils. Pyrexia, sore throat and headaches are common. Ulcers heal within 4-6 days and management is symptomatic with analgesics and antipyretics. Anti-inflammatory (benzydamine) and antimicrobial (chlorhexidine) formulations such as Ansolan 1 and 3 (mucocutaneous forms) or only 3 (mucosal forms) containing acyclovir may be used but not antivirals.

Varicella Zoster (HHV-3)
Varicella is well-known for its pruritic, vesicular skin rash, ulceration and crusting, all occurring concurrently. Crusting is absent in the oral mucosa which instead present as ulcerating papules. A mouthwash compounded from equal parts viscous lidocaine, diphenhydramine (Benadryl®) and Maalox has been advocated although acyclovir 80mg/kg/day divided in four doses for children and 4g/day divided into 5 doses for adults for 5 days instituted within 24 hours of onset of the rash may reduce duration of the lesions. Herpes zoster (shingles) signifies recurrent HHV-3 infection, mostly affecting old and debilitated patients, and follows the dermatome in which the virus established latency. Severe burning or stinging pain to the affected dermatome is followed by fluid filled vesicles that rupture to leave painful shallow ulcerations that may coalesce to form large denuded areas. Oral manifestations signify involvement of the mandibular or maxillary divisions of the trigeminal nerve with pathognomonic abrupt termination of lesions along the midline. Osteonecrosis with tooth exfoliation has been reported, especially in immune deficient individuals. Post-herpetic neuralgia is defined as persistence or recurrence of pain more than a month after onset of shingles and is seen with increased frequency in old patients with facial infection. Administration of antiviral drugs within 72 hours of onset of the rash is recommended in the elderly, immune deficient patients and those with facial shingles. Oral acyclovir (800mg, 5 times/day for 7 to 10 days), valacyclovir 1000mg (3 times/day for 7 days) and famcyclovir 500mg (3 times/day for 7 days) are treatments of choice but does not reduce the incidence of post-herpetic neuralgia. Corticosteroids (i.e. 0.5mg prednisone/kg/day) may relieve the acute phase zoster-associated pain. The Advisory Committee on Immunization Practices (ACIP) recommend the routine use of herpes zoster vaccine in patients over 60 years (Zostavax®).

II Immune-mediated vesiculo-ulcerative lesions
Several dermatological conditions may present with oral mucosal involvement, either concurrent with the skin pathology, as the initial presentation or sometimes as the only clinical presentation. Ulcers have a tendency to be chronic and the systemic signs and symptoms associated with infection usually absent. All immune-mediated forms of mucosal ulceration have to be diagnosed via microscopic examination of a surgical biopsy which preferably contains the transitional zone between the ulcerated and adjacent normal appearing mucosa. The demonstration of tissue-bound or circulatory antibodies via direct (DIF) or indirect immunofluorescence (IIF) techniques on peri-lesional mucosal biopsy is diagnostic.

Pemphigus vulgaris (PV)
Pemphigus, a group of immune mediated mucocutaneous diseases, is mediated by auto-antibodies directed at the proteins of keratinocyte adhesion (desmosomes) causing acantholysis. PV most commonly affects the oral cavity, it’s autoantibodies mainly directed against desmoglein 1 and 3 (mucocutaneous forms) or only 3 (mucosal forms). Patients, typically 40-60 years of age, present with thin-roofed, flaccid intra-epithelial bullae which rupture promptly after development resulting in large irregular areas of painful mucosal ulceration. Pressure applied laterally on a bulla or healthy appearing skin/mucosa, may cause sloughing of the adjacent epithelium, a phenomenon known as positive Nikolsky sign. Oral lesions, seen mostly in areas of friction, are often the initial and sometimes the only presentation of the disease. Microscopic evaluation confirms intra-epithelial vesicle formation with inter-epithelial deposition of mainly IgG antibodies on DIF. The aim of treatment is to bring the disease under control, mostly using systemic corticosteroids, followed by a maintenance period of the minimum dose corticosteroid required for disease control. Treatment withdrawal with
complete and durable remission is obtainable in roughly 75% of patients after 10 years.22 Systemic corticosteroids are the best management option23 although the optimal dosing schedule varies. Mild cases are initiated on 40-60mg prednisone/day and more severe cases on 60-100mg/day as evidenced by the degree of skin surface involved and the rate of appearance of new vesicles. If no improvement is evident after 5-7 days, dosages should be increased by increments of 50% per week. Once remission is achieved and most lesions have healed, doses can be tapered down to the lowest disease controlling levels.

Azathioprine at 1-3mg/kg/day titrated against thiopurine methyl transferase (TPMT) levels is the adjuvant drug of choice and should be instituted simultaneously with the systemic corticosteroids. Topical corticosteroids (rinse or ointment) may improve oral lesions and may be considered as monotherapy in mild disease where only the oral mucosal surfaces are affected.24

**Mucous membrane pemphigoid (MMP)**

A common systemic autoimmune blistering disease with preferential involvement of mucosal membranes. The antibodies are directed at the proteins of keratinocyte to connective tissue matrix adhesion or hemi-desmosomes (BP180 and laminin-332)20 causing the epithelium to split away from its underlying connective tissue bed. The subepithelial nature of the split results in thick roofed vesicles which may still be intact on examination. Rupture of the vesicles leave ulcerative lesions devoid of any epithelium, covered by yellow-white slough. Desquamative gingivitis (erythematous and friable gingiva with epithelial destruction) is a frequent finding.23 Microscopy confirms sub-epithelial vesicle formation with linear deposition of IgG and/or IgA antibodies and compliment in the basal membrane zone on DIF. Management difficulties are ascribed to diverse pathogenic pathways, lack of well-designed clinical trials, variability in disease severity and different efficacies of treatments on different mucosal surfaces.25,26 Patients with oral mucosal involvement only or with limited additional skin involvement, can be managed with moderate-to-high potency topical corticosteroids, dapsone (50-200mg/day) or tetracycline (1-2mg/day) with added nicotinamide (2-2.5mg/day). Patients with diffuse oral mucosal and extraoral mucosal surface involvement are managed with systemic corticosteroids (prednisone 0.5mg – 1.5mg/kg/day). Alternatively, corticosteroid sparing agents such as azathioprine, or mycophenolate mofetil may be supplemented by topical corticosteroids on affected mucosal sites.25,26

**Erythema multiforme (EM)**

Erythema multiforme (EM) is a T-cell-mediated type IV cytotoxic immune reaction to a variety of antigens (viral, bacterial, pharmacological, or chemical) that result in apoptosis-mediated epithelial cell death. Anti-desmoplakin I and II antibodies were recently demonstrated as a possible instigator of the cytotoxic reaction.27 Previously considered to be a spectrum of clinical conditions, EM, formerly known as EM minor, is now accepted as a distinct entity.23 EM mostly affects young, healthy individuals and is often recurrent and temporal with recurrent HSV infections.28 Target lesions of skin are pathognomonic round, oedematous, erythematous papules with well-defined border and paler central vesicle. Oral lesions may either represent the start of further mucocutaneous involvement or may appear in isolation, classically with swollen, cracked, haemorrhagic and crusted lips with or without mucosa blisters and ulcerations.29 Treatment is targeted at the initiating organism. Patients with herpes associated EM often reports a history of recent recurrent HSV infection while the less common drug induced EM is not recurrent. Topical corticosteroids may be sufficient for EM supplemented with disinfecting and anesthetising mouthrinses (Andolex-C®).30 EM associated with HSV can be treated with a 5 day course of acyclovir (5 times/day) which should be instituted at the first sign of lesions.29 Prophylaxis in the form of twice daily administration of acyclovir (400mg), valacyclovir (500mg) or famcyclovir (250mg) for 6 months may be considered in long term management of frequent recurrences. In patients unresponsive to long term viral suppression, azathioprine, dapsone, mycophenolate mofetil, chloroquine, thalidomide or cyclosporine may be of benefit to suppress the aberrant immune response.31 Mycoplasma associated EM is treated with tetracycline.29

**ULCERS NOT PRECEDED BY VESICLES**

This group of oral mucosal ulceration represents the larger of the two groups and includes a wide differential diagnosis which should be considered against a proper clinical history and specific clinical features.

**Mucosal Infections**

Infectious mucosal ulceration not preceded by blisters should generally be considered to be of bacterial or fungal nature rather than viral.

**Common bacterial infections**

**Syphilis**

*Treponema pallidum* infection continues to be widespread, with increasing rates among men who have sex with men.31 The primary lesion presents at the first site of mucosal inoculation, frequently the oral mucosa. A highly infective, painless, solitary ulcer with indurated margins and ipsilateral lymphadenopathy is the most common, with healing within three weeks. Non-characteristic mucous patches alerts to the development of secondary syphilis frequently accompanied by a maculo-papular rash of the palmo-plantar surfaces of the hands and feet, and generalised lymphadenopathy.32 Primary, secondary and early latent syphilis (less than one year since primary infection) require a single dose of parenteral Benzathine penicillin G.33

**Tuberculosis (TB)**

The emergence of drug-resistant TB and the high numbers of HIV-infected individuals in South Africa has resulted in an increase of TB cases urging inclusion in the differential diagnoses of orofacial pathology. Secondary TB in the form of painful, deep irregular ulcers with indurated appearance, undermined edges and thick mucus-like material at the base of any aspect of the tongue are typical. Haematogenous spread from pulmonary TB or secondary inoculation of a traumatic ulcer with infected sputum is the most common pathogenesis. Primary oral TB is distinctly rare, usually associated with *Mycobacterium bovis*. Ulcers resemble chronic traumatic ulceration and even malignancy urging a diagnostic biopsy.34,35 Associated symptoms of pain, fever, lymphadenopathy, hoarseness of voice and weight loss frequently accompany the ulcerations. The diagnosis is confirmed by a biopsy, special stains to visualise the acid fast bacilli or traditional culture methods for positive identification of the organisms. Molecular diagnostics of TB is available but high cost and decreased accuracy in the HIV-positive population is problematic in the South African setting.36
Necrotising ulcerative gingivitis (NUG)/ periodontitis (NUP)/ stomatitis (NUS)

An opportunistic gingival infection caused by an array of bacteria in malnourished children, young adults and immune deficient patients. NUG is often the initial presentation, proceeding into NUP, NUS and ultimately noma. Necrosis and ulceration of the interdental gingival papilla, exquisite pain, severe halitosis, regional lymphadenopathy, malaise and fever differentiate this form of ulceration from others. When the alveolar bone becomes exposed, necrotic bone sequestrae may develop and should be removed with the associated teeth. Treatment includes pain control through analgesics, antimicrobials, and antiseptic mouthrinses containing chlorhexidine (Andolex C®). Metronidazole (400mg 3 times/day) is given to target the anaerobic organisms, while a broad spectrum antibiotic (amoxicillin 500mg 3 times/day) may be added in severe cases. Professional mechanical debridement (scaling and polishing) and institution of proper plaque control is essential. Predisposing factors, such as cigarette smoking and immune suppression, should be investigated and eliminated where possible. Morphological defects of the gingival architecture can be surgically corrected and the patient closely maintained to prevent recurrence.

Common fungal infections: Aspergillus and Mucormycosis

Both superficial and invasive opportunistic fungal infections are encountered in the oral cavity of especially immunocompromised patients. Candida infection is unlikely to present as or cause oral ulceration and should not be included in a differential diagnosis for oral ulceration. Mycoses to be considered include zygomycosis, aspergillosis, histoplasmosis, blastomycosis, and paracoccidioidomycosis. Aspergillus and Mucormycosis, albeit uncommon, are the most commonly encountered and follows the inhalation of the spores from soil, manure, grain, cereal and mouldy flour. Generally both organisms have a propensity to penetrate the walls of small to medium-sized blood vessels, resulting in thrombosis, infarction, tissue necrosis and ulceration. Necrosis results in the exposure of necrotic bone, loss of adjacent teeth and in some instances palatal perforation. Presence of the organisms is confirmed by tissue biopsy with special stains to visualise the fungal hyphae. Histomorphological features may assist in fungus recognition but culture is needed for definitive confirmation. Treatment of aspergillosis depends on whether it is invasive or not (mycetoma and allergic fungal sinusitis respectively). Invasive aspergillosis and mucormycosis is treated by radical surgical debridement and intravenous Amphotericin B or the liposomal variant (1-1.5mg/kg/day). Itraconazole, voriconazole and intravenous caspofungin may also be considered.

II Immune-mediated diseases not preceded by vesicles

Recurrent aphthous stomatitis (RAS)

RAS represents the most common form of oral mucosal ulceration encountered in healthy individuals. The term should be reserved for recurrent ulcers of the oral mucosa, not associated with any systemic disease and which typically commence in childhood or adolescence. Non-keratinised mucosa of the buccal mucosa, lips and soft palate is most commonly affected in contradiction with recurrent HSV seen on keratinised mucosa of the vermilion, gingiva and hard palate. A variety of local and systemic factors including immunologic, allergic, nutritional, microbial organisms, psychosocial stress as well as immunosuppressive drugs, have been proposed as possible etiologic factors. Increased prevalence in close family members also indicate a possible genetic background. RAS has an atypical clinical presentation in HIV-infected patients and should always be considered as differential diagnosis of oral mucosal ulceration in them. When RAS starts later in life, additional mucosal surfaces may be affected and a comprehensive physical examination and medical history should be considered to rule out inflammatory gastrointestinal disease such as Crohn’s, Coeliac disease, Behçet’s syndrome, Sweet’s syndrome, cyclic neutropenia, HIV infection and drug reactions in which case “aphthous-like ulcers” is a more appropriate term. Clinically RAS is classified according to the size of the ulcers, number, location and healing period of the lesions. Minor RAS is the most common variant and the patient typically present with 1-5 ulcers, less than 10mm in diameter surrounded by a bright red inflammatory halo. Ulcers heal spontaneously within 10-14 days. RAS major (Sutton disease) usually appears after puberty and present as deeper, larger, persistent ulcerations with more irregular borders than minor RAS. One to 10 ulcers, usually >10mm in diameter typically take weeks or months to heal. Systemic symptoms such as fever and malaise may accompany the severe dysphagia associated with these lesions which tend to occur in the posterior palate and pharynx and heal with scarring. Herpetiform type RAS are clinically distinct and bears no relationship to HSV infection. It presents mostly commonly in females aged 20-29 years as clusters of 10-100 pinpoint ulcers on the lateral border of the tongue which may coalesce to form large painful ulcerations. RAS is usually preceded by a prodrome of burning pain 1 to 2 days before the extremely painful ulcers covered by pseudomembranes and surrounded by a characteristic flame red halo appears. Treatment strategies depend on the type of RAS in a particular patient but relies mostly on eliminating any instigating or aggravating factors, be it mechanical trauma (toothbrush, food or orthodontic brackets), chemical irritation (some patients relate the onset of ulcers to particular foods) or microbiological (maintaining optimal oral hygiene). Topical analgesics such as 2% lidocaine hydrochloride or benzylamine (Andolex®) may be considered to numb the mucosal pain. The disease process itself can be manipulated by using topical corticosteroids in rinses, ointments or aerosols depending on the distribution and location of the lesions with ointments favoured for solitary lesions that the patient can reach and steroid inhalers used for lesions located on the soft palate or oropharynx. Alternatively a tetracycline mouth rinse (such as a 100mg doxycycline capsule dissolved in 25ml of water and rinsed with 3 times/day) may be used due to its anti-inflammatory properties. Systemic immune modulating agents such as glucocorticosteroids, dapsone, thalidomide and azathioprine should be reserved for more severe cases.

Oral lichen planus (OLP)

OLP is a rather common, chronic inflammatory disorder affecting mainly middle-aged females. The pathogenesis remains uncertain but various subsets of T-lymphocytes and mast cells play a role in the basal membrane damage. The disease may present with a diverse clinical spectrum which includes the atrophic, erosive, ulcerative and less commonly, bullous variants. A mixture of clini-
perform and the history of the patient scrutinised to reach a final diagnosis. Action or lupus erythematosus. A biopsy of an ulcer adjacent surface should be performed. UP sites. Long-term use of topical corticosteroids is associated with an increased incidence of candida infection. Intra-lesional corticosteroids can be used to target ulcerative lesions (Depo-Medrol 40mg/ml with lidocaine 10mg/ml). Only in symptomatic OLP or those with extra-oral involvement resistant to conventional therapy should steroid sparing agents such as chloroquine or azathioprine be considered. Allergic contact stomatitis

Although rare, this form of mucositis has been reported in association with dental impression materials, dental restorative materials, topical benzocaine application and more commonly cinnamon in toothpastes, mouth rinses, and chewing gum. Lesions may appear as mixed red and white patches with ulceration, features that may resemble leukoedema, lichen planus, lupus, leukoplakia and verruous white plaques, swelling of the cheeks and gingival desquamation. The lesions may appear on the lips, cheeks, tongue and gingiva as localised or widely distributed lesions.

Lupus erythematosus (SLE/DLE)

More than half of patients with systemic lupus erythematosus (SLE) may present with oral lesions, most frequently ulceration of the buccal mucosa and lips during the early, active disease phase. Ulcerative lesions and erythematous lesions with or without radiating white striae may also be seen as part of the clinical spectrum of discoid LE (DLE). DLE is considered a potentially malignant disorder of the oral mucosa due to the increased prevalence of OSCC among this population, especially involving the lower lip. Both physical and chemical sun protective strategies should therefore be implemented. Treatment of patients with oral lesions of SLE/DLE should be targeted at the systemic/dermatologic condition which includes the use of nonsteroidal anti-inflammatory drugs, antimalarial agents, glucocorticoids and immune suppressive drugs such as cyclophosphamide, azathioprine, methotrexate and mycophenolate mofetil. Literature regarding the specific treatment of the oral lesions is scarce but topical use of corticosteroids of varying potency is accepted as the general standard of care. The chosen formulation will depend on the distribution and accessibility of the lesions.

III Trauma

Traumatic ulceration of the oral mucosa may be acute or chronic in nature with the latter diagnostically more problematic due to underlying fibrosis and clinical appearance of neoplastic induration. A thorough clinical history will often alert the clinician to a traumatic aetiology or burns caused by warm food or chemicals whilst the intra-oral

Figure 3: Ulceration of buccal mucosa surrounded by erythema and radiating white striae. These features are suggestive of oral lichen planus, a lichenoid reaction or lupus erythematosus. A biopsy of an ulcer adjacent surface should be performed and the history of the patient scrutinised to reach a final diagnosis.

Allergic reactions

Oral mucosal hypersensitivity reactions are less common than cutaneous ones ascribed to the possible allergen dilution and the continuous rinsing effects of normal saliva flow. Lesions may imitate lichen planus or present with non-specific tissue oedema, erythema, cracking, ulceration, hyperkeratotic white plaques or mucosal desquamation. Lesions may start long after the introduction of a drug and may remain for months after cessation thereof complicating diagnosis and management. Three forms of allergic mucosal reactions are discussed briefly.

Lichenoid lesions

When a hypersensitivity reaction to either a systemic drug or direct contact with an offending agent results in clinical and histological features reminiscent of lichen planus, the term ‘oral lichenoid drug reaction (OLDR)’ or ‘oral lichenoid contact lesion (OLCL)’ is used respectively. A temporal or spatial association with an offending agent can usually be identified. Amalgam is often implicated in OLCL, confirmed by patch testing for mercury or amalgam sensitivity. It would however be reasonable to replace a suspicious restoration when patch testing is not available. OLDR is encountered with some frequency in patients treated with angiotensin-converting enzyme (ACE) inhibitors, nonsteroidal anti-inflammatory drugs (NSAIDs) and oral hypoglycaemic drugs. Regardless of the eliciting allergen, both OLCL and OLDR may present with significant ulceration, usually with remarkable erythema and white striations at the periphery of the ulceration reminiscent of LP.

Fixed drug eruption (FDE)

This form of hypersensitivity is remarkable for its fixed anatomical nature and has been described with NSAID’s and other oxicam drugs, gabapentin, fluconazole, systemic antibacterial and antifungal drugs. FDE should be suspected in cases with a temporal association of drug ingestion, may be confirmed through patch testing or oral provocation tests, and managed through drug avoidance or substitution, while the acute lesions can be treated with topical or systemic steroids.

Allergic contact stomatitis

Although rare, this form of mucositis has been reported in association with dental impression materials, dental restorative materials, topical benzoic acid application and more commonly cinnamon in toothpastes, mouth rinses, and chewing gum. Lesions may appear as mixed red and white patches with ulceration, features that may resemble leukoedema, lichen planus, lupus, leukoplakia and verruous white plaques, swelling of the cheeks and gingival desquamation. The lesions may appear on the lips, cheeks, tongue and gingiva as localised or widely distributed lesions.
examination may reveal the causative factor such as sharp broken tooth or restoration or ill-fitting denture. Ulceration due to local anaesthetic most often occurs in the hard palate, the combined result of pressure and ischemic necrosis. A special kind of chronic traumatic ulceration (Riga Fede disease) is sometimes observed on the ventral surface of the tongue of infants with natal, neonatal or even early erupted primary teeth. These ulcerations may interfere with feeding and treatment is essential. If the tooth is a supernumerary tooth, it may be extracted. If these teeth are however the only primary teeth, a soft formed mouth guard for feeding or covering the sharp incisal edges with restorative material may be performed to protect the opposing soft tissue. Any persistent ulcer should be biopsied to rule out malignancy.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Location</th>
<th>Number</th>
<th>Duration</th>
<th>Stand out feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulcers preceded by vesicles</td>
<td>Recurrence - Keratinised</td>
<td>Multiple</td>
<td>Acute</td>
<td>Primary: systemic symptoms</td>
</tr>
<tr>
<td>Herpes Simplex Virus (HSV)</td>
<td>Oropharynx</td>
<td>Multiple</td>
<td>Acute</td>
<td></td>
</tr>
<tr>
<td>Varicella Zoster (HHV-3)</td>
<td>Unilateral</td>
<td>Multiple</td>
<td>Acute</td>
<td></td>
</tr>
<tr>
<td>Ulcers not preceded by vesicles</td>
<td>Oral and skin</td>
<td>Multiple</td>
<td>Chronic</td>
<td>Nikolsky sign</td>
</tr>
<tr>
<td>Pemphigus vulgaris (PV)</td>
<td>Oral, ocular, laryngeal, vaginal</td>
<td>Multiple</td>
<td>Chronic</td>
<td>Desquamative gingivitis</td>
</tr>
<tr>
<td>Erythema multiforme</td>
<td>Oral, ocular, target lesions skin</td>
<td>Multiple</td>
<td>Acute</td>
<td>Bloody crustings of lips</td>
</tr>
</tbody>
</table>

### IV Neoplasia

#### Primary and metastatic malignancies

The oral mucosa may be affected by an array of both primary and metastatic malignancies which may all present as non-specific ulcers. Oral squamous cell carcinoma (OSCC) is the most common, frequently presenting as ulceration with clinical induration, fixation to the underlying tissues, rolled exophytic margins, pain and/or numbness (Figure 4). Histopathological examination of all ulcerated, red, white or mixed oral lesions that have persisted for more than three weeks is mandatory. Metastatic malignancy to the jaws heralds a poor prognosis, often clinically resembling reactive or traumatic lesions, periodontal conditions and even inflammatory enlargement.

#### Table of conditions differentiated by presence of vesicles, location, number and duration of lesions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Location</th>
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<td>Acute</td>
<td>Bloody crustings of lips</td>
</tr>
</tbody>
</table>

### Antineoplastic therapy induced mucositis

Previously thought to be the result of direct epithelial damage caused by cytotoxic therapy, is now known to involve a complex cascade of events which is initiated by reactive oxygen species with extensive inflammation, atrophy, swelling, erythema and ulceration. Chemotherapy-induced mucositis starts within 4-7 days of initiation and peaks within two weeks. Healing occurs only after cessation of therapy. Radiation induced mucositis may be seen following a cumulative dose of 15 Gy and tends to reach full severity at 30 Gy which may last for months. Radiation lesions correspond to the exposed surfaces while chemotherapy induced mucositis affects the entire alimentary tract. The type and dosage of systemic cytotoxic agents, and the dosage and field of radiation will affect

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**Figure 4:** Ulceration of the lower lip with accompanied crusting is suggestive of oral squamous cell carcinoma.
the presence and severity of mucositis. Evidence based guidelines for the management of cancer therapy induced oral mucositis was established and should be referred to in all cases of patients receiving these agents.77 Dental examinations and treatment are however recommended for all patients receiving oncotherapy, especially patients with head and neck cancers.

CONCLUSION

Exploration of the different conditions responsible for oral ulceration reveals marked distinction between lesions that are preceded or accompanied by vesicles and those that are not. Accurate and complete history taking and consideration of the anatomical location of the lesion is therefore essential in reaching an accurate working diagnosis which can be successfully managed with the recommendations provided.

Acknowledgements

Dr Aubrey Masilana for supplying the clinical case photographs.

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References

Lower facial and cervical lymphadenopathy in the context of clinical dentistry

ABSTRACT
The dental practitioner is in a good position to detect lower facial and cervical lymphadenopathy. A medical history and a physical examination of a patient with lower facial and cervical lymphadenopathy might provide important clues as to the underlying cause. Lower facial or cervical lymphadenopathy is usually a manifestation of reactive hyperplasia to local infections of mouth, teeth, jaws or oropharynx; less commonly of malignant metastases. Discrimination between benignly and malignantly enlarged lymph nodes is crucial for appropriate treatment. If the lymphadenopathy does not improve after treatment of a clinically apparent infective cause, then special investigations become necessary for definitive diagnosis and treatment planning.

The purpose of this article is to provide the dental practitioner with some guidelines for evaluating patients with lower facial and cervical lymphadenopathy.

Key words: lymphadenopathy; function and structure of lymph nodes; reactive hyperplasia.

INTRODUCTION
The principle components of the lymphatic system are the lymph nodes, the lymphatic vessels and the circulating immune cells which together have the primary function of protecting the host against infections.

Lymphadenopathy refers to any enlargement of lymph nodes. It may be a manifestation of various infectious, neoplastic or lipid-storage conditions, but in many cases, lymphadenopathy is non-specific, without any identifiable cause. Lymphadenopathy may be associated with the patients’ main complaint or be an incidental finding, in which case the clinician must decide whether to regard the enlarged lymph nodes as merely the legacy of some infection in the past or as a current reaction to disease.

The term regional lymphadenopathy refers to enlargement of lymph nodes within a single defined anatomical region (Figure 1) closely related to the site of the causative condition, whether it be infective or malignant. Generalised lymphadenopathy refers to the enlargement of lymph nodes at several non-contiguous anatomical regions related to a systemic condition. Generalised lymphadenopathy is usually associated with Epstein Barr virus (EBV)-induced infectious mononucleosis, an infectious mononucleosis-like condition caused by cytomegalovirus (CMV), HIV infection (Figure 2), immunological diseases or with haematological malignancies (leukaemia, lymphoma).

The most common causes of regional lower facial or cervical lymphadenopathy are upper respiratory infections, dental infections, periodontal infections, oral soft tissue infections and metastases from head, neck and mouth cancers.
Lymph nodes are peripheral lymphoid organs linked to the blood vascular circulation by afferent and efferent lymphatics. These dense discrete accumulations of lymphoid tissue are ovoid, round or bean-shaped nodules that vary from 2 to 20mm in size. The major functions of lymph nodes are lymphopoiesis, filtration, and recognition and processing of antigens.6 The capsule, the fibrous trabeculae, and a reticulin network constitute the framework of the lymph node. The lymph node consists of three functionally and morphologically distinct zones: cortical, paracortical and medullary (Figure 3). Lymphoid cells comprise populations of B cells, T cells and plasma cells together with follicular dendritic cells and interspersed reticulum cells that have a role in antigen processing and presentation. The resident histiocytes, which are primarily phagocytic cells, remove microorganisms and other foreign particles from the lymph.6 Physiologically, upon activation by antigens, the ‘resting’ lymphoid follicles enlarge and become dynamic cellular complexes comprising pale-staining germinal centres with large B lymphocytes surrounded by dark-staining mantle zones with small antigen-naïve B lymphocytes. The lymphoid follicles are engaged in humoral immunity, and undergo hyperplasia when humoral immune responses are generated. The densely cellular paracortical zone beneath the cortical zone extending between the lymphoid follicles, comprises mainly T lymphocytes and is the site of generation of cellular immunity.7

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The medulla comprises cords of lymphocytes, plasma cell precursors and plasma cells and is the main site of antibody production. The role of plasma cells is to convey antibodies into the general circulation. The lymphatic sinuses are endothelium-lined passages between reticulin fibres in the cortical, paracortical and medullary zones. The phagocytes within the sinuses clear the lymph of foreign particles and play an important role in antigen processing.6

CLINICAL EVALUATION OF A DENTAL PATIENT WITH LOWER FACIAL AND CERVICAL LYMPHadenOPATHY

Medical history
Age, gender, occupation, exposure to pets, promiscuity of sexual behaviour, drug usage, dental and oral history, and symptoms such as sore throat, cough, fever, night sweats, and fatigue or weight loss may provide clues for determining possible causes of the lymphadenopathy. Lymphadenopathy in children and young adults is usually owing to infections, but with increasing age, the possibility of malignancy increases. Some drugs such as diphenylhydantoin and isoniazid are well known to cause lymphadenopathy.4

Physical examination
The size, consistency, mobility or fixation of the lymph node and whether or not it is tender to palpation are all important signs in determining the nature of the lymph node enlargement. In terms of size, abnormal lymph nodes smaller than 1cm in diameter are usually reactive and may persist after resolution of the cause owing to post-inflam- matory fibrosis. On the other hand, lymph nodes bigger than 2cm in diameter are usually associated with malignant or infectious granulomatous diseases. Lymph node tenderness is the result of rapid enlargement with stretching of the capsule, with hyperaesthesia of the associated sensory nerve endings caused by an acute or subacute inflammatory process.2

Figure 1: Clinical distribution of the more superficial and readily palpable lymph nodes of the lower facial and cervical region.

Figure 3: The structure of a lymph node comprises three distinctive zones: the cortex, the paracortex and the medulla. Subjacent to the marginal sinus is the cortex, with the primary lymphoid follicles containing antigen-naive B cells; the paracortical zone between the primary follicles is populated by T lymphocytes; and the medulla, deep to the cortex is the locus of numerous plasma cells and a few lymphocytes. Multiple afferent lymphatics perforate the capsule and empty into the subcapsular marginal sinus, whence the lymph percolates through the node, eventually reaching the medullary sinus and leaving the lymph node through a single efferent lymphatic vessel.

Figure 2: Persistent lower facial and cervical lymphadenopathy as part of a generalised lymphadenopathy in an HIV infected patient (courtesy of Dr CC Rachanis).
Abnormal lymph nodes can be described as being soft, firm, rubbery, hard, discrete or matted, mobile or fixed, tender or non-tender. Acute infection is characterised by regional lymphadenopathy in which the lymph nodes are discrete, tender, mobile and soft, but with chronicity of the infection, the lymph nodes become firmer and less tender. Acute submandibular or submental lymphadenitis is usually caused by dental, oral mucosal and maxillary sinus infections, while acute bilateral cervical lymphadenitis is most commonly caused by upper respiratory viral infection or by bacterial pharyngitis. Subacute and chronic cervical lymphadenitis are typically caused by mycobacterial infection and toxoplasmosis.

In lymphadenopathy from metastatic cancer, the nodes are usually non-tender, hard and fixed to the surrounding tissues; but in the case of lymphoma, they are usually non-tender, large, discrete, rubbery, and mobile.

LABORATORY STUDIES AND IMAGING TECHNIQUES

In the process of evaluation of lymphadenopathy, if the medical history and a clinical examination are not suggestive of a malignant origin, a causative infection must be sought and if found treated. Laboratory investigations are not usually required. Follow-up at about four weeks is advisable to determine if the lymphadenopathy has resolved.

If at this time the lymphadenopathy has not resolved, or has become worse, a complete blood count may provide information about possible leukaemia, lymphoma, EBV or CMV infection. Serological tests may show antibodies against specific viruses; and a culture of a throat swab may demonstrate persistent infection.

Several imaging techniques including computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound and colour Doppler ultrasonography can facilitate the differentiation of benign from malignant enlarged lymph nodes. If anything in the medical history, in the physical examination or in the imaging investigations is suggestive of malignancy, then biopsy of an accessible enlarged lymph node should be done. In general, lower facial and cervical lymphadenopathy should never be treated as being trivial.

REACTIVE CHANGES AND MALIGNANT CELL INVASION OF LYMPH NODES

In response to infections, malignancy or other causes of tissue damage, lymph nodes in the drainage region will undergo reactive hyperplasia. Follicular hyperplasia (hyperplasia of the cortical follicles) with the development of enlarged B cell germinal centres (Figure 4) and the production of B lymphocytes will generate a humoral immune response; parafollicular (paracortical) hyperplasia will result in increased production of T lymphocytes, generating a cell-mediated immune response; and sinus hyperplasia (sinus histiocytosis) with the dilatation of the subcapsular and the medullary sinuses will result in increased numbers and upregulation of functional activity of macrophages and phagocytic sinus-lining cells. In addition, specific chronic granulomatous inflammatory processes in lymph nodes are observed in sarcoidosis, tuberculosis (Figure 5), syphilis and in Crohn’s disease.
Whereas reactive lymph nodes are enlarged owing to the inflammatory changes of vasodilation, with B cell, T cell and plasma cell proliferation and oedema, lymph nodes affected by cancer metastases are enlarged chiefly because of proliferation of the malignant metastatic cells within the lymph node, and only to a lesser extent because of reactive hyperplasia and inflammation.\[13\]

When metastatic malignant cells reach regional lymph nodes via afferent lymphatic vessels, they proliferate in the subcapsular sinus, and then infiltrate the medullary sinuses with progression to from solid malignant masses in the parenchyma of the lymph node (Figure 6).\[12\]

**CONCLUSION**

Lower facial or cervical lymphadenopathy is usually a manifestation of reactive hyperplasia to local infective processes such as dento-alveolar abscesses, acute periodontal diseases, oral soft tissue and salivary glandular infective conditions, systemic conditions, or to malignant metastasis.

Many cases of lower facial and cervical lymphadenopathy related to self-limiting oropharyngeal infections are self-limiting so that most cases resolve and do not per se necessitate any active treatment; but if the lymphadenopathy does not improve, special investigations as outlined above should be done.

Self-evidently, when lymphadenopathy is malignant in origin, radical treatment whether excisional, radio-or chemotherapeutic is mandatory, as may be decided by an oncologist.

**Conflict of interest:** None declared.

**Acknowledgments:** We are grateful to Dr R Ballyram for the illustrations of Figure 1 and Figure 3.

**References**


The use of temporary skeletal anchorage devices amongst South African orthodontists

SUMMARY

Background: Temporary Skeletal Anchorage Devices (TSADs) are small titanium screws that are inserted through the gingival or palatal mucosa into supporting bone to form an independent rigid anchor unit or may be tied to adjacent teeth to enhance their anchorage capability. On completion of orthodontic treatment the orthodontist is easily able to unscrew and remove the screws.

Objective: To conduct a survey on the clinical use of TSADs amongst South African orthodontists.

Materials and method: The method consisted of a structured survey questionnaire which was sent to 110 South African orthodontists registered on the South African Society of Orthodontists database in 2013.

Results: Forty six orthodontists completed the survey, a response rate of 41.81%. Of these respondents, 63.04% used TSADs, and of those, 58.62% placed TSADs themselves while the remainder referred to maxillo-facial surgeons, and to a lesser extent, to periodontists, for placement. The majority (72.41%) loaded TSADs immediately. TSADs were used mostly to provide anchorage when teeth were moved mesially (52%) or distally along the arch.

Conclusions: South African orthodontists have adopted a cautious approach to the use of TSADs. Training in the placement and the clinical application of TSADs should be incorporated in the curriculae of postgraduate orthodontics.

INTRODUCTION AND LITERATURE REVIEW

The term “orthodontic anchorage” was defined by Ottofy as “the base against which orthodontic force or reaction of orthodontic force is applied”. This definition was later expanded upon by Daskalogiannakis who explained it more simply as “resistance to unwanted tooth movement”. In essence, anchorage means the prevention of undesired forward movement of posterior teeth, which are often used as “anchors” when crowded or proclined anterior teeth are being retracted into space created by premolar extraction. Every effort should be made during retraction to prevent the anchor teeth from moving forward.

Orthodontists have traditionally used extra-oral appliances such as headgears and face masks to control anchorage. Headgear obtains anchorage from the back of the head and face masks from the chin and forehead. In more recent times these appliances have lost popularity, with many patients regarding the devices as unappealing to wear, and consequently are not compliant, leading to poor treatment outcomes.

In an effort to overcome these problems, tooth anchorage devices which are not reliant on patient cooperation were designed, such as the Nance holding arch, the transpalatal arch (TPA) and the lingual arch. Unfortunately, unitive mesial movement of posterior teeth anchored with these appliances still occurs.

Recently, temporary anchorage devices (TADs) have been introduced to clinical orthodontics. These are small screws inserted into bone for the purpose of enhancing orthodontic anchorage and are removed following completion of treatment. The first clinical case report on
the successful use of an intra-osseous mini-screw was published in 1983. In that case a patient with a deep impinging overbite was treated using a vitallium bone screw inserted below the nasal spine. An elastic chain was then used to intrude the maxillary incisors. It was only in the early 21st century, however, after the introduction of the more biocompatible titanium screws, that these devices became common. Approval by the FDA for their clinical use was granted in 2003. Since then various terminologies have been used to describe a screw inserted into bone and used for orthodontic anchorage, including: mini-screw, micro-screw, mini-implant, micro-implant, pin-plant, ortho-implant and temporary anchorage device (TAD). A panel of orthodontists meeting at the 2004 conference of the American Association of Orthodontists was mandated to resolve the confusion. It was suggested that the terms micro and screw be avoided as the former implies a metric measurement of 10⁻⁶ requiring for visualisation the aid of a microscope, while the latter may have a negative connotation. The terms miniscrews and TAD were adopted, although the term TAD is actually applicable to other appliances such as the headgear and mandibular holding arch. The term Temporary Skeletal Anchorage Device (TSAD) is today preferred with the pronunciation “tad” with a silent “s”. They are easy to place, even by orthodontists with the patient in the dental chair. Minimal local or topical anaesthesia is required and the tad can be loaded immediately.

Mini-plates were introduced at about the same time that miniscrews were taken into use. Mini-plates are Y, T or L-shaped flat bars of titanium plate surgically inserted and fixated to bone using two to three monocortical screws. The technique has a high success rate. It is claimed that the plates provide reliable stability and can withstand heavy forces. They are therefore reserved for cases where heavy forces such as those used for retraction of teeth en-masse, for distal movement of molars and for skeletal correction are applied. The disadvantages associated with these devices are added cost of the TSADs and their placement as well as the need for a second surgical procedure for the removal of plates and screws on completion of treatment.

Orthodontists have since introduced several uses for TSADs including: retraction of anterior teeth, retraction of whole dentition, distal repositioning of molars, protraction of molars or the whole dentition, orthopaedic correction of maxillary deficient cases, intrusion of teeth and arch expansion. Other minor uses include: improved tooth anchorage in periodontally compromised individuals, uprighting and dis-impacting molars as well as correcting a canted occlusal plane.

The aim of this study was to report on the uses of TSADs by South African orthodontists and to compare the findings with those of similar surveys elsewhere. Information obtained from such a survey could be useful in informing the training of orthodontists.

MATERIALS AND METHODS

A structured self-administered questionnaire, used previously in a survey in the USA, was modified and directed at 110 South African orthodontists registered on the South African Society of Orthodontists database in 2013. Questions were aimed at obtaining information regarding how frequently TADs were used, and sought reaction on how orthodontists viewed the experience. Orthodontists attending the annual SASO Congress in 2013 were invited to complete the questionnaire. A follow-up web-based survey was sent to those who had not attended the Congress and to those who had attended but had not returned their questionnaires.

Descriptive statistical analyses were performed using SAS® (SAS Institute Inc, Cary, NC), Release 9.3, run under Microsoft® Windows® from a personal computer.

RESULTS

A response rate of 41.8% (46 out of 110) was achieved in this study.

The responses to the questions posed in the questionnaire are as follows:

I. Orthodontists using TSADs in their practices

i) How long have you been using TSADs?

<table>
<thead>
<tr>
<th>How long, in years</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 yrs</td>
<td>10.7</td>
</tr>
<tr>
<td>4 yrs</td>
<td>60.7</td>
</tr>
<tr>
<td>5 yrs</td>
<td>7.1</td>
</tr>
<tr>
<td>9 yrs</td>
<td>3.6</td>
</tr>
<tr>
<td>10 yrs</td>
<td>14.3</td>
</tr>
<tr>
<td>20 yrs</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Figure 1: Experience in placement and utilisation of TSADs.

ii) Who places TSADs and to whom do you refer to if you don’t place them yourself?

<table>
<thead>
<tr>
<th>Clinician responsible for placing TSADs</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontist</td>
<td>57.2</td>
</tr>
<tr>
<td>Maxillofacial and oral surgeon</td>
<td>28.6</td>
</tr>
<tr>
<td>Periodontist</td>
<td>7.1</td>
</tr>
<tr>
<td>Maxillofacial and oral surgeon or periodontist</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Table 1: Clinician responsible for placing TSADs

<table>
<thead>
<tr>
<th>Waiting period before loading</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate loading</td>
<td>75</td>
</tr>
<tr>
<td>Waiting period before loading</td>
<td>21.4</td>
</tr>
<tr>
<td>No response</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Table 2: Loading of TSADs
iv) What do you use TSADs for?
An analysis of the responses of the participating orthodontists revealed that TSADs were most commonly used for anchorage when the dentition was being moved mesially (46.2%), for intrusion (42.8%) and for retraction (39.3%). Applications reported less frequently included: distal movement of dentition (32.1%), molar uprighting (25%) and traction of impacted teeth (17.8%). They were used least for correction of an occlusal cant (3.6%) (Figure 2).

Reports in the literature indicate that 54% to 57% of orthodontists place TSADs themselves.39

v) How many TSADs do you place per month?
In this study a large number of orthodontists (75%) placed an average of two to four TSADs per month. Fewer than one was placed per month by 21.4% of the sample while 3.6% placed an average of between five and 10 TSADs per month (Figure 3).

vi) What complications have you experienced in the use of TSADs?
The most commonly reported complication experienced with the use of TSADs was failure (67.9%) (Figure 4).

vii) How many failures do you experience per month? (Failure rate)
No failures were reported by 32.1% of orthodontists in their use of TSADs, while 50% had experienced the failure of one to five TSADs during treatment (Figure 5).

viii) In your experience, would you say that these devices have added value to your clinical practice in terms of clinical/treatment results?
Most respondents who used TSADs (50%) were satisfied, believing that the devices added value to their clinical practice in terms of clinical/treatment results. Only two respondents (7.1%) reported not being completely satisfied with the application of TSADs.

II Orthodontists not using TSADs in their practices

i) Why are you not using TSADs?
Among the 18 orthodontists who were not making use of TSADs in their practices, the most commonly cited reason was that they were not skilled in placing the screws (22.2%). Other reasons provided were that orthodontists were apprehensive of complications that might arise (22.2%), the high cost of TSADs, and patients’ inability to accept TSADs (Table 3).

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Percentage of orthodontists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not skilled in placing TSADs</td>
<td>22.2</td>
</tr>
<tr>
<td>Fear of complications</td>
<td>22.2</td>
</tr>
<tr>
<td>Cost factor</td>
<td>22.2</td>
</tr>
<tr>
<td>Inability of patients to accept TSADs</td>
<td>22.2</td>
</tr>
<tr>
<td>Had not reached that stage yet</td>
<td>5.6</td>
</tr>
<tr>
<td>Too old to change what works</td>
<td>5.6</td>
</tr>
<tr>
<td>Cannot see the need for them</td>
<td>5.6</td>
</tr>
<tr>
<td>I can manage without them</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Table 3: Reasons for not using TSADs

Nature of complications when using TSADs

- Infection: 7.1%
- Failure: 3.6%
- Gingival hyperplasia: 21.4%
- Soft tissue impingement: 67.9%

Figure 4: Complications related to the use of TSADs

Number of failures per month

- 0: 32.1%
- < 1: 14.3%
- 1 - 5: 50%
- Unknown: 3.6%

Figure 5: The number of TSADs failures per month (Failure rate).
ii) What alternative methods of anchorage are you using?
When questioned about the method/s of anchorage that they were using other than TSADs, orthodontists mentioned the following: headgear, transpalatal arch, Nance holding arch, figure eight ligatures, wire stops, pushing springs, bonding second molar teeth, elastics, face mask and the Begg technique.

iii) If lack of skill is your reason for not using TSADs, do you believe a hands-on course would benefit you?
Of the nine orthodontists who cited lack of skill as their reason for not using TSADs, five (55.5%) reported that they believed that a hands-on course would benefit them, and that they would use TADs if another professional was to place them on their behalf. Four (44.4%) of the nine answered “maybe” to the two questions.

DISCUSSION
This study sought to establish the use of TSADs amongst South African orthodontists through the use of a validated, structured self-administered questionnaire. Questions were separated into two categories, namely for orthodontists using TSADs to find out how frequent and for what purpose was their use and a second category for those not using the technique, to explore their reasons and to discover what alternative form of anchorage they are using.

The response rate from participants was modest and rather lower than that achieved in a USA study where the reported response rate was 82%. The 2008 survey of AAO members35 and the Swiss study,36 however had much lower response rates at 6% and 24.4% respectively. (Surveys using questionnaires generally have low response rates.)

The highest percentage of orthodontists using TSADs was in the USA,36 reported as 91%, closely followed by the Swiss at 80%.38 In this South African study, the percentage of orthodontists using TSADs was lower (60.9%). This might be due to delayed arrival of new technology and innovation and a longer lag period in becoming established. Also, when technology finally arrives, it comes at a much higher and possibly prohibitive cost.

The experience levels of orthodontists using TSADs in this study were comparable to those of orthodontists in the USA study in that none of the clinicians reported having used TSADs for longer than 10 years. The majority of respondents (89.2%) had been using the devices for only the past five years or less.36 This finding was to be expected since the technique was still relatively new at the time this study was conducted.

The number of SA orthodontists who place TSADS on their own is comparable to the figures reported in the literature (54% to 57%) and so is the pattern of referral for placement, with the majority of orthodontists involving maxillofacial surgeons and very few referring to periodontists.37,38 The reasons for these preferences are not clear. Even though there is agreement that placement of TSADs is relatively easy,40 some orthodontists are still not comfortable to manage insertion of the screw, an indication that placement and clinical use of these devices should be taught at training centres.

A high number of orthodontists are comfortable in loading TSADs immediately.29,33,36,37 Other researchers agree that immediate loading is not only possible but may also positively affect the osseous density around the screw.41

South African orthodontists use TSADs mostly for mesial movement of the dentition and the least frequent application is for correction of canted occlusal planes. The findings are similar to what has been found elsewhere,35,36 The frequency in the use of TSADs could of course be linked to the prevalence of the specific malocclusion traits with cases requiring mesial movement of the dentition being more common than those requiring correction of the canted occlusal plane.29,33,35-37

A high number of orthodontists (75) using TSADS place an average of four per month. This means that they are fairly comfortable with the clinical application of these devices. In the USA study36 only six of 46 clinicians reported having placed more than 20 TSADs in their clinical lives. TSADs were placed in only 6% of the patients reported in the study by Shirck et al.,36 whereas Keim et al.42 reported an average of only three patients per orthodontist. These findings suggest that orthodontists are very careful and selective in their use of TSADs.

Failure was the commonest complication when using TSADs, although the rate is low and comparable to that found in the literature.33,44 Most studies have shown failure rates of around 10%.43

Most respondents in this study agree that the use of these devices has added value to their practices and only two reported that they are not completely satisfied with TSADs. This indicates how clinically valuable the devices are and perhaps also emphasises the need to offer registrars instruction in their application. It is evident from the literature that the use of TSADs does enhance orthodontic treatment results. In this study, a greater proportion of SA orthodontists (85.7%) was found to consider that TSADs had added value to their treatment outcomes than was shown amongst USA orthodontists (78.7%).37

Most orthodontists not using TSADs seem to still rely on conventional methods of anchorage control. They cite lack of skills to place and use TSADs and concerns about possible complications in their use as reasons for not practising the technique. Perhaps these are normal reactions to new technology. Venkatesh and Parveen included lack of training by 67% of their respondents, fear of risk factors (54%), and patients’ refusal to accept TSADs (29%) as factors hampering the acceptance of TSADs in most practices.33 Most orthodontists not using TSADS confirmed that they would consider using them if they can receive adequate training.

Another factor in South Africa is the high cost of new technology as most of these items are imported at great expense.

LIMITATIONS OF THE STUDY
As a result of the low response rate from a relatively small population, sample size was the greatest limitation of this study.
CONCLUSIONS

The following conclusions can be drawn from the findings, while recognising the limitations of the study:

The majority of South African orthodontists use TSADs in their clinical practices but are selective and cautious in their application. Lack of training and a lack of confidence, fear of performing surgical procedures and the high costs involved contribute to a reluctance for greater usage. We recommend that placement techniques and the clinical use of these devices should be incorporated in the orthodontic postgraduate training programme.

Conflict of interest: None declared.

References

Effect of denture cleansers on flexural strength of heat-polymerized and auto-polymerized acrylic resins.

ABSTRACT
Aim: To compare the flexural strengths of two types of acrylic resins after immersion in three different denture cleansers, for two different time periods.

Materials and methods: 380 rectangular acrylic resin specimens (60mm x 20mm x 2mm) were fabricated and divided into three groups. Group 1 – baseline, ten of each type of acrylic resin; Group 2 - heat-polymerizing, 180 specimens, and Group 3 - auto-polymerizing, 180 specimens. Random samples of 30 specimens from Groups 2 and 3 were severally immersed in three different liquids: two denture cleansers i.e. alkaline peroxide- based (Corega) and sodium hypochloride- based (Jik), and tap water. Immersion time of six hours was taken to represent one day, hence, three and six months of continuous immersion represent one year and two years realtime, respectively. Flexural strengths were determined before, then after the three and six month periods. A two-way analysis of variance (SPSS version 23.0© (IBM USA) determined any statistical differences between the recorded flexural strengths.

Results: Sodium hypochloride decreased flexural strength for both polymethylmethacrylate resins. Water reduced flexural strength of the heat-polymerizing resin. The alkaline peroxide cleaner had no impact on flexural strength.

Conclusion: Flexural strength of heat-polymerizing acrylic resin can be significantly reduced by exposure to denture cleansers.

INTRODUCTION
Acrylic resins are used in the fabrication of different types of dental prostheses. These resins are composed of polymethylmethacrylate (PMMA) or polyethylmethacrylate (PEMA) powder particles, a peroxide initiator, and pigments which are mixed with methacrylate monomers. The material most commonly used is PMMA, which does have limitations in terms of flexural strength, a measure of stiffness and resistance to fracture. PMMA resins may be divided into three types, based on the procedures to be used during processing i.e. heat-polymerization; dough auto-polymerization and pour-type auto-polymerization. All of these resins have low strength, are brittle on impact but, are fairly resistant to fatigue failure and are moderately flexible. The properties of the polymer network may be altered by absorption of water and/or chemical solutions. These alterations include changes in physical properties such as plasticization and softening as well as changes in chemical properties such as oxidation and hydrolysis. As reviewed by Ferracane, the extent of the effect on the polymer network is dependent upon the nature of the aqueous environment as well as the chemistry and structure of the resin.

During delivery of a dental prosthesis, patients are advised and given instructions on denture care. Apart from directions on regular brushing of the dentures, it is generally recommended that patients immerse the prosthesis in denture cleansers for variable periods of time. These instructions are intended to prolong the longevity of the prosthesis as well as to ensure the maintenance of a healthy state of the oral mucosa. Sodium hypochlorides (NaOCl) and the alkaline peroxides are the active ingredients in the two main classes of

ACRONYMS
PEMA: polyethylmethacrylate
PMMA: polymethylmethacrylate

Keywords: flexural strength, heat-polymerizing acrylic resin, self-polymerizing acrylic resin

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denture cleansers. Ideally, cleansers have antimicrobial properties, remove organic and inorganic biofilm, while having minimal effect on oral tissues. They should not alter the physical and chemical properties of the acrylic resin. Paraños found that the chemical composition of cleaners and the immersion time, the contact period between the denture and the cleanser, play significant roles in changes in the acrylic resin over time. This study was undertaken to investigate the effects of denture cleansers and immersion periods on the flexural strengths of two different types of acrylic resins.

MATERIALS AND METHODS

(i) Preparation of specimens

Baseplate wax rectangular patterns of dimensions 60mm x 20mm x 2mm were prepared and invested in type II dental stone (Dentstone KD®) in metal flasks. After setting, the flask halves were separated, and the moulds rinsed under boiling water to remove the wax pattern. The heat–polymerized (Meliodent; Hanau, Germany) and auto-polymerized (Meliodent Rapid Repair; Hanau, Germany), specimens were fabricated separately, 190 of each acrylic type. The acrylic resin was mixed according to the manufacturer’s instructions, was packed into the stone mould and flasked. After flasking the heat polymerizing specimens were subjected to in a thermostatically controlled water bath. The auto-polymerizing specimens were subjected to the process of polymerisation in accord with the manufacturer’s instructions.

(ii) Allocation of specimens

From each acrylic brand, 10 specimens were used to determine baseline values of flexural strength before immersion. A calibrated Instron material testing machine (model 3366), with a 1 KN load cell at a crosshead speed of 0.5mm/min was used for this determination, based on a three point bending test (Figure 1). The remaining 180 specimens were allocated in batches of thirty (30) to three different cleansers (Corega, NaOCl/Jlg and water). Using an accelerated time protocol of six hours of immersion to represent one day, samples of each specimen type remained immersed in each cleanser for a period of either three months or six months, an equivalent of one and two years respectively. The flexural strengths of specimens (N/mm²) were measured after the three and six month periods.

(iii) Immersion of specimen in cleansers

Samples of 30 specimens each were immersed separately in one or other of the three different cleansers viz. the alkaline peroxide brand (Corega tablets, GlaxoSmithKline), the sodium hypochloride brand (household bleaching agent, Jik, Unilever), and tap water. The concentrations and amount of cleansers used were according to manufacturer’s instructions. The tests were performed at room temperature, and cleansers were changed periodically to simulate daily immersion by the patient. Half the specimens remained immersed in their respective cleansers for three months, the remainder for six months, hence the procedure involved twelve Groups (two types of acrylic, three solutions, two time periods). At the end of the three month and the six month immersion periods, the Instron material testing machine was used to measure the flexural strength of each specimen (Figure 1). A single operator conducted the tests in order to minimise systematic error.

(iv) Data analysis

Data were collected and prepared in an electronic database for statistical analysis using SPSS version 23.0© (IBM USA). The effect of the independent variables, the period of immersion and the type of denture cleansers, on the flexural strength were determined by a two-way analysis of variance (ANOVA). Having completed the ANOVA, post hoc testing was enabled, and in the case of significant differences, multiple comparisons were undertaken using Tukey’s HSD test. Hypothesis testing was set at $\alpha=0.05$.

RESULTS

All groups demonstrated a decrease in flexural strength for all cleansers and for both immersion periods. Compared with the baseline values, the effects of Corega and of water on the flexural strengths of auto-polymerizing acrylic were almost equal whilst the hypochloride solution exerted a more dramatic effect resulting in a greater loss of flexural strength (Figure 2). Further, the difference in flexural strengths from the three month period to the six month period showed little change for the Corega and water samples, but there was a marked continued loss over that period in the flexural strengths of the sample which had been immersed in the hypochloride solution (Figure 2).

The heat-polymerizing acrylic samples showed a similar tendency with the hypochloride solution being seen to have resulted in much greater loss of structural strength than was the effect seen with the Corega based sample (Figure 3). Immersion in water, however, produced a loss which at the three month period was even greater than that experienced by the acrylic soaked in hypochloride (Figure 3).

![Figure 1: Instron testing machine: 3 - point bending test.](image1)

![Figure 2: Flexural strength - auto-polymerising acrylic resin.](image2)
Immersion in the chemical cleansers caused a significantly greater reduction of flexural strength for auto-polymerizing acrylic resin compared with the effect on heat-polymerizing acrylic resin (Corega: \(p=0.003\) and NaoCl: \(p=0.000\)) (Students' t test, significance set at \(p=0.05\), Table 1). All three test solutions were found to have deleteriously affected flexural strengths the longer the immersion time, so that measurements of the strengths at the six month period were lower than at the three month stage (Figures 2 and 3). Statistical t test comparison of data related to immersion periods showed significant differences between the weakening of auto- and heat-polymerizing acrylics between three and six months when compared with the baseline data (\(p=0.008\) and 0.002), with the auto-polymerizing sample showing greater loss (Table 1).

A two-way analysis of variance (ANOVA) between the data from the Groups was conducted to explore the impact of the cleansers and the duration of immersion (the independent variables) on the flexural strengths (the outcome variable). For both auto-polymerizing and heat-polymerizing acrylic resins, there was a statistically significant main effect only for cleansers [\(F(2,183) =8.588, p=0.000; F(2,183) =8.185, p=0.000\)]. However it was found following the Tukey HSD posthoc tests that the effect sizes were small (Partial Eta squared =0.086 and 0.082, tables 2 and 3). However it was found following the Tukey HSD posthoc tests that the effect sizes were small (Partial Eta squared =0.086 and 0.082, Tables 2 and 3). However it was found following the Tukey HSD posthoc tests that the effect sizes were small (Partial Eta squared =0.086 and 0.082, Tables 2 and 3). However it was found following the Tukey HSD posthoc tests that the effect sizes were small (Partial Eta squared =0.086 and 0.082, Tables 2 and 3). However it was found following the Tukey HSD posthoc tests that the effect sizes were small (Partial Eta squared =0.086 and 0.082, Tables 2 and 3).

**Table 1: T-tests for different cleansers and immersion period by resin type**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean (sd) (Average of 3 month plus 6 month values)</th>
<th>Type of polymerising acrylic resin</th>
<th>Auto Heat n t p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>54.11(10.90)</td>
<td>Corega 44.85 (15.24) 51.49(12.75) 60 3.07 0.003</td>
<td></td>
</tr>
<tr>
<td>Corega</td>
<td>44.85 (15.24)</td>
<td>NaoCl 33.97 (14.61) 44.33(8.54) 60 4.74 0.000</td>
<td></td>
</tr>
<tr>
<td>NaoCl</td>
<td>33.97 (14.61)</td>
<td>Water 44.01 (18.24) 45.27(9.92) 60 0.64 0.47</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>Mean (sd) (Average of the results for all test cleansers)</td>
<td>Duration 54.11(10.90) 54.11(10.90) 10</td>
<td></td>
</tr>
<tr>
<td>3 months</td>
<td>41.56 (18.75)</td>
<td>3 months 41.56 (18.75) 47.55(10.17) 90 2.66 0.008</td>
<td></td>
</tr>
<tr>
<td>6 months</td>
<td>40.31 (14.62)</td>
<td>6 months 40.31(14.62) 46.51(11.76) 90 3.13 0.002</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: ANOVA of flexural strength of auto-polymerization acrylic resin for different cleansers and immersion periods.**

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanser</td>
<td>4394.451</td>
<td>2</td>
<td>2197.226</td>
<td>8.588</td>
<td>.000</td>
<td>.086</td>
</tr>
<tr>
<td>Duration</td>
<td>70.235</td>
<td>1</td>
<td>70.235</td>
<td>.275</td>
<td>.601</td>
<td>.001</td>
</tr>
<tr>
<td>Cleanser * Duration</td>
<td>176.776</td>
<td>2</td>
<td>88.388</td>
<td>.345</td>
<td>.708</td>
<td>.004</td>
</tr>
<tr>
<td>Error</td>
<td>46618.185</td>
<td>183</td>
<td>255.837</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>382419.512</td>
<td>190</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 3: ANOVA of flexural strength of heat-polymerizing acrylic resin for different cleansers and immersion periods.**

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanser</td>
<td>1818.988</td>
<td>2</td>
<td>909.494</td>
<td>8.185</td>
<td>.000</td>
<td>.082</td>
</tr>
<tr>
<td>Duration</td>
<td>48.439</td>
<td>1</td>
<td>48.439</td>
<td>.436</td>
<td>.510</td>
<td>.002</td>
</tr>
<tr>
<td>Cleanser * Duration</td>
<td>379.262</td>
<td>2</td>
<td>189.631</td>
<td>1.707</td>
<td>.184</td>
<td>.018</td>
</tr>
<tr>
<td>Error</td>
<td>20333.910</td>
<td>183</td>
<td>111.114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>449958.09</td>
<td>190</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

Acrylic resins have different physical and mechanical properties, hence the marked differences in how they react when exposed to diverse environments such as water, disinfectants and denture cleaners.\(^2,10,12\) Repetitive masticatory forces on dentures cause flexural fatigue of the acrylic denture base. Hence a prosthesis should be fabricated with denture base material of high flexural strength in order to withstand these loads. The flexural strength is indicative of the compressive, tensile and shear strengths, which translates as stiffness and resistance of a material to fracture.\(^10\) Therefore flexural strength determines the longevity and success of a denture.\(^3\) To minimise fractures, PMMA resins are reinforced with fibres, glass and aramid.\(^19,20\) Similarly, several processing techniques have been introduced to increase fatigue strength.\(^10\) The consensus is that heat-polymerising acrylic resins have superior flexural strength compared with auto-polymerizing resins.\(^19,20\) The latter are susceptible to porosities and deform relatively easily under load, leading to high rates of fracture.\(^20\)

Denture cleansers remove debris on denture surfaces, and for individuals with impaired dexterity the use of these chemicals is highly recommended.\(^21,22\) Inappropriate choice and use of chemical cleansers can, however, cause damage to dentures.\(^23,24\) Guidance on the selection of cleanser is therefore of high importance.

The study concluded that both acrylic resins demonstrated a decline in flexural strength when immersed in denture cleansers. The findings concur with results from Peracini\(^20\) and Pisani\(^13\) who observed that heat-polymerising resins are more prone to fracture after having been immersed in cleansers. The results of the current study also show...
that auto-polymerising acrylic resins are more adversely affected by chemical cleaners than heat-polymerising resin. It is hypothesised that the very high levels of porosity observed in auto-polymerising resin reduce their flexural strength and weaken the resin. Other effects of porosity include compromised aesthetic properties and increased propensity to harbour and promote growth of Candida in these dentures. Ultimately inflammation and soreness of the soft tissues occur underneath the denture.

The study showed that hypochloride cleansers have greater detrimental effect on the flexural strength of both types of acrylic resins than either Corega or water, a finding supported in the literature. It has also been shown, however, that at 0.5% concentration, sodium hypochloride cleansers cause no structural changes to the dentures, but do provide clinically effective antibacterial and antifungal properties. The increase in concentration above 0.5% results in discoulouration, denture roughness and structural weakness. Extended use of low concentra-

CONCLUSION

Given the limitations of this study, it is concluded that den-
ture cleansers have an effect on the flexural strength of polymethylmethacrylate resins. Specifically, sodium hy-
ýchloride cleansers will result in significant reductions in the flexural strength of acrylic resins after prolonged exposure. Similarly, this study showed that immersion of heat-polymerizing acrylic resin in water for six months weakens the acrylic. Corega remains the most effective cleanser to use for denture care.

IMPLICATIONS FOR CLINICIANS

Generally patients who receive dentures are advised to keep the dentures in water for a period of at least six hours or over-
night. However this study has shown that immersion in water overnight for long durations reduces the flexural strength of the acrylic resins. Therefore it is important that patients are advised to refrain from this practice. It is also important, however, to maintain a moist environment for the dentures when they are not in use, hence the suggestion that the dentures must be wrapped in a wet paper towel and not immersed completely in water when not being worn.

The use of denture cleansers to maintain dentures free of pathogens may be necessary only after meals and not require immersion overnight or for long durations. Where patients elect to immerse dentures in a cleanser, it preferable to use Corega; immersion in water should be done for shorter periods. Sodium hypochloride cleansers can be used for cleaning the dentures without extended periods of immersion in the cleanser. Patients should also be reminded to use a toothbrush to clean the dentures manually.

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References:
5. GSK Data on File Clinical Study RH01515, 2014.

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Continuous education in sedation: Is the current sedation continuum still relevant?

INTRODUCTION
The differentiation of what is light and what is deep sedation is simplistic. Procedural sedation should be viewed as a continuum with many different possible clinical endpoints along the continuum, rather than having two endpoints, mild versus deep sedation. The current sedation continuum differentiates these endpoints through patient responsiveness and other physiological parameters.

Keywords: sedation continuum, procedural sedation, monitoring, patient safety

DISCUSSION
The goals of procedural sedation are first and foremost to consider patient safety and welfare as priority.1 The principles highlighted by the General Dental Council in the UK emphasize professional knowledge and competence, trust and putting first the interests of the patient. The onus is then greater and more comprehensive than we perhaps expected: it is not just about what the patient expects and needs (or pays for), but also what is expected of us as guardians of the safety of our patients.

Sedation is a drug-induced depression of consciousness, with a continuum that varies from minimal sedation/anxiolysis, and moderate sedation and analgesia, to deep sedation, and finally, general anaesthesia, as outlined in Table 1.2 Practitioners need to understand that increasing depths of sedation levels are associated with progressive respiratory depression and so the risks for potential adverse events increase. Simply put, the more drugs we give, the deeper becomes the sedation of the patient.3 Sedation levels are defined by the South African Society of Anaesthesiologists Sedation Guidelines, as well as internationally by various Sedation Societies.2,4 The graded levels of sedation accept that as the depth progresses, there is a corresponding need for expanded physiological monitoring, practitioner skills and rescue capability.3

The authors Green and Mason outlined the limitations of the current sedation continuum in terms of subjectivity, counterproductive effect and drug limitations. According to them, the current sedation continuum is vulnerable in terms of subjectivity due to its fundamental reliance on identifying and quantifying patient safety gauged on the response of the patient to verbal or tactile stimulation.5 The perceived responses are considered subjective and physicians are unlikely to consistently agree on the interpretation thereof, according to the authors. They also outlined the limitations due to patient factors, where patients are verbally or neurologically impaired, or, being developmentally compromised, would not be able to respond to tactile or verbal stimulation.

The counterproductive effect of continuously testing patient responsiveness is the fact that clinicians need to intermittently assess and reassess the patient, thereby disturbing the fundamental aim which is to induce anxiolysis, restfulness, amnesia and sleep. This leads then to the question whether sedation providers are in fact consistently and frequently reassessing the patients via response or whether the interpretation of the sedation level is made from observation only.

Certain drugs like ketamine and dexmedetomidine are thought to act independently of the continuum due to their fundamentally different nature and effects on patients during sedation. The dissociative state induced by the use of ketamine renders a patient to a trans-like state that cannot be judged alongside the normal continuum for other drugs.2

The optimal endpoint of any sedation should depend on the predicted level of pain or discomfort associated with the procedure, the level of anxiety of the patient as well as their cardio-respiratory reserve.1

Would it be possible to use the sedation continuum as a measure to keep patients safe, especially when the patients are fluctuating between moderate and deep levels of sedation? It is suggested that the sedation continuum...
should be a simplified frame of reference that can be used across the board to evaluate patient safety.

Tools that we can use alongside the continuum are sedation scales (Wilson and Michigan sedation scales), capnography and the Bispectral index (BIS) monitor. However, to make full use of both the Wilson and Michigan sedation scales to assess sedation depth, the patient’s tranquil state is repeatedly disturbed via voice or touch. The use of capnography to monitor end-tidal carbon dioxide permits the sedation practitioner to assess the ventilatory status and provides the earliest indication of respiratory compromise. The BIS monitor can be used to follow depth of sedation of adults receiving propofol but further prospective studies need to be done to be able to incorporate the BIS monitor on clinical decision-making regarding differentiation between moderate and deep sedation. Other limitations also include children with various levels of developing brain function and with the use of other drugs, like ketamine.

According to Innes et al, who were considering sedation in the emergency department, patients respond differently to drugs and any sedative or analgesic has the possibility of causing cardiorespiratory compromise. Children, the elderly and patients with underlying cardiorespiratory disease carry a higher risk. Therefore, any patient can unexpectedly progress to a deeper level of sedation than intended. Sedation practitioners should not sedate patients unless they are confident in their ability to deal with all the possible complications that may arise.

How do we, as practitioners, ensure that our patients are safe? Can the current continuum be transformed into a reference sequence that governs the safety of each individual? By accreditation and training of the sedation provider and the staff, by ensuring that the sedation environment and recovery area are properly equipped and by having systems in place to prevent human errors, we can ensure safe sedations to our patients.

The guidelines for sedation for medical and dental practitioners should remain unified and should clarify questions about monitoring modalities and provide updated information from the literature to further improve safety and outcomes for patients.

Studies looking at the current continuum recommend not abolishing the original precept completely but propose an expansion by incorporating an objective mechanism to predict the ongoing risk of serious adverse events. The different levels in the continuum could be correlated, through research, with reference thresholds for the relevant physiological monitors. For each level could be identified the staff, training and equipment needed to meet the ongoing and escalating risks.

The question is whether we are making the concept too complex – should it not just be a simple tool that is easy to remember and possible to be applied by all? On the other hand, if it were accurate in stratifying risk it would enable the correlation of sedation levels with associated risks. Such a system could become a very important tool for clinical governance, allowing for clinical practice audits, adverse event reporting and much more.

To put it concisely, any new continuum should be an integrated guideline that provides a standardized and evidence-based approach to base clinical decision-making while planning and proceeding with a sedation.

The responsibility lies with the sedation providers, who are indeed the gate-keepers of adverse events. The sedation practitioner needs to be able rescue patients who unintentionally slip down the continuum.

New, validated, advances and development in physiological monitoring should be timeously integrated with the current parameters to improve and define the sedation continuum. These efforts will further increase patient safety and reduce morbidity as procedural sedation and the continuum of sedation are governed on an international, multidisciplinary front.

**CONCLUSION**

The current sedation continuum implies that sedatives are capable of inducing graded levels of consciousness anywhere along the spectrum. Implicit in this notion is the responsibility of the practitioner to carefully titrate and administer drugs to achieve the lowest possible level of sedation for the specific procedure planned.

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**Table 1: The continuum of sedation and sedation end-points**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Minimal sedation/ anxiolysis</th>
<th>Moderate sedation and analgesia (&quot;conscious sedation&quot;)</th>
<th>Deep sedation and analgesia</th>
<th>General anaesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsiveness</td>
<td>Responds to verbal stimuli</td>
<td>Purposeful response to verbal or tactile stimuli</td>
<td>Purposeful response only after repeated or painful stimuli</td>
<td>Unable to rouse</td>
</tr>
<tr>
<td>Airway</td>
<td>Unaffected</td>
<td>No intervention required</td>
<td>Intervention may be required</td>
<td>Intervention often required</td>
</tr>
<tr>
<td>Spontaneous ventilation</td>
<td>Unaffected</td>
<td>Adequate</td>
<td>May be inadequate</td>
<td>Frequently inadequate</td>
</tr>
<tr>
<td>Cardiovascular function</td>
<td>Unaffected</td>
<td>Usually maintained</td>
<td>Usually maintained</td>
<td>May be impaired</td>
</tr>
</tbody>
</table>

References

When radiotherapy is used in the treatment of malignant lesions in the oral cavity and related structures, detrimental changes of the mandible and maxilla are usually unavoidable. Osteoradionecrosis (ONR) is defined as bone necrosis secondary to radiation damage. Osteomyelitis does not occur until infection is introduced into devitalized bone. The classic sequence is radiation, trauma and infection. ONR is not a primary infection but a complex metabolic and tissue homeostatic deficiency caused by radiation-induced cellular damage. Micro-organisms only play a contaminant role, leading to superimposed osteomyelitis. ONR with osteomyelitis is more common in the mandible than the maxilla and more common in males than females. Patients usually have severe pain and swelling, with or without draining sinuses. There may be sloughing of the oral mucosa with subsequent exposure of large areas of bone (Fig.1). Note “moth eaten appearance” (yellow arrow, Fig.2). The cardinal radiological features include no changes in the early stages, progressing to areas of bone rarefaction, cortical destruction that is ill-defined resulting in a mixed sclerotic lucent pattern and sequestration, especially affecting the buccal bone (red arrow, Fig.3). Absence of soft tissue mass is an important feature in differentiating it from neoplastic recurrence, but the presence of soft tissue does not exclude osteoradionecrosis. In advanced cases pathological fractures may occur. Radiographically, the condition is indistinguishable from a rarefying osteomyelitis with a pure microbial origin. Therapeutically, prevention of infection of an irradiated bone is very important. Teeth in an area to be irradiated should be extracted 10-14 days before irradiation. Primary closure of the mucous membrane is to be performed. Differential diagnoses include osteomyelitis and malignancies.

**ACRONYM**

ONR: Osteoradionecrosis

**Reference**

INTRODUCTION
For clinicians wishing to embark on research, the obvious choice may be to use their large patient pool, already at their disposal. Gathering information from old files and records is relatively easy and harmless, as long as anonymity and confidentiality are maintained. However, if they choose to conduct investigations on new materials or techniques, their patients could inadvertently and unwittingly become study participants, which raises ethical concerns. This paper aims to clarify the difference between using novel approaches as part of routine clinical treatment and conducting clinical research, and explores the possibilities of straying over the fine dividing boundary, which could lead to “patient experimentation”.

CLINICAL TREATMENT
The Online Medical Dictionary defines Clinical treatment as “the management and care of a patient by provision of therapy focused on combatting a disease or disorder, or with interventions aimed at improving health”. It usually follows accepted standards, and has an expectation of success. Health refers to “the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” In the dental field, restoration of health can be effected by a number of different treatment modalities.

Active treatment: is immediate treatment of an injury, management of a disease process or provision of pain relief.

Restorative treatment: replaces structures which are missing or have been lost.

Active treatment:

Restorative treatment:

Causal treatment: is directed against removing the cause of the dental problem or disease.

Conservative treatment: provides minimally destructive operative and restorative procedures.

Empiric treatment: refers to treating in a manner that experience has proven to be beneficial in the past.

Rational treatment: is based upon education and knowledge of the disease process, the mechanisms behind the actions taken, and the expected outcome of the remedies or interventions.

Expectant treatment: is directed toward relief of untoward symptoms, while leaving the cure of the disease or healing to natural forces.

Extraordinary treatment: is usually highly invasive and may present with increased burdens and risk to the patient. E.g. provision of osseointegrated implants carries the burden of high costs, time, need for extensive surgical and anaesthetic procedures, potential pain, possible damage to surrounding anatomical structures, and risk of failure or loss. These risks need to be weighed up against the potential benefits for each patient and situation.

Specific treatment: is treatment that has been adapted to suit special patient needs, in unusual conditions, or in peculiar circumstances.

Palliative treatment: is empathetic care in situations where therapeutic interventions are no longer possible, desirable or deemed to be of benefit.

Supportive treatment: is the provision of adjunctive counseling, therapy or aids to augment the initial treatment e.g. bite splints after full mouth rehabilitation.

Preventive treatment: is prophylaxis in terms of screening, education, instruction, monitoring and at times provision of non-invasive therapy. E.g. fluoride application, fissure sealants, mouth guards.

Refusal of treatment: this may be on the part of the patient or the clinician. A patient has the right to refuse any treatment for whatever reason, and does not need to divulge that reason. Unless this situation is life threatening...
or could potentially put a third person at risk, the clinician cannot over-rule their desires. If a paternalistic approach is taken and treatment is "forced", the clinician must have enough motivation to support such interventions should the patient take legal action against him/her. By the same token, a dentist may refuse to treat if the patient’s demands are unrealistic or potentially damaging to the patient, or if the dentist does not feel morally comfortable or sufficiently competent enough to carry out the procedure.

**CLINICAL RESEARCH**

Research consists of “investigations undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humans, culture and society, and the use of this knowledge to devise new applications.” It is used to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems, support hypotheses, or develop new theories. A research project may also be an expansion on past work in the field. To test the validity of instruments, procedures, or experiments, research may replicate elements of prior projects, or the project as a whole. The primary purposes of research are investigation, discovery, interpretation, documentation, and the dissemination of knowledge. In other words, it is a “process of steps used to collect and analyze information to increase our understanding of a topic or issue”. It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question.4

“Clinical research aims to develop generalizable knowledge to improve health and/or increase understanding of human biology.” As such, it often involves patients as research participants. This has led to the explosion of literature on the ethics of the exploitation of human subjects, and on the provisions for safeguarding vulnerable subjects.5 Vulnerability is susceptibility to harm, attack or injury. A patient /participant may be vulnerable due to the possibilities of experiencing physical pain; debilitation; emotional stress; economic, educational or knowledge deficiencies; power differentials; a perception of subordination; dependency; peer pressure; or by coercion, inducement or offers of incentives. All of these decrease the freedom of volunteering and render patients susceptible to exploitation.

**CLINICIAN INTENT AND PATIENT EXPECTATIONS**

When a patient consents to any form of dental treatment, that agreement is based on the expectation that the dentist should be competent, that the materials have been approved by the appropriate manufacturers and authorities, that the techniques are recognized and generally accepted in the scientific community, and that both parties have an expectation of success. At the same time the intention of the clinician is to provide a therapeutic benefit to the patient. When a clinician knowingly decides to “test out” a new material or procedure during the course of routine treatment, his/her mental state shifts. Astington termed this the “Intentional chain” which consists of a sequence of processes starting with desires, beliefs, and intentions that lead to actions in order to reach a goal. The focus becomes a commitment to carrying out an action in the future that requires a certain amount of planning and forethought in order to accomplish a desired goal, based on the belief that the course of action will satisfy that desire.8

The intentional chain equates to clinical research, which can be conducted only with the patient’s full awareness, understanding and free, voluntary consent. Patients can never be kept blind to the fact that they are being used in a trial, and should not be manipulated, offered incentives such as offers of free donations (implants) or treatment, or in any way coerced in return for their participation. In addition, they cannot be denied routine treatment if they refuse the experimental alternative.

**THE “REASONABLE MAN” RULE**

Even if a clinician has received free, educated (informed), autonomous patient consent, there remains a moral commitment that a novel procedure is undertaken only if there is a high expectancy of success, based on sound clinical judgment, and supported by a general consensus from peers. In addition, it should be performed only if the clinician has the necessary skills, experience and training to attempt the new approach. If all of these criteria are not satisfied and the intention is experimental rather than therapeutic, then the actions must be seen as research and not treatment. The patient too assumes a new role, and becomes a (potentially) vulnerable research subject.

In order to protect both parties, a research protocol should be drafted and submitted to any reputable scientific and ethical review board for approval and monitoring. The “Reasonable Man” theory refers to a test whereby a hypothetical person is used as a legal standard, especially to determine if a negligent act was performed. This hypothetical person, referred to as the reasonable/prudent man, is gauged as exercising the average care, skill, and judgment in conduct that society requires of its members for the protection of their own interests and of that of others. This serves as a comparative standard for determining liability. The process often involves the application of an objective test in which one compares the particular action to that which a reasonable person would perform under similar circumstances. Thus when embarking on clinical research which carries both risks and benefits for patients and clinicians, the same principle can be applied. A prudent practitioner should ask “What would a reasonable clinician do under these circumstances, and what would a reasonable patient expect?” Furthermore, when weighing up the risks against the benefits, consider whether a reasonable person, in the position of the patient, if warned of the risks, would find them significant? The clinician should also be astute enough to know whether the patient would indeed consider the risks significant.

**CONCLUSIONS**

There are two sets of simple “AEIOU” questions, one for patients, one for clinicians. Asking these questions may help those embarking on research within the ambit of routine treatment to decide whether it is scientifically and morally justified.

For the patient: Have they been granted full Autonomy in the decision making process? Were they adequately Educated about the procedure? Were they given all the necessary Information needed to make a decision? Were
they permitted time to seek other Opinions? Did they display full Understanding of the risks and benefits?

**For the clinician:** Will the study provide Added knowledge or benefits to future patients and the scientific community? Is the intervention Ethically sound? What is the primary Intention? Are there anticipated Outcomes of success? Do the actions display a Utilitarian approach (i.e. the greatest good for the greatest number). Note that the “I” is always in the middle because both parties must always be central to all decision making processes.

**Conflict of interest:** None declared.

**References**

GENERAL

Satisfaction with Oral Health Services among South African adults: a structural equation model. (p 442)
1. Being enrolled in a medical aid had no effect on the level of satisfaction with dental services received.
   a. True
   b. False

The efficiency of the referral system at Medunsa Oral Health Centre (p 448)
2. The longest waiting time for treatment was for Prosthodontics.
   a. True
   b. False

Comparing repeat and first visit patients’ satisfaction with service quality at Medunsa Oral Health Centre. (p 454)
3. The study confirmed that the more important determinants of satisfaction were:
   a. access, empathy, short waiting time and responsiveness.
   b. access, empathy, reliability, equipment and physical surroundings of the service
   c. responsiveness, physical surroundings, reception and referral efficiency
   d. empathy, short waiting time, equipment and chairside staff

Piloting the community service attitudes scale in a South African context with matching qualitative data (p 460)
4. What makes the Community Service Attitude Scale attractive to the researcher?
   a. Because it has a strong conceptual basis that measures social accountability.
   b. Because it was developed by a credible School in the USA.
   c. Because patients can easily answer the questions.
   d. Because there are no other measures of social accountability.

5. Based on the literature, service learning generally:
   a. Increases students’ social accountability.
   b. Has no effect on social accountability.
   c. Decreases students’ social accountability.
   d. Has a profound effect on communities.

Refusal of potentially life-saving dental care: Antithetical conflict of ethical principles. (p 467)
6. Undertaking patient consultation in secluded spaces, away from clinical areas, may assist in alleviating the intensity of phobia.
   a. True
   b. False

Styloid process elongation according to age and gender: a radiological study. (p 470)
7. The styloid process is considered elongated if it measures less than 30mm.
   a. True
   b. False

Bacteriology and empirical management of orofacial infections in a maxillofacial and oral surgery clinic, South Africa. (p 474)
8. The study showed that erythromycin remains the treatment of choice for orofacial infections and expressed reservations on the common use of penicillin.
   a. True
   b. False

Trends in the seasonal variation of dry socket at Medunsa Oral Health Centre. (p 478)
9. Identify the correct answer: Dry socket has been called:
   a. alveolar osteitis
   b. localized osteomyelitis
   c. postoperative alveolitis
   d. alveolalgia
   e. all of the above

Mandibular third molar and angle fractures: a meta-analysis. (p 483)
10. This study provides consolidated evidence that the presence of mandibular third molars increases the risk of angle fractures and therefore justifies their prophylactic removal.
    a. True
    b. False

Clinical and radiological features of 90 odontomas diagnosed in the Oral Health Centre at Sefako Makgatho Health Sciences University. (p 489)
11. This study showed that microscopic examination is essential for accurate diagnosis of odontomas, radiological examination being insufficient.
    a. True
    b. False

Immune-mediated response of bone in osteomyelitis - fundamental concepts. (p 493)
12. Radiologically, acute osteomyelitis is depicted as an area of poorly demarcated bone loss at the site of the inflammation.
    a. True
    b. False

Biological significance of palatine tonsillar epithelium: microstructure and disease. (p 496)
13. The main function of a tonsillar crypt is to initiate the first step of the adaptive immune reaction
    a. True
    b. False
Oral mucosal ulceration - a clinician’s guide to diagnosis and treatment. (p 500)
14. Topical steroid ointments are not adhesive to the oral mucosa but may be combined with the following to improve their use on oral mucosa:
   a. Fissian paste
   b. Denture adhesives
   c. Placed within acrylic dentures
   d. Kenalog
   e. All of the above

15. Desquamative gingivitis is a sign of the following disease:
   a. Erythema multiforme
   b. Mucous membrane pemphigoid
   c. Lupus erythematosus
   d. Varicella zoster infection
   e. All of the above

Lower facial and cervical lymphadenopathy in the context of clinical dentistry (p 509)
16. In lymphadenopathy from lymphoma, the nodes are usually hard, non-tender and fixed to the surrounding tissues:
   a. True
   b. False

The use of temporary skeletal anchorage devices amongst South African Orthodontists (p 513)
17. Daskalogiannakis defined anchorage as “Resistance to unwanted movement.”
   a. True
   b. False

Effect of denture cleansers on flexural strength of heat polymerized and auto-polymerized acrylic resins (p 518)
18. The use of sodium hypochloride cleansers was shown to have minimal effect on the flexural strength of acrylic resins at 3 and 6 months:
   a. True
   b. False

Maxillo-Facial Radiology case 146 (p 526)
19. Teeth in an area to be irradiated should be extracted 10-14 days before irradiation:
   a. True
   b. False

Continuous education in sedation: Is the current sedation continuum still relevant? (p 524)
20. The notion of graded levels of sedation accepts that as the depth progresses, there is a corresponding need for expanded physiological monitoring, practitioner skills and rescue capability:
   a. True
   b. False

ETHICAL Treatment versus Research: Part 5: Bridging the Boundaries. (p 527)
21. A patient has the right to refuse any treatment for whatever reason, and does not need to divulge that reason:
   a. True
   b. False

22. Patients should never be coerced in any way in return for their participation in clinical trials:
   a. True
   b. False

23. Treatment which is directed toward relief of untoward symptoms, while leaving the cure of the disease or healing to natural forces is known as:
   a. Optimistic
   b. Non Invasive
   c. Propitious
   d. Expectant

24. When a new technique is undertaken, there is a moral commitment of a high expectancy of success:
   a. True
   b. False

25. The concept of “the reasonable man” may not be used in determination of liability:
   a. True
   b. False

Readers will note that we have reduced the number of General Questions to twenty whilst retaining five Ethics based questions. Our allocation of CPD points remains unchanged. There is optimism that this section will continue to provide members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure Continuing Education. Please note that SADA is no longer offering the ‘CPD via SMS’ service.

Contact Ann Bayman at SADA, Tel: 011 484 5288, for any enquiries and assistance.

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South African Dental Association
Tel: 011 484 5288
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Skeletal muscle relaxants interrupt the pain-spasm-pain cycle¹

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References:

Proprietary name (and dosage form): NORFLEX CO

Tablets.

Composition:
Each tablet contains 35 mg Orphenadrine citrate and 450 mg Paracetamol.

Pharmacological classification:
A.2.9 (Other analgesics).

Reference number:
B 1098 [Act 101/1965]; Scheduling status: S2

Proprietary name (and dosage form): NORFLEX

Tablets.

Composition:
Each tablet contains 100 mg Orphenadrine citrate.

Pharmacological classification:
Category: A.2.10 (Centrally active muscle relaxants).

Reference number:
H 1612. [Act 101/1965].

Name and business address of applicant:
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