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The crocodile (suborder Crocodylinae) is a semiaquatic reptile. The jaws are of equal size and the lower teeth are fitted along the edge of the upper jaw when the mouth is closed. Hence these teeth are visible, as opposed to the alligator. The lower fourth tooth fits into a groove in the upper jaw, a species-defining characteristic. Crocodiles are polyphyodont, and can replace each tooth up to 50 times during their lifetimes of 35 to 75 years, reliant upon the stimulation of odontogenic stem cells that are found in the dental lamina.
Most people would see this as a straight line. The rare ones have the ability to turn it into a heartbeat.

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The Health-Care profession shares with distraught parents the heart-rending distress at the arrival of an eagerly awaited baby who presents with an oro-facial cleft. How wonderful it is that, worldwide, teams of dedicated health professionals are immediately on hand to advise and to counsel the parents and family and to provide expert care for the infant.

July was designated National Cleft and Craniofacial Awareness and Prevention Month in the USA, an initiative which appears to have been promoted in 1943 by the American Cleft Lip and Palate Association, based in Chapel Hill. South Africa has followed that lead and the past month was indeed an opportunity for South Africans to focus on the defect. Gillian Adonis, a Speech Therapist in Cape Town, comments in a website “the month is an observance by people and organisations to help raise awareness of and provide information about cleft and craniofacial defects.”

It is recognised that cleft lip and palate is one of the most common congenital abnormalities. Worldwide the prevalence ranges between 1/1000 to 2.69/1000 births. Whilst the data varies considerably with reports from different regions and countries and is also affected by the methods of collection, it may be stated that on average clefts occur in about one in every 500 to 750 live births. Studies in South Africa cite prevalence rates of 0.3/1000 to 0.33/1000 births.

These bland data can in no way reflect the concern of the parents of a CLP baby for whom of course the prevalence is One Hundred percent. Enter now the team who will deliver over several years the intricate treatment which will ensure that the affected patient can lead a normal and happy and healthy life.

The disturbance in development which leads to facial clefts is one of a delicate balance. In the embryonic stage the frontonasal process should fuse with the maxillary components of the first branchial arch to form the primary palate. In the second stage, forming the secondary palate, occurs the marvel of the elevation of the palatal shelves, and the subsequent fusion of the primary palate, the shelves themselves and the nasal septum, all requiring the intriguing process of cell apoptosis... and all demanding an intricate system of balance with the controlling genes. Recent work has shown that the Epithelial Adhesion Molecule (CEACAM1) is associated with the initiation of palatal fusion. There may be a critical role for the enzyme GSK-3β in the osteogenic differentiation of palatal mesenchyme. The fusion of the processes demands both adhesion and a transformation of epithelia to mesenchyme and transforming growth factor (TGF β3) is an essential... without which cleft palate results. Other genes have been identified as contributing directly or indirectly to the failures of fusion which result in facial clefting. These meticulous studies point to the intricacies of timing and activation which allow for normal development, but an upset in that delicate balance may mean years of involved and demanding treatment for the child who presents with facial clefting.

A vastly encouraging thought is that as the delicate balances are investigated and their mysteries unravelled, so will there be the possibilities of prevention of these disturbing anomalies. That is indeed one of the objectives of the National Cleft and Craniofacial Awareness and Prevention Month.

Dedicated people have identified with the considerable problems of cleft patients and organisations have emerged which offer invaluable assistance. The Smile Foundation (which is supported by the South African Society of Orthodontists), the American Cleft Lip and Palate Association, Transforming Faces and many others contribute. Recognition is accorded in this issue of the Journal to the Wentworth Foundation in Durban which has over several years offered free treatment to cleft patients who may not otherwise have
been able to access the necessary therapy. There are teams of specialists in major centres and at Dental Hospitals in South Africa who combine their expertise in handling the complexities of the anomaly. This is indeed a problem which requires teamwork delivered in a balanced fashion.

Just as balance has also been the requirement of the team that organised the 2017 Congress of the South African Dental Association. The diversity of the programme demanded that the schedule be delicately balanced to ensure that the equally diverse interests of the members be satisfactorily accommodated. With more than fifty separate lectures, courses or discussions, there should have been no tight rope walking necessary to enable attendance at the topics of individual choice. It is that precise combination of delicate balance and team work that ensures success for both Congress organisers and cleft palate experts. Sincere congratulations go to both these dedicated teams.

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The recent approval by Cabinet, and the subsequent gazetting, of the White Paper on National Health Insurance (NHI) attracted considerable media attention. It has also raised many questions and concerns amongst the dental profession.

Whilst these, and the unease of other professions, are acknowledged, the ideal of Universal health care should be embraced and not feared. Admittedly, there are still many questions surrounding the implementations of the NHI, but the solutions cannot be provided by Government alone. The concerted collaboration by all stakeholders will be essential. As healthcare providers, our moral compass guides us to serve and protect our fellow human beings in their times of need, irrespective of their ability to pay for treatment or the limitations of their medical schemes plans. Universal health-care provides exactly that system in which health-care and financial protection are available to all people irrespective of background. NHI is South Africa’s answer to the World Health Organization’s call for Universal health-care by 2030 as part of the Millennium Development Goals. Our Health Minister, Aaron Motsoaledi intends for the South African NHI to be fully operational by 2025.

Health-care in South Africa has historically been a two-tiered system with only 20% of the country’s healthcare providers servicing 84% of the population in the public sector. It is no wonder that state facilities are synonymous with long queues and with an often questionable quality of service. As a nation, universal health coverage is a goal worth fighting for, but it will not be achieved without the support and commitment of the private health-care sector. While it is true that health-care delivery and reimbursement models will have to undergo radical change to ensure equitable access to care for all South Africans, this does not necessarily mean that providers will suffer disadvantages as a result of the changes that need to be made. Once the vast majority of the population secure access to the private sector, it is likely that a greatly increased number of patients will be seen by private practitioners per day..... which could likely increase earnings, despite the capitation payment models intended for implementation by the NHI. A similar situation was observed in the US with the advent of Obamacare.

Health-care providers need to be ready to play a role in this crucial planning.
The effect of different polishing systems on the surface roughness of a nanocomposite and a microhybrid composite.

INTRODUCTION

The surface smoothness of composite restorations is of great importance in the ultimate success and longevity of restorations. Surface roughness has an influence on the amount of plaque accumulation on composite surfaces. A surface roughness threshold of below 0.2µm is necessary to prevent bacterial adhesion and plaque accumulation, which can cause secondary caries and subsequent failure of the composite restoration. Surface texture also plays an important part in the aesthetics of the restoration. A rough composite restoration is more prone to discolouration and may be unacceptable to patients as they can detect a surface roughness greater than 0.50 µm with their tongues.

Most composite restorations require finishing after placement in order to remove overhangs and excess composite material as well as restoring the occlusion and morphology. The finishing process, however, increases the surface roughness above the acceptable threshold. Polishing is therefore needed to reduce the surface roughness to acceptable values.

Finishing of a restoration is defined as the gross reduction of excess material to achieve the ideal morphology and optimal function. It is achieved by using either fine and extra-fine diamond burs, or multifluted tungsten carbide burs. Polishing of a composite restoration is defined as the reduction of roughness and scratches which were created whilst finishing the composite.

There are different types of polishing abrasive systems: aluminium oxide, carbide compounds, diamond abrasives, silicon dioxide, zirconium oxide and zirconium silicate. Polishing can also be achieved by using different instruments: coated abrasive discs and strips, stones, aluminium oxide or diamond pastes, soft or hard rubber cups or points, and wheels or brushes impregnated with abrasives.

The manufacturers of composite polishing systems tend to claim excellent polishing results with their systems. Different factors, however, can influence the effectiveness of any polishing system, for example, the composition of the composite, dissimilarity in hardness between the abrading particles of the polishing system as well as the hardness of the composite, speed with which the abrasive polishing system is applied to the composite and the use of lubricants during the polishing process. Therefore, different classes of composites, treated with different abrasive systems, will lead to unique surface properties.

Profimetry (surface roughness detection) has been found to be a very good and acceptable method to use in order to study surface roughness of composite samples.

AIM AND OBJECTIVES

The aim of this study was to evaluate and compare the surface roughness of a nanocomposite and a microhybrid composite after they had been polished with different systems.
The objectives of this study were to:

- Polish two different composites with six different polishing systems.
- Measure the surface roughness for each group.
- Compare the different polishing techniques per composite.
- Compare the two composites for polishesability.
- Obtain scanning electron microscope (SEM) images of the polished surfaces of one sample per group for evaluation and for comparison with the profilometer readings.

DESIGN

The study-design for this study was a two-factor (composite and polishing systems) experimental investigation.

METHODS

Two types of composite were used in this study: a nanocomposite, Filtek Supreme XTE (3M ESPE, St Paul, USA) and a microhybrid composite, Z100 (3M ESPE, St Paul, USA) (Table 1).

Six different polishing methods were tested in this study (Table 2). Thirty-five 2-mm thick composite samples were made from each of the two composites, by placing the uncured composite into ring moulds which had been cut from a 10 mm diameter aluminium pipe with an ISOMET low speed saw (Buehler Ltd., Lake Bluff, USA).

Mylar polyester strips (Du Pont Co., Wilmington, USA) were placed on both sides of the uncured composite in the ring mould, which was then pressed between two glass plates (each 1mm thick) with light finger pressure to extrude the excess material. The composite was cured under a Mylar polyester strip to ensure a standard smooth surface for all samples.6,28 Each sample was cured for 40 seconds per side with the tip of the curing light (Valo, Ultradent, South Jordan, USA) being held at right angles in contact with the cover slip and therefore at a 1mm distance from the composite surface. The intensity of the curing light was tested at the beginning of each group of samples in order to evaluate curing constancy using a Bluephase radiometer (Ivoclar Vivadent, Schaan, Liechtenstein). After curing the composite samples were removed from the aluminium ring mould. Five of these cured samples were randomly selected to provide a control sample.

After curing, all the samples, except for those of the control group, were finished with a red stripe finishing diamond bur ISO 806 314 249 514 012 (Dentsply/Maillefer, Ballaigues, Switzerland), followed by a yellow stripe finishing diamond bur ISO 806 314 249 504 012 (Dentsply/Maillefer, Ballaigues, Switzerland). This was done using a Sirona T4 Racer fast hand piece and Sirona T4 Line B 40 slow hand piece (Sirona Dental, Bensheim, Germany) with copious water spray. In order to mimic the clinical situation, the finishing procedures were completed before polishing of the composite samples. A single operator performed both the finishing and polishing steps to reduce variability.

The 30 remaining finished samples of each composite (Z100 and Filtek Supreme XTE) were randomly allocated to six different polishing groups (n = five per group for each composite) and polished according to the manufacturer’s instructions for each polishing system, as follows:

Group 1: Mylar Strip : Control Sample

No finishing or polishing was done after the composite had been cured as described above ie. through mylar polyester strips.

Group 2: Sof-Lex XT Finishing and Polishing Discs (3M ESPE, St Paul, USA)

The composite surface was polished using the Sof-Lex XT Finishing and Polishing Discs (coarse, medium 40 µm, fine 24 µm and superfine 8 µm). The Sof-Lex XT Discs were used sequentially without water coolant in a low-speed handpiece with intermittent light pressure. The coarse-grit disc was used at medium speed (approximately 10 000 rpm) for 5 seconds. The disc was then rinsed with water and dried with a 3-in-1 air syringe. Polishing with the medium-grit disc followed, used without water at approximately 10,000 rpm for 15 seconds. The sample was again rinsed and dried. Now the fine grit Sof-Lex XT Disc was used at high speed (approximately 30 000 rpm) for 15 seconds. After further rinsing and drying, final polishing of each disc was done using the superfine grit Sof-Lex XT Disc at high speed (approximately 30 000 rpm) for 15 seconds. The powder/debris was washed away with water.14

Group 3: Sof-Lex Spiral Finishing and Polishing Wheels (3M ESPE, St Paul, USA)

The same sequence of polishing using grits of progressively smaller dimensions was followed, interspersed by the routine of washing and drying. The composite surface was first finished with a medium grit Sof-lex XT Polishing Disc, applied at 10 000 rpm for 15 seconds. The beige finishing Sof-Lex Spiral Finishing Wheel was then used in a slow handpiece in forward motion with light pressure at a speed between 10 000 rpm – 20 000 rpm for 15 seconds. The Spiral Wheel was used in constant motion over the composite surface. The composite samples were then polished with the white Sof-Lex Spiral Polishing Wheel, using light pressure at a speed between 10 000 – 20 000 rpm for 15 seconds. The surface was finally rinsed with water and dried.15

Group 4: Shofu Dura-White Stones (Shofu Inc., Kyoto, Japan)

Shofu Dura-White Stones were used in a fast hand piece under copious water spray to polish the composite samples for 10 seconds.15 The surface was rinsed with water and dried.

Group 5: Intensiv UniglossCellbrushes (Intensiv SA, Montagnola, Switzerland)

An Intensiv UniglossCellbrush was initially used dry (without water coolant) with the hard filaments for 15 seconds, under light pressure and low speed (approximately 5000 rpm). Water spray was subsequently added for a few
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seconds whereupon the filaments changed from hard to soft consistency. In order to achieve the final gloss, polishing was done for a further 15 seconds in a wiping motion, with minimal pressure being applied. The surface was rinsed with water and dried.16

**Group 6: Enhance (Dentsply, Milford, USA)**
An Enhance Finishing Disc, fitted on a slow speed handpiece, was used to apply moderate to light, intermittent pressure in a buffing motion to the dry disc surfaces for 15 seconds at approximately 20 000 rpm. Prisma Gloss Polishing Paste, dispersed into a dappen dish and applied in a polishing cup, was used to polish the composite surfaces using light pressure and circular overlapping motions for 15 seconds. A small amount of water was added to the polishing paste and the surfaces were polished with the paste for a further 15 seconds using light pressure at moderate speed (approximately 20 000 rpm) in a buffing motion to increase surface lustre. The excess debris and polishing paste were rinsed off with water and the surfaces then dried.17

**Group 7: Zircon-Brite (Dental Ventures of America, Corona, USA)**
After polishing the composite surfaces of the discs as described in Group 3 using the Sof-Lex Spiral Finishing and Polishing Wheels, a further polishing sequel was done using a felt wheel and Zircon-Brite Polishing Paste to polish the composite samples for an additional 10 seconds.19

A Surftest SJ 210 profilometer (Mitutoyo, Tokyo, Japan) was used to determine the surface roughness. The composite samples were mounted on a wheel template with three markings: 0˚, 120˚ and 240˚. Three readings, in the different directions, were taken on each specimen, resulting in 15 readings per group. The average of the three readings per sample was taken as the average surface roughness value for each sample. After every three readings the profilometer was calibrated using the precision specimen.21

After profilometry one sample per group was evaluated in the scanning electron microscope (JEOL JSM-5800 LV, Tokyo, Japan). The samples were investigated and

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### Table 1: Composition and technical information : Z100 and Filtek Supreme XTE

<table>
<thead>
<tr>
<th>Product</th>
<th>Resin Matrix</th>
<th>Type of Filler</th>
<th>Mean particle size (µm)</th>
<th>Filler vol. %</th>
<th>Manufacturer</th>
<th>Batch no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z100</td>
<td>Bis-GMA*</td>
<td>Zirconia/Silica</td>
<td>0, 01 to 3, 5 micron.</td>
<td>66%</td>
<td>3M ESPE, St Paul, USA</td>
<td>LOT N585492</td>
</tr>
<tr>
<td>Filtek Supreme XTE</td>
<td>Bis-GMA*</td>
<td>Non-agglomerated/ non-aggregated Silica fillers</td>
<td>i. 20 nm Silica ii. 4 - 11 nm Zirconia iii. 0.6 - 10 µm Zirconia/Silica clusters</td>
<td>63.3%</td>
<td>3M ESPE, St Paul, USA</td>
<td>LOT N596719</td>
</tr>
</tbody>
</table>

* Bis-GMA: Bisphenol A glycidyl dimethacrylate; § TEGDMA: Triethylene glycal methacrylate; ¶ UDMA: Urethane dimethacrylate; # PEGDMA: polyethylene glycol dimethacrylate; †Bis-EMA: Bisphenol A ethyl dimethacrylate

---

### Table 2: Product information about the finishing and polishing systems

<table>
<thead>
<tr>
<th>Surface treatment</th>
<th>Type</th>
<th>Composition</th>
<th>Manufacturer</th>
<th>Batch no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sof-Lex Extra Thin Polishing discs</td>
<td>Disc and mandrel</td>
<td>Polyester film, Aluminium oxide Different grits: - Coarse: 55 µm - Medium: 40 µm - Fine: 24 µm - Superfine: 8 µm</td>
<td>3M ESPE, St Paul, USA</td>
<td>LOT N195023</td>
</tr>
<tr>
<td>Sof-Lex Spiral wheels</td>
<td>Finishing wheel Polishing wheel</td>
<td>Thermoplastic elastomer impregnated with aluminium oxide particles</td>
<td>3M ESPE, St Paul, USA</td>
<td>LOT N485117</td>
</tr>
<tr>
<td>Dura White stone</td>
<td>Stone</td>
<td>Aluminium oxide</td>
<td>Shofu Inc., Kyoto, Japan</td>
<td>LOT 0514382</td>
</tr>
<tr>
<td>Intensiv Ungloss Cellbrush</td>
<td>Cellulose brush</td>
<td>Ultratine diamond particles</td>
<td>Intensiv SA, Montagnola, Switzerland</td>
<td>LOT 271127</td>
</tr>
<tr>
<td>Enhance system</td>
<td>Finisher discs, points, cups. Prisma Gloss Composite Polishing paste</td>
<td>Cured urethane methacrylate resin impregnated with aluminium oxide Water soluble aluminium oxide paste</td>
<td>Dentsply, Milford, USA</td>
<td>LOT 1106071</td>
</tr>
<tr>
<td>Zircon-Brite</td>
<td>Polishing paste</td>
<td>Zirconium silicate</td>
<td>Dental Ventures of America, Corona, USA</td>
<td>Not available</td>
</tr>
</tbody>
</table>
photographed under 500 x and 1000 x magnification.

Data were analysed using analysis of variance (ANOVA) with the main factors being the composite and the polishing systems.

RESULTS
Profilometry
The mean surface roughness values (± SD) for all experimental conditions are presented in Table 3. The average results of the individual polishing procedures, as well as those of the two composites could be combined, as the two composites acted in an almost parallel manner when treated with the individual polishing systems (End-column and end-row in Table 3).

Statistically significant differences were found between the seven experimental groups (p<0.001) (Table 3 – lower case letters). For the combined composite surface roughness values the Mylar strip gave the smoothest finish and was significantly different from the Sof-Lex XT Discs, the Sof-Lex Spiral Finishing and Polishing Wheels and the Sof-Lex Finishing and Polishing Spiral Wheels + Zircon-Brite Polishing Paste, which, in turn, gave a significantly smoother finish than the Intensiv UniglossCellbrush and Enhance + Prisma Gloss Polishing Paste. Dura-White Stones provided the roughest finish and the resulting surfaces were significantly rougher than in all other groups. These differences are illustrated graphically in Figure 1 where polishing systems under the same black line are not statistically different from each other, while those that do not share a common line are statistically significantly different from each other.

Figure 2 illustrates the different, yet almost parallel, performance by Z100 and Filtek Supreme XTE when polished by the individual polishing systems with Z100 having slightly rougher surfaces after polishing than Filtek Supreme XTE.

Scanning Electron Microscopy
The Z100 and Filtek Supreme XTE surfaces cured under the Mylar strip appeared quite smooth, but showed small protruding particles and irregularities, possibly polishing debris or small filler particles that protruded from the resin matrix (Figure 3A & B). Visually there was no obvious difference in roughness of the surfaces.

The surfaces of the Z100 and the Filtek Supreme XTE samples polished

![Table 3](image-url)
with Sof-Lex XT Discs (C, M, F, SF) are shown in Figure 4 A and B. Both surfaces were quite smooth with only a few scratch lines and protruding filler/debris particles visible.

The Z100 sample polished with Sof-Lex Spiral Finishing and Polishing Wheels showed a few scratch lines and small voids on the polished surfaces (Figure 5A). Small protruding particles were also noted. The Filtek Supreme XTE sample, in turn, had a relatively smooth surface, with few protruding nano-clusters and smaller filler particles visible (Figure 5B).

The surfaces of both the Z100 and the Filtek Supreme XTE samples polished with Dura-White Stones had a very rough, wavy and uneven appearance, showing clearly visible crests and valleys (Figure 6 A & B).

The surface of the Z100 sample polished with the Intensiv UniglossCellbrushes had a wavy appearance with clear crests and valleys (Figure 7A) while the surface of the Filtek Supreme XTE sample showed a very wavy, uneven surface, with voids and protruding filler/debris particles visible (Figure 7B).

When Z100 samples were polished with the Enhance system, voids and surface irregularities were visible on the surface, possibly due to the plucking effect of the polishing system (Figure 8A). Protruding filler/debris particles were also visible on the surface. The Filtek Supreme XTE sample, in comparison, showed a wavy appearance, and composite smear lines with protruding filler particles were visible on the surface (Figure 8B).

The surfaces of the Z100 and the Filtek Supreme XTE polished with Sof-Lex Spiral Finishing and Polishing Wheels followed by Zircon-Brite Polishing Paste are shown in Figure 9 A and B. Both the surfaces for Z100 and Filtek Supreme XTE appeared smooth, with only a few protruding filler/debris particles, and small scratch lines visible.

**DISCUSSION**

The composites that were chosen for this study represented two advanced products in composite technology, namely a nano-composite Filtek Supreme XTE, and a more conventional microhybrid composite, Z100. The polishing systems were also carefully chosen, so that most of the major types of polishing systems available on the South African dental market were represented in this study.

Clinically, most composite restorations need to be subjected to some finishing and contouring in order to obtain the correct shape and morphology before polishing. Therefore, to mimic the clinical situation, all the composite samples were first finished with a red label finishing diamond bur, followed by a yellow label finishing diamond bur. In this study diamond finishing burs were chosen over carbide finishing burs, because the literature demonstrated that carbide burs caused more damage than diamond burs during the finishing procedure, and also that damage which had been caused by diamond burs could more easily be remedied by a good polishing system.

The results in this study confirmed that the smoothest composite surface was obtained when the composite was cured against a Mylar strip. These samples were statistically smoother than the roughnesses obtained for any of the other polishing systems tested. Several other studies reported similar findings when curing against a Mylar strip.
The surface roughness of Z100 before polishing was greater than the surface roughness of Filtek Supreme XTE (Table 3). The lower surface roughness value for Filtek Supreme XTE could be explained by the smaller filler particles (nano particles and clusters of nano-sized fillers) that were incorporated in Filtek Supreme XTE.10

After polishing with the different polishing systems, Filtek Supreme XTE had a statistically significant smoother surface when compared with the surface offered by Z100 (p=0.005). This suggests that Filtek Supreme XTE has better polishability than Z100. This is in accord with a study by Da Costa et al who also demonstrated that Z100 had a statistically significant higher surface roughness value after polishing compared with the surfaces of Filtek Supreme XTE.27

The polishing systems acted in a parallel manner on the Z100 and Filtek Supreme XTE, meaning that the polishing systems which recorded results which differed significantly from each other when used on Z100, also differed significantly in results when used on Filtek Supreme XTE. This is in accord with a study by Da Costa et al who also found no significant interaction between the type of composite used, and the particular polishing system.27 Z100 and Filtek Supreme XTE samples displayed surface roughness of 1.284 µm and 1.162 µm respectively after being polished with Dura-White Stone (Table 3). This is above the 0.2 µm threshold for surface roughness allowing for plaque adhesion, and much higher than the 0.5 µm that patients can detect with their tongues.2,28 Therefore, Dura-White Stone, used on its own, is not sufficient for the polishing of micro-hybrid and nano-composite restorations.

The following polishing systems provided the smoothest surfaces after polishing: Sof-Lex Spiral Finishing and Polishing Wheels in combination with Zircon-Brite Polishing Paste, as well as the Sof-Lex Spiral Finishing and Polishing Wheels and Sof-Lex XT Finishing and Polishing Discs used without additional pastes. The surfaces prepared by these systems were significantly smoother than those produced by the Enhance method used in combination with Prisma Gloss Polishing Paste, and also by the one-step polishing system, Intensiv UnglossCellbrush. There was no statistically significant difference between the results produced by Sof-Lex Spiral Finishing and Polishing Wheels in combination with Zircon-Brite Polishing Paste, the Sof-Lex Spiral Finishing and Polishing Wheels or the surface roughness after polishing by the Sof-Lex XT Finishing and Polishing Discs. The fact that Sof-Lex XT Finishing and Polishing Discs produced some of the smoothest surfaces after polishing is supported by several other studies.29-31

The surface roughness for Z100 after polishing with Sof-Lex Finishing and Polishing Discs was found in a study by Yap...
and co-workers to be 0.22µm.\textsuperscript{32} This is very close to the value found in the current study, namely 0.26µm. Enhance, in combination with Prisma Gloss Polishing Paste, and the Intensiv UniglossCellbrush did not differ significantly from each other in results produced, but both were over the 0.2µm thresholds for plaque accumulation. The finding, within the confines of this study, that Enhance performed poorly was in accord with a study done by Kaplan and co-workers.\textsuperscript{33}

The surface roughness values obtained for all the polishing systems in this study were the lowest when they were used on Filtek Supreme XTE. The finding that the polishing systems gave better results when used on a nanocomposite than on a microhybrid composite is in agreement with a previous study.\textsuperscript{34}

The surface roughness values for Sof-Lex Spiral Finishing and Polishing Wheels and also for Sof-Lex XT Finishing and Polishing Discs, when used on Filtek Supreme XTE, were measured as 0.211µm. This is below the plaque accumulation threshold and the patient’s sensory feeling threshold, rendering these systems appropriate for clinical use.

The smoothest surface for Z100 was obtained with a combination of Sof-Lex Spiral Finishing and Polishing Wheels and Zircon-Brite Polishing Paste. No previous studies have been done where Zircon-Brite was used in combination with Sof-Lex Spiral Finishing and Polishing Wheels. This combination, although proving to create the smoothest surface, was not statistically different compared with the data of the Sof-Lex Spiral Finishing and Polishing Wheels or the Sof-Lex XT Finishing and Polishing Discs groups. When Zircon-Brite Polishing Paste was used on Filtek Supreme XTE there was no difference in final surface roughness compared with Sof-Lex Spiral Finishing and Polishing Wheels. This can be attributed to the nano filler particles of Filtek Supreme XTE.\textsuperscript{10} The operator found that using Zircon-Brite Polishing Paste in combination with Sof-Lex Spiral Finishing and Polishing Wheels, was time consuming and more costly than just using the Sof-Lex Spiral Finishing and Polishing Wheels alone. Cost efficiency points to the use of Sof-Lex Spiral Finishing and Polishing Wheels alone.

The Sof-Lex XT Finishing and Polishing discs, the Sof-Lex Spiral Finishing and Polishing Wheels, as well as the Sof-Lex Spiral Finishing and Polishing Wheels combined with the Zircon-Brite Polishing Paste showed a lower variability in the final smoothness than the Enhance and Unigloss Cellbrush systems, as well as the Dura-White Stone - as indicated by the standard deviations of each system (Figure 1). Clinically, this may mean that the Sof-Lex XT Finishing and Polishing Discs and the Sof-Lex Spiral Finishing and Polishing Wheels, as well as the Sof-Lex Spiral Finishing and Polishing Wheels combined with the Zircon-Brite Polishing Paste, may provide a less technique-sensitive polishing sequence to the dental operator.

**CONCLUSION**

Filtek Supreme XTE, used in this study as an example of a nanocomposite, displayed significantly better polishability than Z100, used in this study as an example of a microhybrid composite. Some polishing systems produced statistically smoother surfaces than others. The smoothest surface was obtained after curing through a Mylar strip. The smoothest surface after polishing was the Zircon-Brite/Spiral Wheel combination, followed by Sof-Lex Spiral Finishing and Polishing Wheels and Sof-Lex XT Finishing and Polishing Discs. These systems did not differ significantly from each other, but did give significantly smoother surfaces than Enhance, Intensiv UniglossCellbrush and Dura-White Stone. The polishing results in this study are true for Z100 and Filtek Supreme XTE and the conclusion about polishing systems is limited to use on Z100 and Filtek Supreme XTE. Further studies using other composite products of the same classification and from across the trade need to be performed as comparison.

**Acknowledgements**

The authors give acknowledgement to the Pameijer Fellowship (IADR) and the Dentistry Development Foundation Trust (SADA) which provided financial assistance and to 3M ESPE (St Paul, USA) for sponsoring some of the materials used in this study.

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The availability of the basic oral health care package in the Western Cape

ABSTRACT
The majority of the uninsured population in the Western Cape, estimated at about 4.5 million, is dependent on public dental clinics. Dental caries remains the most common chronic disease worldwide. Caries experience among 6-year-old children in the province increased from 82% to 84% in the period 2002 – 2015. Oral health programmes to promote good oral health at schools and clinics are very limited. A cross-sectional study investigated 128 dental clinics in the Western Cape to determine the availability of the basic oral health care package, which includes promotion of oral health, prevention of oral disease and basic oral health treatment. Less than a third (31.5%) offered the basic treatment package and slightly less than two thirds (65%) were offering only dental extractions. Despite clear policy guidelines, public dental care delivery in Western Cape is seen to be not adherent to the guidelines, norms and standards. There is an unavailability of dentists outside the main clinics and it appears there is a minimal focus on prevention of oral disease and promotion of good oral health. Dental caries must be recognized as an epidemic in the Western Cape, and basic oral health care should be made available.

BACKGROUND
About 4.5 million persons in the Western Cape have no dental insurance and must rely on public dental clinics simply because they do not have the financial means to consult a private dentist. There are approximately 120 public dental clinics in the Western Cape at which it may be expected that a basic oral health package should be offered. This service would include promotion of oral health, preventing oral disease and basic oral health treatment including an oral examination, bitewing radiographs, simple 1-3-surface restorations, and dental extractions. The majority of the clinics may not sufficiently equipped to offer even that basic package.

Nevertheless, several good policy documents point the way for improved oral health delivery in the public sector. These include the Norms and Standards for Oral Health Care in SA, National Oral Health Strategy and the National Oral Health Policy.

INTRODUCTION
Dental caries remains worldwide the most common chronic disease. According to the last National Children Oral Health Survey conducted in 1999 – 2002 the caries experience among 6-year-olds stood at 82.3%. This figure was much higher than the National Mean of 50%. Recent data from the Oral Health Service in the Province indicates that the caries experience amongst this age group has increased to 84%.

It is a priority for a dentist in the public sector to attend to patients with pain and sepsis. These patients are finally driven to seek help, and at that stage, the most feasible treatment option is to extract the tooth in order to relieve the pain. There are many pre-school children who suffer from tooth ache associated with dental caries and in some instances they are treated under general anaesthetic. A study conducted in the Western Cape by Peerbhay and Barrie (2012) showed that only 0.0001% of all treatment done in the public sector on pre-school patients under general anaesthesia were for dental restorations while 99.94% were for extractions. The mean number of teeth being extracted per patient was ten.

Children with poor oral health are 2.3 times more likely to perform poorly in school and yet programmes to promote good oral health in the school setting and at clinics are very limited. Indeed, there is an uncertainty regarding the degree of availability of these services in the public sector. This paper reports on a study conducted in 2014 which aimed at establishing the availability of the basic oral health care package in the Western Cape.

Figure 1: Availability of the basic oral health care package
MATERIAL AND METHODS
A cross-sectional study was conducted to describe the availability of the basic oral care package in the Western Cape. The study included 128 dental clinics (93% of all clinics) and interviews were conducted with 60 dentists, that is 88% of all dentists employed by Government of the Western Cape. Available National and Provincial policy guidelines were used as a reference point to determine which procedures should be included in the basic package. Telephones were used to administer a questionnaire in the collection of data. The most recent census data was used to calculate dentist/population ratios.

Aim
To determine the availability of basic oral health care offered through the Provincial Dental Clinics in the Western Cape.

Objectives
- To determine the proportion of clinics that offer the basic oral health care package
- To calculate oral health professional : population ratio for each district
- To determine the number of days per month the clinic is visited by a dentist
- To ascertain work time distribution of dentists
- To investigate oral health promotion programmes and oral disease prevention activities offered in the public sector
- To investigate reasons for difficulties in delivery of services.

Data analysis
Data was recorded on a customized data capture sheet on Microsoft Word 2010 and the statistical analysis was completed on Microsoft Excel 2010 and Epi Info. A variety of statistical tests were used e.g. Student’s t-test for means and Chi-square test for proportions. Statistical level of significance was determined as p < 0.05.

Ethical considerations
- The research proposal was approved by the Senate and Faculty Research Ethics Committee of the University of the Western Cape (13/3/4) as well as by the Research Ethics Committee of the Government of the Western Cape (RP 042/2014).
- Participation was on a voluntary basis.
- The identity of the participants remained anonymous at all times.
- A signed informed consent form was obtained from all participants.

RESULTS
The proportion of clinics offering the basic oral health treatment package

Less than a third (31.5%) of all clinics offered the basic treatment package (Figure 1) and just under two thirds (65%) were offering dental extractions only. Less than half (43%) were able to offer a scale & polish and/or fillings while bitewing radiographs could be taken at only 30% of clinics. Fissure sealants which are essential to dental caries prevention were done at only 37% of clinics. The Metro health district had the best record in the Province with almost half of the clinics being able to offer the basic package compared with only 17% in the West Coast district.

There was an association between the ability to offer the basic package and the clinic type (p <0.005). Main clinics were defined as a facility at which the dentist was based and the presence of the dentist could be guaranteed at least for a portion of the day. Satellite clinics were usually more remote and visited infrequently by a dentist; once a week, twice a week or on a monthly basis. Main clinics were 4.5 times more likely to offer the basic package compared with a week, twice a week or on a monthly basis. Main clinics were 4.5 times more likely to offer the basic package compared with Satellite clinics (Risk Ratio = 4.5). Only 15% of Satellite clinics could offer the basic package compared with 68% of Main clinics (Figure 2).

There was an association between the ability to offer the basic package and the geographic location of the clinic (p <0.009). Metro clinics were located in the Metro Health District which resembles the City of Cape Town. Rural clinics were defined as clinics situated outside the Metro Health District. Metro clinics were 2.5 times more likely to offer the basic package compared with Satellite clinics (Risk Ratio = 4.5). Only a quarter of Rural clinics could offer the basic package while at least half of all the Metro clinics could deliver those services (Figure 3).

Dentist : population ratio
In the present study, the dentist : population ratio for the Western Cape was calculated for each district (Table 1). The ratio for the whole province was 1: 71 875 (Table 1). The two districts having the highest proportions of population were Metro (1:60,429) and Eden (1:72,069). These ratios are all far from the recommended ratios as stipulated in the National Oral Health Strategy (2005), that document recommending figures of 1:60,000. The current study found that there is a shortage of 13 dentists, 18 Oral Hygienists and 43 dental assistants in the Province.

Table 1: Dentist : Population ratios in the Western Cape

<table>
<thead>
<tr>
<th>District</th>
<th>Dentists</th>
<th>Uninsured population</th>
<th>Dentist : Population ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro</td>
<td>38</td>
<td>3 056 296</td>
<td>1 : 80 429</td>
</tr>
<tr>
<td>West Coast</td>
<td>5</td>
<td>263 385</td>
<td>1 : 52 677</td>
</tr>
<tr>
<td>Cape Winelands</td>
<td>10</td>
<td>595 646</td>
<td>1 : 59 565</td>
</tr>
<tr>
<td>Overberg</td>
<td>4</td>
<td>198 613</td>
<td>1 : 49 653</td>
</tr>
<tr>
<td>Eden</td>
<td>7</td>
<td>504 483</td>
<td>1 : 72 069</td>
</tr>
<tr>
<td>Central Karoo</td>
<td>1</td>
<td>53 422</td>
<td>1 : 53 422</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td>4 671 844</td>
<td>1 : 71 875</td>
</tr>
</tbody>
</table>
Availably of dentists at public clinics
The availability of dentists at various clinics was ascertained by recording the number of days in a month that a dentist was physically present at the clinic (a maximum of 20 days). The mean number of days that a dentist is present overall at clinics is 7.3 days (SD = 7.8) per month. There was a significant difference between professional attendances at Main and Satellite clinics (p < 0.0005). At Main clinics, a dentist was present for 16.6 days compared with Satellite clinics where dentists were present for only 3.2 days per month.

Working time distribution
Working time was measured by the number of hours in a normal working day (8 hours/100%) that the dentist rendered services at the relevant Main clinic (where the dentist was based). Working time was further categorized into performing dental extractions, fillings, other clinical services, administrative duties, or driving to nearby schools or clinics.

The mean time per day which was dedicated to dental restorations was 2.06 hours which represented 26% of a working day and in this instance there was no significant difference between Metro and Rural clinics. Half of the time (3.78 hours) in a working day was dedicated to performing dental extractions and there was a significant difference between Metro and Rural clinics (p < 0.05). Dentists from districts dedicated a larger proportion of the day to extractions compared with the Metro clinics. The mean time per day allocated to administrative duties was 1.34 hours and there was no significant difference in this aspect of work between dentists from Metro and Rural clinics. The mean time per week which was taken up in driving to surrounding clinics and schools was 1.8 hours and there was a significant difference between dentists from Metro and Rural clinics (p < 0.0005). Dentists who were working in the Rural districts spent more time driving to schools and Satellite clinics compared with dentists in the Metro clinics.

Oral promotion & prevention
Almost two thirds of the responding dentists visited schools at least once a year to render oral health services which were mostly dental screening. Only 20% of dentists visited baby clinics annually while 15% visited crèches (Figure 4). The “Road to Health” chart/booklet for infants and young children is a national instrument which is used to monitor growth and development of an infant and young child. On certain days a special clinic (baby clinic) is scheduled for infants and toddlers to monitor their growth and development. Page 20 in the booklet is dedicated to oral health and can be completed by a dentist, dental therapist or an oral hygienist. The majority of dentists have knowledge of the oral health page but only 47% actually completed it at least once per year.

Factors contributing to unavailability of the basic package
Whilst the majority of dentists do have access to a government vehicle to use in visits to Satellite clinics and surrounding crèches, these are not always readily available.

The time required to repair or replace dental equipment is an essential component in the consistent provision of the basic oral health care package. The mean equipment repair time was three weeks and the mean time of acquiring new dental equipment was seven months. There was no significant difference between Metro and rural clinics regarding equipment replacement/repairing times (p > 0.05).

Waiting times for appointments for dental treatment under general anaesthesia, dental restorations and general waiting time for patients at the dental clinic were also included in the study. The mean waiting time for a dental patient from arrival at the clinic until contact with a clinician was 1.5 hours. The waiting time for an appointment for treatment under general anaesthesia (GA) for a child was three months. The mean waiting time for an appointment for dental fillings was three weeks.

According to the study, dentists indicated that the basic package could not be offered at clinics for various reasons. A major obstacle was the unavailability of equipment including dental chair light, suction, dental material, film and radiograph developer. A shortage of oral health staff and poor working environments were further problems, given that at some clinics dentists were working on a plastic or ordinary desk chair and sharing a surgery with other professionals, resulting in a lack of privacy.

The most common main complaint of patients was pain and sepsis, resulting in the majority of treatments being dental extractions. However, some participants also mentioned that the community demanded extractions instead of restorations.

Time constraints due to high numbers of patients or extensive travel distances also played some role in limiting the variety of dental care which could be offered.

DISCUSSION
Activities involving oral health promotion and prevention of oral disease are essential components of basic oral health care as stipulated by National Oral Health Policy documents.

A comprehensive oral health plan had been approved by the Provincial Minister in 2007.1 In this planning document, specific recommendations for basic oral health care were made in terms of instrumentation, equipment and infrastructure requirements for public dental care. As yet, it has not been implemented due to limited resources.1 In March, 2014, a policy document, “Healthcare 2030 – The Road to Wellness”, was issued by the Provincial Government of the Western Cape.11 The Oral Health chapter in this document alludes to the importance of oral conditions, the oral health services platform which require strengthening, a focus shift from curative services towards preventive and promotion services and the role of the Oral Health Centre in the provision of outreach and support to District Health services. There is also mention of the community-based services designed to support Integrated School Health Programmes and home-based care services.12 These platforms should be used to drive supervised tooth brushing strategies, in conjunction with services from the Department of Basic Education as well as Social Development.

The present study also showed that the line of reporting from dentists to their managers also seemed problematic.
Participants indicated that they report to the Primary Health Care Practitioner of a health sub-district. This person is usually a nurse who is not familiar with oral health procedures and the scope of clinical practice of the different oral health professionals. Procurement for dental instrumentation and equipment is channeled through this officer and often dentists experience frustration as the requirements and standards of a public dental clinic are not always appreciated. Dental statistics and work load requirements are also managed by the Primary Health Care Practitioner. This often leads to further frustration among dentists when headcounts and the number of extractions are regarded as the main indicators for the delivery of oral health services. There is considerable scientific evidence that these statistics are inaccurate indicators for measuring the quality of oral health services. Logically, oral health services should surely be managed by an oral health professional.

The dentist: population ratio in South Africa is extremely low compared with other middle income countries. The National Policy for Oral Health in South Africa suggested that the dentist: population ratio should be 1 : 15,000, as calculated from the National Oral Health Survey 1988/1989. That ratio has changed dramatically to a suggestion that there should be one dentist for 60 000 people. According to the most recent National Policy documents the oral health professional: population ratios should be as follows:

- Oral Hygienist: Population 1: 100 000
- Dental Therapist: Population 1: 60 000
- Dentist: Dental Therapist 1: 5
- Dental Therapist: Oral Hygienist 5 : 1

These ratios are questionable since no scientific evidence justified the recommended ratios. The question should also be asked whether these ratios are still applicable to the public sector today, recognising the effects of urbanization and the rising prevalence of dental caries. Ratios of oral health clinician: population should preferably be calculated through utilising the needs/services and demand-based approach. These calculations are depended on DMFT-scores which are specific for different age groups.

A serious case can be made for the need to appoint a specialist in Community Dentistry to assist the Provincial Government with policy development, economic evaluation, epidemiological surveillance, statistical analyses and the management of oral health services. The lack of specialist services outside the Oral Health Centre is contributing to escalating waiting lists, the inability to apply epidemiological and statistical trends and the escalating burden of oral disease in the Western Cape. Other dental specialist groups such as Orthodontics, Oral Pathology, Prosthodontics, Periodontics and Maxillo-Facial and Oral Surgery are also restricted to the Oral Health Centre. These specialists have a main focus on tertiary clinical services, research and post-graduate teaching and learning. Consideration should therefore be given to the appointment of dental specialists at selected regional and district hospitals to enable the provision of equitable oral health specialist care to public patients.

CONCLUSION

The majority of public dental clinics in the Western Cape are unable to offer basic oral health care and about two thirds of clinics restrict services to extractions. The most recent Provincial Policy document, “The Road to Wellness” and the National Oral Health Strategy document describe the picture of oral health care for the future as well as proposing the structure and system to address inequities in providing for oral health. However despite these clear policy guidelines, public dental care in Western Cape is found to be not adhering to these norms and standards. The socioeconomic and psychological factors of oral disease are also being ignored. Infrequent visits at Satellite clinics by dentists emphasize unavailability of professionals outside the Main clinics. Infrequent visits to schools and creches and the poor completion rate of the oral health page in the Road to Health booklet highlight a minimal focus on oral disease prevention and on the promotion of good oral health.

Basic Oral health should be regarded as a human right deserved by each South African, not only the 16% of the population who have access to private health care. Managers and decision makers should implement existing health strategies to prevent oral disease and promote good oral health.

The availability of basic oral care is essential, exemplified by the rising prevalence of dental caries amongst children. Furthermore, it is time that dental caries must be recognized as an epidemic in the Western Cape. It is a disease affecting the majority of society and it restricts the quality of life. Recognition of oral health issues and making basic oral health care generally available is essential to address the oral health problems in the Western Cape.

References

Oral medicine case book 75: Mucoepidermoid carcinoma of the lower lip: review and a case report

ABSTRACT

Mucoepidermoid carcinoma (MEC) is the most common malignancy of salivary gland origin, comprising 30% of all these neoplasms. Major salivary glands are more commonly involved, with most MECs presenting in the parotid gland. The palate is the most commonly involved site in minor salivary glands. MEC of the lower lip is extremely rare with only a few cases reported in the literature. We report a case of a low grade MEC of the lower lip in a 49 year old female patient. She presented with a mass in the lower lip of six months duration with a history of a recent rapid increase in size. Surgical resection was the treatment of choice and histopathological examination of the excised mass confirmed a diagnosis of low grade MEC. We present this case to highlight that although relatively rare, MEC should be included in the differential diagnoses of lower lip masses.

INTRODUCTION

MEC is a malignant epithelial salivary gland neoplasm characterised by proliferation of epidermoid, mucous and intermediate cells in varying proportions. The majority of tumours arising from the minor salivary glands are malignant. The MEC was first described by Stewart et al in 1945 as a mucoepidermoid tumour categorised into “favourable” (benign) and “unfavourable” (malignant) variants. It later, however, became apparent that all variants of the neoplasm are malignant and capable of loco-regional and distant metastasis, hence the adoption and endorsement of the term “MEC” by the Second 2005 WHO classification of salivary gland neoplasms. MEC is reported to represent 12–29% of all salivary gland malignancies and 12-30% of all salivary gland neoplasms. Although MEC can occur at any age, the peak incidence is between the third and sixth decades of life. MEC demonstrates diverse histomorphological features and biological behaviour, with prognosis correlated with histopathological grade, early detection and management. Treatment options for MEC include complete local excision for low grade MEC and surgical resection with or without radiation for high grade MECs.
CASE REPORT

A 49-year-old African female patient presented with a six month history of a painless, slow growing swelling on the lower lip. The patient reported a 34-year history of snuff dipping on the lower labial sulcus, with a medical history that was non-contributory. Extraoral examination revealed palpable, mobile, non-tender bilateral submandibular lymph nodes. On intra-oral examination, a solitary dome-shaped, smooth surfaced, non-ulcerated intramucosal swelling of normal colour was visible on the lower left labial mucosa (Figure 1).

The clinical differential diagnoses included mucocele, fibro-epithelial polyp, salivary gland neoplasm, lipoma and haemangioma. The lack of an associated history of trauma favoured the latter three options. The mass was surgically excised (Figure 2A). The specimen was multi-lobular; round to oval in shape with a yellowish cut surface, and measured 12 x 8 x 6 mm (Figure 2B).

Histopathological examination of the specimen showed features consistent with those of a mucoepidermoid carcinoma characterized by proliferation of neoplastic epidermoid, mucous and intermediate cells lying within a fibrous connective tissue stroma (Figure 3).

Cystic spaces lined by mucous cells and a few scattered basaloïd and cuboidal intermediate cells were observed (Figure 4 A). On higher magnification of the tumour section, a focal area showing epidermoid, mucous and intermediate cells is observed (Figure 4B).

Histochemical examination demonstrated the presence of intra-cytoplasmic mucin in mucous cells and pools of mucin as highlighted by diastase resistant Periodic Acid Schiff (PAS) and mucicarmine positivity. The neoplastic cells were negative for S100 and SMA but positive for the P63 stain. The tumour had a mostly solid composition, and showed no signs of neural invasion, necrosis, mitotic division nor cellular anaplasia; thus giving it a total score of Two and a classification of a grade One/low grade MEC according to the Armed Forces Institute of Pathology grading system (AFIP)\textsuperscript{3,5} Positive tumour margins were identified and the patient was subsequently recalled three weeks later for wider excision margins. More than a year after the second surgical procedure the patient remains tumour free.

The correlation between the tumour size and the histological grade is in line with the observation made by Triantafillidou et al. who suggested low grade MECs showed a disposition for a diameter less than 4cm, circumscription, lack of a capsule and a predominantly cystic composition.\textsuperscript{18} In our case the MEC was less than 4cm in diameter, lacked circumscription but had a predominantly solid composition. By demonstrating a cystic component of less than 20%, our low grade MEC underscores the significant role played by factors other than the architectural growth pattern in the grading of MECs.

GRADING CRITERIA

The most popular grading systems for MECs are the Modified Healey, the AFIP and the Brandwein systems.\textsuperscript{2,3,7,8,12–23} All three grading systems classify MECs into three grades: low, intermediate and high grade. The Healey system places great emphasis on the morphological features of the tumour whereas the other two systems are point based and assess various histopathological parameters (Tables 1, 2 & 3).

The Brandwein grading system is a modified AFIP grading system with three additional histopathological features (Tables 2 & 3).\textsuperscript{21,22} Currently no consensus exists with regard to which of the three systems is the best. The AFIP grading system is reproducible and demonstrates relatively good correlation between histological grade and clinical behaviour\textsuperscript{12,25} but tends to downgrade MECs and to cluster intermediate and high grade tumours as reported by Brandwein et al.\textsuperscript{22} In an attempt to correct this, Brandwein et al. modified the AFIP grading system
by increasing the weighting of perineural invasion when present from 2 to 3 and added three more parameters, namely, pattern of invasion, lymphovascular and bony invasion bringing the total number of histopathological parameters examined and scored to eight.20-22 Of these parameters necrosis, mitotic activity, perineural, lymphovascular and bony invasion are considered to be the main determinants of tumour grade.22 In both grading systems the individual scores are added and a grand total score is then used to classify MEC into low, intermediate, and high grades.21-23 However, Nance et al.24 demonstrated that the Brandwein system is not without fault as it has a tendency to upgrade tumours, by clustering low grade and intermediate tumours. These differences have significant implications on treatment modalities and prognosis for MECs which are largely dependent on the histological grade of MECs.25 Regardless of these challenges, numerous studies have proven histological grading based on these systems to be the most significant independent prognostic factor for MECs. An exception to the rule is the MEC of the submandibular gland which is associated with increased risk for metastasis and poor prognosis irrespective of the histological grade. In addition to the site of involvement, gender, age, clinical stage, disease-free margins and lymph node metastasis have proven to be of prognostic significance.26,27

**DISCUSSION**

The most common malignant tumours to arise from minor salivary gland tissue include mucoepidermoid carcinomas (21.8%), adenocarcinomas (7.1%), adenoid cystic carcinomas (6.3%), and acinic cell carcinomas (1.6%). In the past, prior to proper description, MECs, particularly the high grade variants have been misdiagnosed as squamous cell carcinoma or unspecified adenocarcinoma.21,23 This is not surprising considering that high-grade tumours are predominantly solid, and show a great degree of cellular atypia similar to that seen in squamous cell carcinoma.21,23 The misdiagnoses and changes in the diagnostic and grading criteria of these salivary gland neoplasms also explain the conflicting data regarding the frequency of MECs reported in literature over the years, which on average was reported as 27% of all malignant salivary gland tumours before 1990, and 45% thereafter.21 However, there are a few studies reporting on the MEC of the lower lip;17 Neville et al. found in their study MEC to be the most common malignancy involving the lower lip, with 15 of 16 lower lip malignancies diagnosed as MEC.25 Most reported MECs are classified as low grade tumours,7 emphasizing the significant role of early disease detection in altering disease outcome and determining patient survival.

No causal effect relationship has been demonstrated in the literature between tobacco use, alcohol consumption and the development of salivary gland neoplasms. While the patient in the current case reported a 34-year history of snuff dipping on the lower labial sulcus adjacent to the site involved by the MEC, it is then unlikely that the development of the MEC on the lower labial mucosa is associated with the habit.

**CONCLUSION**

In conclusion, we present this case to highlight that, MEC, although relatively rare, should be included in the differential diagnoses of lower lip masses to guide the treatment approach, avoid recurrences and possible repeat surgery in order to achieve curative margins. Whilst

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**Table 1: Mucoepidermoid Carcinoma: Modified Healey Microscopic Grading System.**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Differentiated mucin producing epidermoid cells, often in a 1:1 ratio; minimal to moderate intermediate cell population</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Daugher cyst proliferation from large cysts</td>
</tr>
<tr>
<td></td>
<td>Minimal to absent pleomorphism, rare mitoses</td>
</tr>
<tr>
<td></td>
<td>Broad-front, often circumscribed invasion</td>
</tr>
<tr>
<td></td>
<td>Pools of extravasated mucin with stromal reaction</td>
</tr>
<tr>
<td>High</td>
<td>No macrocysts, predominantly solid but may be nearly all glandular cell constituents</td>
</tr>
<tr>
<td></td>
<td>range from poorly differentiated to recognizable epidermoid and intermediate to ductal type adenocarcinoma</td>
</tr>
<tr>
<td></td>
<td>Considerable pleomorphism, easily found mitoses</td>
</tr>
<tr>
<td></td>
<td>Unquestionable soft tissue, perineural and intravascular invasion</td>
</tr>
<tr>
<td></td>
<td>Chronic inflammation at periphery, fibrosis separates nests of cells and groups of nests</td>
</tr>
</tbody>
</table>

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**Table 2: Mucoepidermoid Carcinoma: AFIP Microscopic Grading System.**

<table>
<thead>
<tr>
<th>Histopathological Parameter</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infracystic component &lt;20%</td>
<td>2</td>
</tr>
<tr>
<td>Neural Invasion</td>
<td>2</td>
</tr>
<tr>
<td>Necrosis</td>
<td>3</td>
</tr>
<tr>
<td>≥ 4 mitoses/10 HPF*</td>
<td>3</td>
</tr>
<tr>
<td>Anaplasia</td>
<td>4</td>
</tr>
</tbody>
</table>

**Table 3: Mucoepidermoid Carcinoma: Brandwein Microscopic Grading System.**

<table>
<thead>
<tr>
<th>Histopathological Parameter</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infracystic component &lt;25%</td>
<td>2</td>
</tr>
<tr>
<td>Tumour front invades in small nests and islands</td>
<td>2</td>
</tr>
<tr>
<td>Pronounced nuclear atypia</td>
<td>2</td>
</tr>
<tr>
<td>Lymphovascular invasion</td>
<td>3</td>
</tr>
<tr>
<td>Bony invasion</td>
<td>3</td>
</tr>
<tr>
<td>&gt;4 mitoses/10 HPF*</td>
<td>3</td>
</tr>
<tr>
<td>Perineural invasion</td>
<td>3</td>
</tr>
<tr>
<td>Necrosis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table: Mucoepidermoid Carcinoma: Modified Healey Microscopic Grading System.**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Characteristic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Differentiated mucin producing epidermoid cells, often in a 1:1 ratio; minimal to moderate intermediate cell population</td>
</tr>
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<td>Intermediate</td>
<td>Daugher cyst proliferation from large cysts</td>
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<td>Broad-front, often circumscribed invasion</td>
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<tr>
<td></td>
<td>Pools of extravasated mucin with stromal reaction</td>
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<tr>
<td>High</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Chronic inflammation at periphery, fibrosis separates nests of cells and groups of nests</td>
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</tbody>
</table>

---

**Table: Mucoepidermoid Carcinoma: Modified Healey Microscopic Grading System.**

<table>
<thead>
<tr>
<th>Histopathological Parameter</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumour Grade:</td>
<td>Point score</td>
</tr>
<tr>
<td>Low</td>
<td>0-4</td>
</tr>
<tr>
<td>Intermediate</td>
<td>5-6</td>
</tr>
<tr>
<td>High</td>
<td>7 or more</td>
</tr>
</tbody>
</table>

*HPF=high power fields*
it is unlikely that the MEC in this case was associated with the reported history of the use of smokeless tobacco (snuff dipping), given the ‘coincidental’ existence of the MEC on the site where the smokeless tobacco was habitually placed over the years, future studies should evaluate the possibility of this association.

Declaration: No conflict of interest declared.

References
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Localised “vertical relapse” following orthodontic correction in young growing patients with cleft lip/ palate: Case studies potentially leading to a revision of the retention protocol.

ABSTRACT
Vertical dental relapse following orthodontic treatment has been observed in growing cleft lip and palate patients who had been treated at a Cleft Centre in Kwa-Zulu Natal. It appears that such relapse may occur in those who had had alveolar bone grafts in the cleft area and that it takes place at a time coinciding with the eruption of the maxillary canines. This communication is based on case studies of patients who presented three different types of clefts. All the grafts had been taken from the iliac crest. The observations may indicate a need for an in-depth study to investigate whether teeth erupt normally through iliac crest bone grafts in cleft patients. Confirmation of an altered eruption pattern may indicate a need for a change in retention protocol.

INTRODUCTION
Most cleft lip/palate (CLP) patients are treated from birth to adulthood, undergoing various phases of treatment delivered by a coordinated team of many care givers. One of the most important aspects of treatment is the objective to achieve orthodontic alignment of the dentition, which has been greatly facilitated by secondary alveolar bone grafting for patients with clefts involving the maxillary alveolus. This has transformed the dental management of these patients, with bone grafting of the cleft area being effected in late childhood (i.e. during late mixed dentition, early permanent dentition). Over the years there has been a steady improvement in the bone grafting procedures leading to enhanced success of the grafts.1-7

However, a major complication of bone grafting techniques is the resorption of the grafted bone in the cleft area, especially if there are no teeth to secure the graft.8 Whilst the scheduling of bone grafts is quite variable and controversial, grafting in the cleft areas is normally done around the ages of 9 years to 11 years, timed to coincide with the eruption of the canine into the graft area. Various studies have indicated that the erupted canine with good periodontal support helps maintain the grafted bone.8,9 It is commonly believed that this supported bone allows for orthodontic tooth movement in the cleft area.9

Today most grafts are harvested from the iliac crest. Other donor sites include the mandibular symphyseal bone and the retromolar pad area, and allografts. A study in Netherlands showed a positive outcome with mandibular symphyseal bone grafted into the cleft area, but, notably, the authors also advocated life-time fixed upper and lower retention for cleft lip/palate patients.10

Although most cleft lip/palate patients are missing the maxillary lateral incisors in the cleft area, those that do in fact have these teeth can be considered for an earlier bone graft at age 6-7 years. The lateral incisor should preferably be on the mesial side of the cleft. Hence, the recommended age of grafting is variable and is still very controversial.11

A search of the literature has shown no studies or research which have been undertaken of the stability of the dentition in and adjacent to the bone grafted cleft area following orthodontic treatment in young pre-pubertal and pubertal cleft lip/ palate patients. Since grafting is intended to provide bone for the successful stabilization of the dentition in the grafted area, it is warranted to evaluate cases who have received grafts to assess the degree of post treatment stability.

A series of case studies was therefore carried out on cleft lip and palate patients who had received bone grafts. These case presentations show vertical relapse or
movement of the dentition adjacent to clefts which had been grafted with iliac crest bone. The type of relapse is localised to teeth adjacent to the cleft area. This appears to not have been previously reported.

OBJECTIVE
To investigate the post-orthodontic stability of well aligned upper teeth in young cleft lip/palate patients who had had bone grafts placed in the cleft area.

To describe and to evaluate the extent and character of any relapse and to propose suitable retention protocols, amended if necessary.

MATERIALS AND METHODS
The study involved an investigation of four cases which included two patients with unilateral cleft lip/alveolus, one with a unilateral cleft lip/palate and one with a bilateral cleft lip/palate. These are patients from a joint private practice/public service Cleft lip/palate Clinic in the province of Kwa Zulu Natal in South Africa. The public sector clinic is run under the auspices of the Wentworth Foundation* for Cleft lip/palate Service, a non-Governmental Organisation (NGO). Most patients at that facility are treated from birth.

All ethical considerations have been taken into account. The necessary permission for publication of patient information has been obtained.

This is a photographic evaluation which depicts and records dental changes in the post orthodontic treatment phase (i.e. retention phase). It is confined to those cleft lip/palate patients who received bone grafts during the growing phase of life, timed to coincide with the eruption of the maxillary canine. All grafts were from the iliac crest. An outline of the active treatment phase and the passive post treatment phase (retention) is given, showing the changes in the dentition. “Debanding” of patients refers to removal of fixed braces. The patients comprised three young females and one male. All are based in Kwa Zulu Natal, South Africa.

CASE 1: UNILATERAL CLEFT LIP ALVEOLUS
This patient is a young male. He presented with a unilateral cleft lip and alveolus. The primary operation for the lip was performed at about four months of age. A first phase orthodontic treatment was commenced at the age of nine years with a removable expansion device. At that stage the patient had a supernumerary tooth in the cleft area, on the mesial side of the cleft. The lateral incisor (22) was on the distal side of the cleft (Figure 1 A, B).

The second phase of fixed orthodontic appliances commenced when the patient was 12 years of age. A bone graft, taken from the iliac crest, was placed within three months of commencement of fixed orthodontic treatment, when the supernumerary was also extracted. Space closure began about six months after placement of the graft, the delay allowing for complete postoperative healing (Figure 2 A, B).

On completion of fixed orthodontics at age 14 years, the patient was debanded and placed on a removable upper retainer and a lower fixed retainer (Figures 3 A, B, C). The discrepancies in the gingival heights of teeth adjacent to the cleft was of immediate concern.

Six months into the retention phase the failure of the eruption of the teeth adjacent to the cleft became apparent (Figure 4). The vertical relapse continued the situation deteriorated further one year into retention (Figure 5 A, B). To prevent further relapse a fixed retainer was placed on the teeth adjacent to the cleft. This will remain in place until re-treatment at the age of 18 years to correct overbite (Figure 6 A, B).
CASE 2: UNILATERAL CLEFT LIP ALVEOLUS
This patient presented, as a young female, with a unilateral cleft lip alveolus (Figure 7 A, B). Her cleft was on the left side with the lateral incisor on the distal aspect of the cleft. Fixed orthodontic treatment was commenced at age nine and a half years. The bone graft, harvested from the iliac crest, was inserted about 12 months after initiation of the fixed appliance orthodontic treatment. No movement of the teeth into the cleft area was undertaken for some six months post-surgery to allow for the consolidation of the graft. The patient was debanded at the age of 11½ years (Figure 8 A, B) and upper removable and lower fixed retention appliances were fitted.

One year post retention, the patient presented with vertical relapse of the teeth adjacent to the cleft (Figure 9 A, B). The patient was retreated with fixed appliances to align the upper teeth (Figure 10 A, B). A fixed “bond-a-braid” retainer was placed on the upper teeth across the cleft area to adjacent teeth (Figure 11). The patient was advised that a third phase of orthodontic treatment could be necessary at 18 years of age.

CASE 3: UNI-LATERAL CLEFT LIP/PALATE
This young female patient presented with a unilateral cleft lip/palate. The cleft was on the left side. The panorex radiograph showed the presence of a supernumerary tooth on the distal aspect of the cleft and a lateral incisor on the mesial side of cleft. A preliminary phase of orthodontic treatment was started at the age of eight years with a removable expansion device (Figure 12 A, B).

The second phase fixed orthodontics was started at the age of approximately nine years. A bone graft taken from the iliac crest was placed in the cleft area when the patient was one year into the fixed appliance orthodontic treatment (Figure 13 A, B). The supernumerary was actively erupted through the graft in an effort to consolidate the graft. This was unsuccessful and a second bone graft with extraction of the supernumerary was done a year later (Figure 14 A, B).

Spaces were closed and the patient was debanded a year later (after almost 40 months of fixed orthodontic treatment). (Figure 15 A, B, C). A removable upper retainer and a lower fixed retainer were placed. Six months into retention a failure of eruption of the teeth adjacent to the cleft could be observed (Figure 16 A, B). Twelve months into retention the teeth adjacent to the cleft showed no signs...
of erupting any further, with a gradual decrease in the anterior overbite (Figure 17 A, B). Two years post-treatment the trend continued in the cleft area (Figure 18 A, B). A fixed retainer was placed to prevent further relapse. It was decided to retreat the patient at 18 years of age to re-establish a good overbite.

CASE 4: BILATERAL CLEFT LIP/ PALATE

This patient presented in the early mixed dentition as having a bilateral cleft lip/ palate with a Class 3 occlusion. She was missing her lateral incisors. Initial treatment was started with a removable expansion screw and progressed to fixed appliance with continued expansion (Figure 19 A,B,C).

A “Hyrax” expansion appliance was placed in (early permanent dentition stage) to facilitate bone grafting as the canines were erupting. An iliac crest bone graft was placed during fixed orthodontic treatment. On completion of the orthodontic treatment the patient was debanded and a removable upper retainer incorporating the missing laterals was inserted (Figure 20 A,B,C,D).

One year post treatment there was a noticeable amount of vertical relapse (Figure 21A,B).

Five years later there was an increase in the anterior open bite (Figure 22A,B).

RESULTS

It is evident in all cases that there was a gradual dental relapse over a period of time which was confined to the area of the cleft, affecting the teeth adjacent to the cleft. In all these cases successful iliac crest bone grafts had been performed. The observed relapse appeared to continue to deteriorate until the late stages of facial growth.

DISCUSSION

This study is a review of cases from a cleft lip/palate centre and is focused on localised vertical relapse (or failure of eruption?) of the teeth in the cleft area following orthodontic treatment and bone grafting. Although
orthodontic relapse is a major problem in cleft lip/ palate patients, few studies have been undertaken to determine the causes of the vertical relapse. The etiology can be varied, for example, a loss or shrinkage of grafted bone, the type of bone or scar tissue. Much has been written about surgical relapse and collapse of the maxillary arch following orthodontics and orthognathic surgery.\textsuperscript{12-14} Timing of bone grafting should ideally coincide with the eruption of the maxillary canine to ensure stability. No studies have been conducted on understanding the physiology of the eruption of teeth through the bone grafts (autogenic/alloplastic).

Further longitudinal and cross sectional studies is required, using appropriate yardsticks (eg. Goslon Yardstick), and this research should include cleft centres.

CONCLUSION

The vertical relapse, in spite of good retention appliance wear, is possibly due to the failure of eruption of the teeth in the cleft area and may point to the need for an extensive revision in the retention appliance protocol to prevent an open bite vertical relapse. One or two re-treatment phases with fixed appliances are possibly required and patients should be so informed.

The failure of eruption of teeth in the grafted cleft area of the maxilla in the growing patients is a common observation in our cleft clinic. In view of this we have added a new retention protocol. In addition to the post orthodontic removable retainer a fixed bonded retainer is placed on all teeth adjacent to the cleft (the bonded retainer should be placed from one non-cleft area across the cleft to the other non-cleft area, incorporating two or three teeth on either side of the cleft). This precaution, whilst achieving some control, has not been observed to completely control vertical relapse. Further research is required to overcome the vexing question of achieving and maintaining vertical stability.

References


*The Wentworth Foundation, founded by Dr Surandar Singh, renders a free service to indigent cleft lip/ palate patients in the province of KZN. The Wentworth Foundation has been registered as an NGO and a Public Benefit Organisation. Website: www.wentworthfoundation.org.za
Managing sodium hypochlorite accidents: the reality of toxicity

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E Patel¹, M Gangadin²

ABSTRACT
Sodium hypochlorite (NaOCl) is the most commonly used endodontic irrigant due to its effective antimicrobial function and ability to dissolve organic matter. However, when NaOCl escapes from the root canal system, the cytotoxic effects are severe, regardless of the concentration used.

A case of undiagnosed external root resorption that lead to the extrusion of a 1% NaOCl solution into the periapical soft tissues is presented. This report considers guidelines and highlights the obligation of clinical practices to develop protocols for, and to maintain, the ability to manage and treat accidents involving NaOCl.

Keywords: Sodium hypochlorite accident, irrigation toxicity, tissue necrosis.

INTRODUCTION
The earliest reported use of sodium hypochlorite (NaOCl) was limited to stain removal in clothing. The first evidence of its use in endodontics was published by Coolidge and Crane in 1919 and 1920, respectively, long after it had been recognized in 1843 as an antimicrobial agent. NaOCl continues today to serve as an endodontic irrigant, its popularity stemming from its role in the dissolution of organic matter.¹² The hypochlorite ion irreversibly oxidizes enzymes, thereby terminating the metabolic activities of tissues or organisms it contacts. The reaction of NaOCl with lipids and amino acids in pulpal tissue leads to liquefactive necrosis within minutes.³⁷ There is no consensus as to the most effective concentration of NaOCl when used as endodontic irrigant, but an empirical concentration range of 0.5% to ≥5.25% is generally accepted.⁸¹⁰

ACRONYMS
NaOCl: sodium hypochlorite
NSAID: non-steroidal anti inflammatory drug

An increase in NaOCl concentration leads to an increase in cytotoxicity.¹¹

We present a protocol for the management of a NaOCl accident with an illustrative case.

CASE REPORT
A 70 year old female patient with a complex medical history presented to the Wits Oral Health Centre with a main complaint of ‘feeling an abscess in her front tooth’. Highlights from her medical history included hypertension, hyperlipidaemia, a peptic ulcer, an earlier angiogram and cardiac coronary bypass, a cataract in right eye, and a hypersensitivity to penicillin. She explained that for one week she had noticed pus draining from the gum area below her lower front tooth. She had no associated pain. Her dental history included multiple prior extractions due to caries and she wore a single maxillary complete denture constructed in 2001.

Extra-oral examination revealed bilateral masseteric tenderness. Intra-orally, only the six lower anterior teeth were present, all with generalized attrition. The right lower lateral incisor was tender to percussion and non-responsive to thermal tests. A buccal vestibular draining sinus with inflammation of the adjacent labial mucosa was found. Radiographically, widening of the lamina dura in the apical third of the tooth was observed. Root canal treatment was initiated for the lower right lateral incisor. The endodontic protocol of the clinic was followed and included rubber dam isolation, access cavity preparation using the Endo Access Kit® (Dentsply, South Africa), and extirpation using k-files. Irrigation was performed using a 1% NaOCl solution via a side-ported needle and syringe delivery. NaOCl was introduced into the coronal third of the root canal and thereafter advanced to the middle third. The patient reported severe burning with pain radiating down the neck following syringe withdrawal. As per protocol (Table 1) aspiration of the residual NaOCl was immediately attempted. Local anaesthetic (Xylocain E80-A) and saline were introduced to dilute the effects of the NaOCl as well as to assist with analgesia. A calcium hydroxide dressing (AH Temp®; Dentsply, South Africa) was inserted into the root canal after which a resin-
modified glass ionomer (Vitremer®; 3M, South Africa) was placed as a temporary restoration. An analgesic (Tramadol, 50mg, twice daily) and a steroid (Methlyprednisolone, 20mg, at night for five days) were prescribed. Antibiotics were not prescribed at this stage as major necrosis was not envisaged.

The patient was contacted telephonically in the first 24 hours and was clinically reassessed at 48 hours post-accident. Several signs and symptoms were observed including: pain, dysphagia, and a midline swelling in the neck extending down to the level of the hyoid bone which was tender to palpation (Figure 2 A,B). Intra-orally, buccal gingival necrosis was noted about 1cm in diameter and with a mildly erythematous border (Figure 3 A). Superficial sublingual necrosis, approximately 2cms in diameter, was also observed in the mucosa of the floor of the mouth (Figure 3B). At this stage, an antibiotic (Clindamycin, 300mg, twice daily for five days), coupled with a chlorhexidine mouthwash was prescribed. Clindamycin was chosen for this patient due to her penicillin hypersensitivity; and the twice daily regimen provides for better patient compliance than a 6-hourly dose.

The patient was recalled again eight days after the incident. She reported that whilst the pain had dissipated, her dysphagia had still persisted. Extra-orally, resolution of the neck swelling could be appreciated (Figure 2C, D). Intraorally, the buccal gingiva healed uneventfully (Figure 4A). The previously superficial sublingual necrosis advanced to an ulcer with the concomitant development of a second ulcer in the contralateral side of the floor of the mouth (Figure 4B). At this stage class III mobility was recorded for the lower right lateral incisor and canine. As outlined by the protocol in Table 1, these findings prompted consultation with a maxillofacial surgeon who further guided the management of this case, and the patient was assessed bi-weekly.

At eight weeks post-accident, the patient was re-examined and the panoramic radiograph displayed a radiolucent lesion, extending 20mm apical to the lower right lateral incisor, approximately 15mm in width (Figure 5). This finding, coupled with the persistent class III mobility on the lower right lateral incisor and canine led to both teeth being extracted. Four months later complete healing had taken place. The treatment plan was resumed and a mandibular partial denture was constructed.

### DISCUSSION

Sodium hypochlorite is the most commonly used endodontic irrigant worldwide and continues to be favoured as it remains the only material capable of dissolving organic tissue within the root canal system. Although NaOCl is regarded as safe for endodontic use, the cytotoxic results of mishaps and/or accidents must be highlighted. It is essential that clinicians are trained, and remain skilled and equipped, to deal immediately and effectively with any repercussions of a NaOCl accident.

The concentration of NaOCl required to efficiently disinfect the root canal system has long been a topic of debate. The Wits Oral Health Centre (Johannesburg, South Africa) employs a 1% NaOCl solution in its undergraduate endodontic clinic. The rational for this is: (a) comparatively lower concentrations are safer Table 1: Clinical Guidelines following NaOCl accident of the Wits Oral Health Centre (Adapted from Bosch-Aranda et al. 2012)

<table>
<thead>
<tr>
<th>Period</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately following extrusion of/ exposure to NaOCl</td>
<td>1. Aspiration of all possible NaOCl from site of entry</td>
</tr>
<tr>
<td></td>
<td>2. Local anaesthetic to assist analgesia</td>
</tr>
<tr>
<td></td>
<td>3. Saline to assist dilution of the irrigant</td>
</tr>
<tr>
<td></td>
<td>4. Tooth temporized with a calcium hydroxide intra-canal medicament and resin-modified glass ionomer restoration</td>
</tr>
<tr>
<td></td>
<td>5. Prescribe analgesics and anti-inflammatories (First choice is NSAIDS such as ibuprofen. If contraindicated then a steroid such as methylprednisolone and an opioid such as tramadol, where indicated)</td>
</tr>
<tr>
<td></td>
<td>6. Case evaluation by a maxillofacial surgical consultant</td>
</tr>
<tr>
<td></td>
<td>7. Patient must be advised to apply cold packs to facial region (to prevent/limit further swelling)</td>
</tr>
<tr>
<td>24 hours post-accident</td>
<td>1. Assess clinical sequelae of accident and severity</td>
</tr>
<tr>
<td></td>
<td>2. Antibiotics – prescribed on basis of anticipated necrosis</td>
</tr>
<tr>
<td></td>
<td>3. Chlorhexidine mouthwash</td>
</tr>
<tr>
<td></td>
<td>4. Patient must be advised to apply hot packs and rinse frequently with warm oral rinses (to stimulate local circulation)</td>
</tr>
<tr>
<td>7 days post-accident</td>
<td>1. Reassess clinical sequelae and severity</td>
</tr>
<tr>
<td></td>
<td>2. Maxillofacial consultation</td>
</tr>
<tr>
<td>14 days post-accident</td>
<td>1. Reassess healing to date</td>
</tr>
<tr>
<td></td>
<td>2. Continue with endodontic treatment (if healing satisfactory)</td>
</tr>
<tr>
<td></td>
<td>3. Alternate irrigants must be used (eg. EDTA, Chlorhexidine)</td>
</tr>
</tbody>
</table>

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**Table 1:** Clinical Guidelines following NaOCl accident of the Wits Oral Health Centre (Adapted from Bosch-Aranda et al. 2012)

**Figure 1:** Preoperative panoramic radiograph exhibiting the six remaining mandibular teeth

**Figure 2:** Comparative decrease in the neck swelling from 48 hours post-accident (A, B) to that of eight days after (C, D).
for use by novice clinicians, and (b) by increasing the volume of irrigant used, with regular exchange, the antimicrobial efficacy of lower concentrations of NaOCl solution is sustained. This case reinforces the fact that even at reduced concentrations, NaOCl retains potent cytotoxicity that demands extreme caution during use.

NaOCl extrusion beyond the apical foramen is an infrequent occurrence and is rarely reported. However, iatrogenic damage and/or pathologic processes such as root canal perforation, poor length control during canal preparation, and external root resorption favour this complication when their presence is undiagnosed. In this case, external root resorption in the apical third of the root canal, undetectable with routine two dimensional apical radiographs, permitted the exit of the NaOCl into the periapical tissue. The incident highlights the limitations of two-dimensional radiographs in endodontic diagnosis and preoperative assessment.

Figure 5: Panoramic radiograph following extraction of the lower right lateral incisor.

The commonly reported clinical sequelae following a NaOCl accident include: pain, ecchymosis, swelling, chemical burns and necrosis, ulceration, neurologic damage (paraesthesia and anaesthesia) and at times respiratory compromise. Multiple factors influence the progression of these clinical sequelae (Figure 6). The volume of NaOCl that enters the tissues and the clinician’s reaction time to recognize and initiate treatment protocols have perhaps the most critical influence.

Pain is a hallmark of tissue injury and was reported in this case within seconds of the accident. Swelling of the surrounding mucosa, subcutaneous tissue and skin occurred a few hours later. This inflammatory response originates from the reaction of hypochlorite ions with proteins and lipids resulting in soluble soap complexes that facilitate the permeation of the ion deeper into the tissue. This process complicates efforts to neutralize or dilute the NaOCl. Furthermore, tissue necrosis of the fascial spaces is not uncommon in cases of NaOCl extrusion and is a direct result of a chemical burn in the tissue.

In a review of clinical characteristics following NaOCl accidents, Zhu et al. (2013) observed reports of a higher occurrence of ecchymosis in the periorbital and angle of the mouth regions. According to their findings, the mode of spread was associated with anastomoses around the facial vein that permitted the rapid spread of the NaOCl solution. Minimal bruising/ecchymosis was observed in this case due to the anatomy of the sublingual fascial space.

Anatomically, the sublingual space is delineated by the mucosa of the floor of the mouth superiorly, the mylohyoid muscle inferiorly and the lingual surface of the mandible laterally. Its contents include the submandibular (Whartons) duct, lingual nerve, sublingual gland and the sublingual artery and vein. The space is divided in the midline only by loose connective tissue which explains the spread of the NaOCl to the contralateral side (from the sublingual region of tooth 42 of tooth 32). Furthermore, the mucosa of the floor of the mouth is classified histologically as lining mucosa - a thin, non-keratinized layer of epithelium with an underlying lamina propria. The friable nature of this tissue and its relative inability to act as an effective barrier against NaOCl further explains the chemical burns and subsequent ulcers that were encountered in both the right and left sublingual regions.

Antibiotics, analgesics and anti-inflammatory drugs are often prescribed following a NaOCl accident. The choice of drugs used for this case was selected based on the patient’s medical conditions. Although a non-steroidal anti-inflammatory (NSAID) is the first drug of choice to limit immediate swelling, a steroid (methylprednisolone) was prescribed in this case due to the patient’s intolerance to NSAIDS. In addition, the gastrointestinal side effects of the steroid were neutralized by the patient’s chronic medication - Omeprazole (20mg). Even though antibiotic prescription was based on the merit of each NaOCl accident case, and on the expectancy of moderate to severe necrosis of the affected tissue, it is still largely empirical.

In this case, the decision to delay prescribing an antibiotic was due to the clinician envisaging minimal to no tissue necrosis. However, following observation of the resultant buccal and lingual necrosis at the 48 hour recall visit this decision was revised to prevent the development of secondary infection. Clindamycin is the second drug of choice where patients are allergic to penicillin and was
prescribed as the preferred twice-daily dose to improve compliance over the 6-hourly dose.

Exigency is an important factor for the successful management of NaOCl accidents. The time taken by clinicians to recognize and diagnose the accident, and the immediate implementation of a NaOCl incident protocol have an influence on the severity and outcome of the clinical sequelae in the days that follow. The Wits Oral Health Centre follows a specific set of guidelines developed for the management of NaOCl accidents (Table 1). These guidelines emphasise the uniqueness of each case and that intervention or treatment decision is made on a case-to-case basis that relies on additional empirical input. The follow-up period varies based on the specific signs and symptoms that present in each patient during the course of the incident. In this case, the patient was recalled (in addition to the guidelines) at four weeks, six weeks and eight weeks post-accident. This was due to the persistent mobility on teeth 42 and 43, which were extracted at week eight. Healing of the extraction sites was uneventful.

**CONCLUSION**

NaOCl remains the irrigant of choice for endodontic treatment due to its ability to dissolve organic tissue and resultant antimicrobial activity. However, the cytotoxicity of the medication requires caution during clinical procedures. Not only is it imperative that undergraduate and postgraduate endodontic curriculums highlight the possibility of NaOCl accidents, the avoidance and the management thereof, but that clinicians remain skilled and equipped to deal appropriately and timeously with the repercussions of an accident.

**Conflict of Interest:** None declared

**References**


Maxillo-facial radiology case 152

SADJ July 2017, Vol 72 no 6 pxxx
CJ Nortjé

Below is a clinical picture and radiographic images of certain malignancies that may present in the salivary glands of the maxillofacial region. What are the important features and what are your diagnoses?

INTERPRETATION

Fig. A is a photograph of a 65 year old male patient presenting with a slow growing swelling of the parotid gland on the right side of the face, which he noticed about eight months ago. Sialography of the parotid gland (Fig. B) shows that contrast medium uptake is prevented by tumour formation, resulting in a poorly imaged right parotid gland (arrow). Fig. C is an axial CT of the same patient demonstrating an ill-defined tumour with an infiltrative margin, indicating malignancy. The right masseter muscle also lacks definition because of infiltration by a malignant tumour (red arrow). A diagnosis of an epidermoid carcinoma was made. The tumour was termed mucoepidermoid by Stewart et al in 1945, who considered it to be divided into benign and malignant types. The WHO regards this tumour as a lesion with malignant potential but believes that, in a variety of clinical instances, it is inappropriate to call any of these tumours “carcinomas”. The WHO consider this neoplasm to be intermediate between adenoma and carcinoma. Thirty percent of mucoepidermoid malignancies occur in the salivary glands and appear commonly in the 3rd to 4th decades. The sialogram in Fig. D shows irregular non filling defects suggestive of a malignant pleomorphic adenoma (malignant mixed tumour). The CT sialogram (Fig. E) of the same patient shows an ill-defined tumour mass (arrow). Pathologically, malignant pleomorphic adenoma results from the transformation of the epithelial tissue in a pleomorphic adenoma. These tumours occur predominantly in patients older than 50 years. The transverse T1 weighted MRI scan (Fig. F) of an adenocarcinoma of the right parotid gland shows a poorly defined, non-homogeneous, infiltrating mass (arrow). Adenocarcinomas most commonly involve the minor salivary glands and submandibular glands, accounting for 5% to 10% of salivary gland tumours. A break in the duct and leakage of contrast medium are sialographic signs of malignancy, and are usually found in epidermoid carcinoma, adenocarcinoma, and high-grade mucoepidermoid carcinoma. However, most of the malignant tumours have a low rate of malignancy.

Reference

Laser is the acronym for “Light Amplification by Stimulated Emission of Radiation,” a usage that dates back to approximately 50 years ago. In 1960, the first functioning laser was built by the American physicist Maiman at the Hughes Research Laboratories by using a synthetic ruby crystal made of aluminum oxide and chromium oxide. In general, lasers are composed of the three principal parts: an energy source, an active medium and a set of two or more mirrors that form a resonator. Properties such as wavelength are determined primarily by the active medium, which can be a gas, crystal or a solid-state conductor.

In orthodontic practice, lasers have many common applications, including acceleration of tooth movement, bone remodeling, enamel etching prior to bonding, debonding of ceramic brackets, pain reduction after application of orthodontic forces and prevention of enamel demineralization. Soft-tissue applications such as frenectomies, gingival contouring and crown lengthening can also be achieved using the dental lasers.1

The proper use of a laser in an orthodontic office can accelerate treatment, reduce the number and length of appointments needed, and provide superior results. Two types of lasers may be used in orthodontic practice: soft tissue surgical lasers, which are used to incise/excise tissue; and photobiomodulating (PBM) lasers, which decrease posttreatment discomfort, favourably affect bone growth rate, and accelerate tooth movement.

One primary consideration important to orthodontists would be the ability to effectively treat soft tissue while avoiding alteration of hard tissues. Additional considerations might be portability and cost. Manufacturers claim all wavelengths are capable of performing soft tissue procedures, but some wavelengths, such as those emitted by the erbium family of lasers (Er:YAG, Er:Cr:YSGG), are also promoted as suitable for hard tissue procedures. These lasers usually require water cooling, so they tend to be bulky and relatively expensive in comparison with lasers producing other wavelengths. Carbon dioxide (CO2) laser wavelengths are well absorbed by water, and because oral mucosa is more than 90% water, CO2 lasers are very effective soft tissue lasers. In addition, CO2 lasers often have a “superpulse” feature, providing relatively high energy in short spurts, offering a very efficient means to ablate soft tissue. On the other hand, CO2 lasers often are larger and more expensive than diode lasers which are currently available in four distinct wavelengths (810 to 830, 940, 980, and 1064nm). Neodymium-doped yttrium-aluminum-garnet (Nd:YAG) lasers (1064nm) emit energies that are well absorbed by haemoglobin and melanin, so these lasers work well for ablation of pigmented and vascular tissues such as oral mucosa. Diode lasers have a much shallower depth of penetration than Nd:YAG lasers and may be less likely to cause pulpal damage, making them an excellent choice in orthodontics. In addition, diode lasers tend to be the least expensive and most portable of lasers of all wavelengths—another considerable advantage in orthodontics.2

Many procedures can be done with a soft tissue laser in orthodontic practice, but most fall into two categories: access gingivectomies and aesthetic procedures.

Access gingivectomies involve exposing more tooth tissue for earlier or more ideal bracket or band placement. Aesthetic procedures involve removing redundant gingival tissues to optimize gingival aesthetics and to improve the appearance of completed orthodontic cases. In the performance of these procedures safely and efficiently, with the least discomfort for the patient, it is important to know what not to do. Three primary considerations should be kept in mind in performing soft tissue laser procedures: biologic width or zone, pocket depth, and keratinized...
tissue. For gingival aesthetic procedures, several additional diagnostic considerations are of importance as well: Access to partially erupted teeth, access to unerupted teeth, access for ideal bracket placement and enhancing access in gingival hyperplasia resulting from poor oral hygiene. Additionally lasers can be applied for other orthodontic procedures such as: labial frenum removal, lingual frenum removal and aphthous ulcer pain relief. (Aphthous ulcers can be extremely painful, and laser therapy can relieve pain and speed healing). The vast majority of laser procedures in an orthodontic office may be performed using topical anaesthesia. 

PHOTOBIOMODULATING LASERS IN ORTHODONTICS

PBM lasers by definition are nonsurgical—that is, they are incapable of cutting tissues. As their name implies, they use light (photo) energy to biologically modulate cellular functions.

Tooth movement during orthodontic therapy may cause patient discomfort both when the appliances are initially placed and when more force is placed on the appliances. PBM lasers have been successfully used to alleviate this pain. 

CONCLUSIONS

Lasers are considered as “light at the end of the tunnel” in dentistry. It has been proven that when used effectively and ethically, lasers can be an exceptional modality of treatment for many clinical conditions. There are many advantages of lasers which include improved oral hygiene and aesthetic finishing. An adjunctive procedure such as lasers can dramatically enhance the entire procedure in the practice of an orthodontist who is committed to provide the best possible service.

References
Comparison of alveolar osteitis with post implant removal osteitis.
(Can a “dry socket” occur after implant removal?)

MOTIVATION
The introduction of dental implants spawned an exponential growth in the number of fixtures being placed to meet the increasing functional and aesthetic demands of patients. In response, manufacturers have flooded the market with new, cheaper systems, and many general practitioners have begun placing implants to support restorations. Enhanced life expectancy means that implants placed in younger people are expected to function effectively over many years. Studies have shown that a certain low percentage of implants will develop early or late complications,¹ and that the risks are greater with increased usage.² It is thus anticipated that practitioners will be faced with increasing numbers of implant-related complications that will require appropriate management, or even implant removal.¹ Hence the majority of complications will be in older persons where healing may be compromised due to physiological ageing, systemic medication, or other age-related factors.³

The literature is replete with references of difficulties associated with implant placement, as well as reasons for implants requiring removal, but very little is mentioned on any problems following implant removal. Early removal is generally easy as the fixture will not yet have integrated with the surrounding bone. Late removal may be more difficult, especially if there are still areas of bony union, and could potentially result in trauma to the surrounding bone, similar to that seen after a difficult tooth extraction. It is thus postulated that a condition of post implant removal osteitis (it shall be referred to as PIRO in this paper) could develop, which may resemble post extraction alveolar osteitis (AO). If this is so it may be associated with implant placement, as well as reasons for implant removal, or other age-related factors.³

This paper provides a brief review of AO in terms of aetiology, pathogenesis, treatment, and prevention, as well as a brief overview of peri-implantitis (PI). It then explores reasons for implant removal and expands on the possibility that a similar condition to AO may be encountered post implant removal.

INTRODUCTION
Alveolar osteitis (AO)

This is a relatively common post-extraction complication resulting in inflammation of the extraction socket which is accompanied by intense throbbing pain within and around the extraction site.⁴ It begins within the first 24 hours after extraction, and increases in severity if left untreated.⁵ It is usually due to loss or disintegration of the blood clot in the base of the socket, with resulting accumulation of bacteria and food debris in the socket, and a distinctive malodour / halitosis.⁴⁶ Reported frequencies vary from <1% to 19.14%, with an average range of about 1.7% following non-surgical extractions to 15% after surgical removal.⁵

Aetiology
This is multifactorial and many factors have been reported to predispose to an increased risk of development of AO. They include procedures involving flap reflection, excessive grinding and removal of bone; tooth splitting leading to tooth and bone fragments remaining in the socket;⁴ flap design (especially in third molar surgery); poor oral hygiene; pre-operative infection; traumatic extractions causing compression of the bone lining the socket; thrombosis of underlying vessels;⁴ smoking which retards healing; increased age; systemic disorders; single extraction sites; extraction of impacted third mandibular molars as well as other mandibular teeth with thick cortical bone and / or poor blood networks;⁴ use of large amounts of local anaesthetics; intra-ligamentous injections; antibiotic use prior to surgery; difficult surgery, increased surgical time, or poor surgical techniques; the use of certain post-operative analgesics (specifically ibuprofen); previous osteomyelitis; extraction in irradiated bone; and post extraction irrigation with saline or water which interferes with blood clot

ACRONYMS
AO: alveolar osteitis
PI: peri-implantitis
PIm: Peri-implant mucositis
PIRO: photobiomodulating
formation, (recognising that accepted literature advocates socket irrigation to remove bone and tooth debris that could impede healing.) In females; the use of oral contraceptives containing oestrogen which affects coagulation; and extractions in the middle stages of the menstrual cycle are additional possible predisposing factors.

**Pathogenesis**

Fibrinolysis is a physiologic process whereby fibrin is laid down and then may be removed from the body by enzymatic digestion as part of ongoing healing and repair. Plasminogen is incorporated in the fibrin network as it forms. Later, lysis of the blood clot occurs due to the action of tissue kinases liberated during inflammation by direct or indirect activation with conversion of plasminogen to plasmin in the blood. Plasmin acts to dissolve the clot. Direct activators such as tissue and endothelial plasminogen activators are normally present. However, indirect activators such as streptokinase and staphylokinase, are produced by bacteria and bind to the plasminogen causing its activation to plasmin and speeding up the clot dissolution. This confirms the theory for bacterial involvement in AO development. The pain characteristic of AO is due to the presence of kinins within the socket. Many organisms have been cultured from infected sites including Capnocytophaga, Fusobacteria, Streptococci, Treponema, Actinomycetes, and other anaerobes. Many of these bacteria secrete pyrogens which are indirect activators of fibrinolysis. Infection results in the host producing high levels of serum-C reactive protein which increases the potential for dissemination of the infection, as well as disturbing alveolar repair processes.

**Treatment**

Treatment consists of irrigation, surgical curettage and antibacterial or analgesic dressing, with or without adjunctive antibiotics. Algoyl (benzoicaine, balsam of Peru and eugenol) is a commonly used dressing due to its immediate pain relief, low cost, ease of use and favourable outcomes. Various other medicaments have also been tested, such as zinc oxide eugenol (ZOE) on a gauze strip, thermosetting gels (2.5% pilocaine and 2.5% lidocaine), SaliCept, and pastille GECB (3% gualacol, 3% eugenol, 1.6% chlorobutanol). Plasma rich growth factors (PRGF) have also been used to speed up healing, but relief of pain is more effective with conventional ZOE gauze.

Recent studies show improved healing in those treated with curettage, irrigation and continuous mode diode laser irradiation. Antimicrobial photodynamic therapy (aPTDT) with HELBO Blue and TheraLite lasers may help decontaminate extraction sockets, and could be used for prevention and/or treatment of AO. If necessary, antibiotics may be prescribed, most commonly amoxicillin.

**Prevention**

The use of prophylactic antibiotics is controversial, given the hazards of unnecessary and over-prescription. It should be restricted to those with a history of AO or immunocompromised patients. While some authors advocate prophylactic use of azithromycin, penicillin, clindamycin, erythromycin and metronidazole, other investigators found no difference between patients given prophyllactic amoxicillin to those without antibiotic cover. The placement of sutures and haemostatic agents prolongs operative time, a predisposing factor. The use of chlorhexidine (0.12 – 0.2% concentrations) as a pre-operative irrigant and post-operative mouthrinse has been shown to significantly reduce the incidence of AO. More recent studies have investigated various topical gels such as “gelatamp” (colloidal silver impregnated sponges), parahydroxybenzic acid, tranexamic acid, polymer polyactic acid, and chlorhexidine gel (0.2%) to help prevent AO. Results were inconclusive for most except chlorhexidine gel, which was found to remain the best medicament for prevention of AO. Ultimately, one of the most critical preventive measures is the maintenance of a sterile surgical environment.

**OVERVIEW OF PERI-IMPLANT MUCOSITIS AND PERI-IMPLANTITIS**

**Aetiology**

Peri-implant mucositis (Pm) is a reversible inflammation of the soft tissues surrounding a functioning osseointegrated implant with no loss of the supporting bone. Peri-implantitis (Pi) is an inflammatory process affecting the tissues around a functioning osseointegrated implant resulting in the loss of supporting bone. Clinically Pm presents with bleeding on probing with/without suppuration, and probing depths of 4-5mm. Pi has deeper probing depths and progressive supporting bone loss beyond biological bone remodelling. Pain is seldom a feature of either disease, and progression is usually slow. Patient risk factors include poor oral hygiene; design of the overlying prosthesis (which may hamper good oral hygiene practices); lack of keratinised mucosal attachment which predisposes the soft tissue to mechanical damage and plaque accumulation; history of previous periodontitis; failure to follow a regular maintenance programme; genetic traits influencing host inflammatory responses; diabetes; smoking; and alcohol consumption.

Surgical and prostodontic implant risk factors include implant site (both anterior mandible and anterior maxilla have been associated with increased risks of Pi associated bone loss); implants placed too deeply or too close to each other, with overcompression of adjacent bone; insufficient irrigation during placement; immediate placement and immediate loading; microgaps at the bone level; residual cement in peri-implant tissues; over-contoured or poorly designed prostheses which prevent adequate oral hygiene; occlusal overload; full rehabilitation as opposed to single crown replacement; foreign body reactions to certain metallic components; and restorations which are carried out by general practitioners as opposed to specialists. Neither different flap designs nor implant surfaces had significant effects on the development of Pi, whilst platform switching is believed to reduce its incidence.

**Pathogenesis**

Marginal bone loss is mainly due to bacterial infection and is mediated by biofilms similar to that in natural dentition. The host responds to this biofilm on the implant surface by a series of inflammatory reactions, initially confined to the soft tissues, but later progressing deeper. Deep pockets around the implant create favourable anaerobic environments for periodontal pathogens, but these micro-organisms may not be solely responsible for the initial bone resorption. Often there are underlying implant, patient or clinician related factors that initiate the inflammatory process, which is later exacerbated by bacterial infection. Following the initial inflammatory process, certain immune cells (macrophages, neutrophils, lymphocytes and plasma cells) provoke tissue damage. Pro-inflammatory cytokines in the form of interleukins and tumour necrosis factor are upregulated, and enhance the inflammatory response leading to tissue damage. Once the soft tissue peri-mucosal seal has been compromised, bone destruction usually follows.

**REASONS FOR IMPLANT REMOVAL**

Dental implants may develop a variety of biological or
biomechanical complications. These include inflammation and infection of the surrounding soft tissues, severe bone involvement and loss, and structural or mechanical failures. There is no clear consensus on how to treat a failing implant. If it is due to bacterial-host responses, conservative debridement with antiseptics and adjunct antibacterial drugs is a first line approach. More severe bone loss requires more invasive surgical approaches combining implant surface decontamination with guided bone regeneration procedures.\(^\text{31}\) Implant removal may be needed in cases of persistent infection; significant bone loss; pain, fractures, incorrectly positioned implants that cannot be restored, implant mobility, lack of bone coverage, advanced gingival recession with implant thread exposure, and fractured screws that cannot be retrieved.\(^\text{32}\) Fractured cross headed screws are almost impossible to remove and may result in the need to remove the entire implant, despite it being fully integrated.\(^\text{33}\)

Reports have shown that just under 1% of implants placed could fracture, especially in partially dentate cases, and in posterior regions where occlusal stresses are the highest.\(^\text{2}\) Later studies\(^\text{34}\) showed that these fractures were mostly due to metal fatigue as opposed to material corrosion. Depending on the level of the fracture, most of these implants are unrestorable and need removal. A fractured implant, or one with a fractured screw, may still be fully integrated, thus removal procedures could be potentially damaging to surrounding bone, increasing the risk of PIRO.\(^\text{32}\)

Various instruments may be used to remove a failing implant, and selection should be based on those which will produce the least tissue damage. Unfortunately, if there are areas where the implant remains tightly integrated, the surrounding bone is often compromised in the process.\(^\text{32}\) This may lead to complications, one of which occurred on a patient treated at the University of Pretoria Oral and Dental Hospital. This patient developed a localized osteitis following implant removal. The site (“socket”) was treated conservatively following the protocol used for AO, and healing was uneventful.

**COMPARISON OF AO AND PIRO**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Alveolar Osteitis</th>
<th>Post Implant Removal Osteitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction procedure</td>
<td>Extractions with flaps raised</td>
<td>Flapless</td>
</tr>
<tr>
<td></td>
<td>Tooth splitting &amp; tooth contamination of socket</td>
<td>Trophes result in metallic contamination and foreign body reactions</td>
</tr>
<tr>
<td>Site</td>
<td>Third molar Single extraction sites</td>
<td>Anterior maxilla and anterior mandible; Cases with multiple implant sites; Partially dentate patients</td>
</tr>
<tr>
<td>Host response</td>
<td>Inflammation Initial response is due to biofilm on implant surface</td>
<td></td>
</tr>
<tr>
<td>Bone situation</td>
<td>Areas of thick mandibular cortical bone</td>
<td>Deeply placed implants &amp; implants close to each other Retrograde peri-implantitis</td>
</tr>
<tr>
<td>Anaesthesia</td>
<td>Intraligamentous injections</td>
<td>Peri-implant injections</td>
</tr>
<tr>
<td>Organisms</td>
<td>Must still compare Most anaerobes</td>
<td>Mostly anaerobes</td>
</tr>
<tr>
<td>Presentation</td>
<td>Pain, malodour May have pain</td>
<td></td>
</tr>
<tr>
<td>Surrounding tissue</td>
<td>Surrounded by keratinised mucosa</td>
<td>Surrounded by non-keratinised mucosa</td>
</tr>
<tr>
<td>Predisposing factors</td>
<td>Underlying patient and dental factors Underlying patient, implant, clinician and biomechanical factors</td>
<td></td>
</tr>
</tbody>
</table>

Implants are very different to teeth in that the surrounding soft and hard tissues are both devoid of an independent blood supply. This results in reduced immunological defences against injury. Furthermore there is a weaker mucosal seal as there are fewer attachment fibres around implants which run more vertically and attach to the alveolar crest, as opposed to the larger amounts of horizontally oriented Sharpey’s fibres which attach to a tooth’s cementum.\(^\text{35}\) There is merely an abutting of soft scar-like connective tissue against the implant surface. The resulting weaker peri-mucosal seal around implants allows for easier bacterial penetration. Despite this, these conditions are remarkably similar, with few notable differences (Table 1).

**CONCLUSIONS**

Despite differences, many similarities support the notion that PIRO is clinically similar to AO and thus preventive and treatment strategies should also be similar. The final message for clinicians is that they should be alert to patients and situations where there is an increased risk of developing PIRO. These include implant removal in older patients, females, partially dentate cases, fractured components, deeply placed fixtures, immunocompromised hosts, and those where removal has resulted in traumatic bone injury. It is advised that immediate implant replacement be not carried out in these cases as subsequent osseointegration may be complicated by the development of PIRO. A replacement implant should only be considered after soft tissue closure, with complete resolution and healing of the site. This can be verified by a periapical radiograph, and will also reveal whether further bone grafting is needed before a new implant is placed. Proceed with caution as this patient would already be classified as high risk for complications.

**References**


This article, with the additional references (10 - 35), is available on request as a separate pdf document.
“In my mouth”: Part 11:
Ethical concerns regarding dental over-treatment and under-treatment.

INTRODUCTION
Dental practitioners have been accused of over-treating, failing to treat, or delaying treatment. However, deciding precisely on what constitutes each is not easy or clear cut, and it is often hard to draw a distinct line between necessary treatment and over- or under-servicing. Every dentist will have a different opinion depending on his/her training, clinical perspective, philosophy towards intervention, facilities and personal viewpoints. Much like beauty, this obscurity makes each difficult to define, yet “we all know it when we see it”.

Overservicing
This may take the form of any unnecessary, inappropriate, excessive or fraudulent treatment. It includes supplying, administering or prescribing any diagnostic test, medicine, medical device or therapy which is not indicated, unnecessary or inappropriate to the circumstances, or which is not in accordance with recognised protocols and procedures. Over-servicing may also involve increasing the number of procedures provided per patient per course of treatment over and beyond the quantity needed to achieve oral health. Not only is this unethical, but it also constitutes a breach of the integrity of the profession. The main motive is usually financial gain. It may be driven by a need to compensate for low medical aid tariffs, a reduction in item fees, delayed payment from funders, high telephone bills arising particularly from calls to medical aids for authorisation, increased medical aid subscriptions and subsequent decreased membership, the weakening economy, oversupply of dentists, increasing costs of materials and equipment and high practice overheads.

In these situations, “over-servicing may occur because treatment decisions are based on the economic needs of the dentist rather than the clinical needs of the patient”. Over-servicing may also be unintentional, due to professional factors. Clinicians may have out-dated philosophies, inadequate clinical skills, have not maintained their knowledge on current evidence-based approaches, lack diagnostic ability, have no clear criteria defining standards of care, or may have differing clinical opinions. This may result in their carrying out invasive and dated procedures when current preventive measures may have been better. This highlights how imperative it is for clinicians to regularly attend continuing education courses.

Over-servicing tends to occur more in patients with few restorative needs where dentists feel that in order to make their work financially worthwhile they have to do a minimum number of procedures per patient session. Naegele et al (2010) found this to be on average 3-4 fillings in patients with low treatment needs and 1-2 fillings in those assessed with no actual need. Very often it is the basic services that are exploited as these are more difficult for medical aids to regulate. Examples include refilling of minimally jagged sealants, cosmetic replacement of amalgam restorations, radiographs (especially panoramic) taken with no clinical justification, scaling and polishing on patients with no visible plaque, extraction of asymptomatic third molars, and replacement of restorations with crowns. On the contrary, the research found that in patients with greater requirements there was less disparity between need and treatment provided. This may be because dentists feel less compelled to over-treat or they carry out more complex (thus higher paying) procedures. Clinicians may also be tempted to over-service patients who arrive in and around the times when there have been last minute cancellations by another patient, in order to compensate for perceived lost clinical time and earnings.

Note: Issues such as charging for a three-surface filling when only one surface was restored is not over-treatment. This is pure FRAUD!

More subtle forms of over-servicing may result from dentists campaigning for patients by promoting...
themselves or their services. This may be via practice advertisements, brochures or web-based posts. It is often accompanied by the use of personal superlatives such as “the best” “top-class” “word-famous”. This form of touting along with the promotion of specific products, use of actors or patient testimonials, fear-mongering, and indirect defamatory comments about competitors is unethical and is prohibited by the HPCSA.6

Patient-initiated demands for cosmetic rehabilitation may also lead to over-treatment when dentists “exploit human vanity and ignorance of dentistry and its less costly, more biologically acceptable alternatives”.5 In addition to raising the costs of care, this form of treatment often has very few oral health benefits, and may even be detrimental in the long-term.5 Other patients seek treatment to “use up their medical funds”. They often ask for purely cosmetic procedures such as bleaching, veneers and replacement of amalgams with tooth coloured restorations, yet there is no actual requirement for these. Many of these cosmetic procedures are not covered by medical aids, and as a result the patients often end up with more extensive (and destructive) restorations such as full coverage crowns which are covered by their funders. They generally have little knowledge of the possible detrimental consequences of these treatment modalities, or are blinded by the brilliance of their shining new A1 smiles! A dentist who conceives to these unwarranted requests could be guilty of over-treating.

Over-servicing, irrespective of the reason, is ethically and legally wrong, and results in conflicts of interest among the patient, the dentist and the medical funder. However, there is no “gold standard” “to use for assessing need or determining the necessity of the intervention.”4

Perhaps, rather than trying to formulate a classification or definition, it can simply be stated that over-treatment is any treatment that has no remediable qualities.1

While some people may be considered to have “Motor Mouths”, that is still no reason to over-service them!

UNDER-TREATMENT

Not providing treatment is the exact opposite situation, and is far less often discussed or elucidated. Clinicians may be accused of failing to treat, delaying treatment, of supervised neglect or planned inactivity.9 There may be subtle differences and explanations for each, making recognition more complex to determine from a clinical examination alone. Supervised neglect refers to “the situation where a patient’s oral health has been allowed to deteriorate over a period of time, in spite of regular attendance at the dentist for treatment and care”.2 This may be due to many reasons. Dentists may be less attentive to patients’ needs if they are under stress, unwell physically or mentally, have not realised their own deteriorating eyesight, are too busy, are understaffed, or have matured with their patients and both become accustomed to settling for minimal intervention dentistry.2 Multiple cases of supervised neglect may be seen in the practices of newly retired practitioners after they leave. The patient pool is usually taken over by a new colleague, who will look at all patients with “fresh eyes and without the benefit of knowing their past history”2 nor the circumstances under which the work was carried out. It is common for dentists to be more critical of the work done by others than they are of their own. For example, they may be quick to criticise a less than perfect restoration without knowing that the previous dentist had been monitoring it over the years, and left it untreated because it was deemed to be stable. It’s also tricky deciding whether and how to inform such patients as their responses are unpredictable. The patient may see it as a sign that the previous dentist was negligent, or the exact opposite and suspect that the new clinician is trying to over-service them!

This is not the same as that situation where a patient’s oral health has deteriorated due to their own lack of effort or concern despite of the dentist’s best efforts to intervene. This makes it crucial for dentists to keep accurate records which would highlight that they had identified the problems; carried out the necessary investigations needed to make a proper diagnosis; formulated a treatment plan with options; identified any associated risk factors that may have contributed to the poor oral status; informed the patient about the condition and how it could be improved; explained whether treatment had been offered; and had noted how monitoring had been conducted. Many times this is done but not documented.2 Even informal treatment discussions with more familiar patients should be entered into their records.

Another situation that may lead to “supervised neglect” is that of patients who frequently present at unscheduled times with dental emergencies. They tend to get treated with patch-work dentistry, and never progress to having definite pro-active treatment plans formulated or completed.2

Similarly if a patient declines treatment for whatever reason, this should be recorded, as well as late / repeated cancellations or failure to arrive for scheduled appointments. It is good practice to always offer such patients an alternative date and document this, so they cannot later claim that the dentist could never fit them in. Appointment books are seldom useful to defend supervised neglect on the grounds that the patient had repeatedly cancelled, as many times names are written in pencil and erased to accommodate changes. Clinicians must also take note there is a difference between a patient who actively declines treatment and one that they “assume would not be interested”. The latter poses a risk of being undertreated if the dentist never actually asks or confirms their suspicions.

Finally there is the issue of under-treatment due to cost barriers. Is this neglect? Many patients who cannot afford treatment don’t ever go to a dentist, so their needs will not be detected. However what about those who do present with urgent and / or necessary needs, but who cannot afford the recommended procedures. Is it neglect to make a decision not to treat based on economic grounds? It surely goes without saying that no patient can be turned away while still in pain, but what are the dentist’s obligations legally and ethically beyond this?

ETHICAL PRINCIPLES

Hartshorne and Hasegawa presented an excellent overview of the ethical issues and moral rules related to over-servicing which is well worth re-visiting.5 They stressed...
that clinical ethical decision-making requires practitioners to be constantly judging themselves, asking questions such as: Would it be unethical not to do this treatment, and could that inactivity result in any harm? Will the treatment benefit the patient? Is the decision to treat being governed by financial incentives? Has the patient been educated as to the risks, benefits and consequences of treatment? Has the patient given informed consent? Thereafter they should select the choice of action that best answers all of these questions and that is in the best interests of the patient.

CONCLUSION
Assessing need and suitability of treatment is a complex issue based on differing opinions, dental and patient-related factors, and always carries with it an element of subjectivity. Not only do opinions vary, but there may even be individual inconsistencies when the person commenting is also responsible for providing the treatment as opposed to when they are only evaluating need. Personal financial gains, business profits or economic survival can never justify over-servicing. At the same time, the risks of neglect are minimised if all patients are presented with an accurate diagnosis, a list of possible treatment options, a recommended plan, time and cost implications, and alerted to the risks and benefits of each option. They must also be afforded the opportunity to accept or decline the proposed treatment based on an educated understanding of the consequences of their choice. Ultimately, regardless of the circumstances, all clinicians have an ethical duty to provide the best and most appropriate treatment for their patients, based on current thinking and up-to-date knowledge of diagnostic and therapeutic interventions, keeping the patients best interests as the driving motivation behind their actions (or planned inactivity).

Perhaps the ultimate deciding factor in each situation is for the clinician to ask themselves "What would I do IN MY MOUTH?"

REMEMBER
Treatment-based Guidelines of SADA state:
“The Dental Association respects the clinical freedom and judgement of every practitioner to institute whatever treatment he or she considers appropriate in given circumstances, provided it is based on a sound clinical diagnosis and the patient is given informed choice regarding the treatment options available”.7

References
Recent data from the International Diabetes Federation (IDF) estimates that 7% of South Africans between the ages of 21 and 79 years have diabetes. Based on the latest population estimates for South Africa, this means that 3.85 million South Africans in this age group may have diabetes. However, these statistics only shed light on the surface of a much deeper problem. To fully appreciate the current statistics on the prevalence of diabetes in South Africa, one needs to look back. In 2010, the prevalence of type 2 diabetes in South Africa was estimated at 4.5%. Thus, a 155% increase in six years!

The majority of people with diabetes can be classified as having Type 1 or Type 2. Type 1 diabetes is an autoimmune disease, whereby tissues are attacked by the body’s own immune system. The condition tends to occur at a younger age and it is essential that it is treated with insulin. Type 2 diabetes is eight to nine times more common than Type 1. It occurs as a result of a combination of lack of response to insulin (insulin resistance), and a lack of insulin production. It tends to occur in later life and in the early stages may be treated with oral medication.

Both Types 1 and 2 diabetes have been associated with many oral diseases. Observational studies have suggested diabetic links with periodontal diseases (including peri-implant disease), caries (with its risks of tooth loss), oral mucosal disease (including oral infections), oral cancer, salivary dysfunction and oral dysaesthesias, including taste disturbances. However, with all the studies investigating these associations there has been little consensus with respect to the overall effect of diabetes mellitus on oral health and vice versa. D’Aiuto and colleagues undertook a rapid review of articles published between 2005 and 2015, investigating the relationship between diabetes and oral health. A rapid review is a synthesis of the most current and best evidence to inform decision-makers. It combines elements of systematic reviews with a streamlined approach to summarise available evidence in a timely manner.

**REVIEW METHODS**

A search strategy was developed using syntax and MeSH terms for three electronic databases: Cochrane, PubMed, OVID (Embase, MEDLINE [R] and PsycINFO). Inclusion criteria were systematic reviews/meta-analyses involving diabetes and oral health, published in the ten-year period, involving human research and requiring that the full text be available in English. Only systematic reviews and/or meta-analyses of observational and experimental studies were included in the final results. Two independent searches were undertaken, screening papers by title and abstract for relevance and duplication. Each researcher reviewed their search results and excluded papers that were not systematic reviews/meta-analyses, were not related to diabetes and any aspect of oral health, and were not available in English despite contacting the authors. After the final selection the searches were combined and duplicates removed. The researchers discussed all papers before final agreement on those which were to be included for the rapid review.

The following information was extracted from each paper: author; year, title, population studied, oral disease/intervention, definitions used, methods, comparison/intervention and controls, outcomes, results, authors’ conclusions, quality and quality justification; all shown in the data extraction table. From a total of 2,406 papers initially identified, there were 30 articles identified by the review for inclusion. Quality assessment was undertaken for each systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and AMSTAR (Assessing the Methodological Quality of Systematic Reviews) tools to ascertain risk of bias. An AMSTAR assessment was carried out on all papers with the methodological quality of the review being rated as ‘High’ with a score between 11 and eight, ‘Moderate’ between seven and four, and ‘Low’ between four and zero. The quality of all papers was confirmed by
group discussion. Of the 30 systematic reviews, 12 were deemed to be of high quality, 14 of moderate quality and four were of low quality. Common AMSTAR quality issues were a) lack of an a priori design or question, b) no quality appraisal, c) missing tables, and d) no duplicate study selection.

Within the theme identified by this review, reviews related to investigation of a) glycaemic control and periodontal therapy and b) the risk of oral cancer in patients with diabetes were considered of high quality, while articles on the association between dental implant therapy, osseo-integration and diabetic neuropathy, with oral diseases or therapy were of low quality.

RESULTS
The results were reported in nine sections, each relating to an oral disease or condition investigated. Each section contained evidence of any association between the oral disorder and diabetes and also on the impact of oral therapy on diabetes and diabetes management on oral health.

1. Periodontitis and diabetes
There is high quality evidence that diabetes (Type 2) is a risk factor for periodontitis. There is some moderate quality evidence that while the extent of periodontitis, that is, percentage of surfaces/sites affected is similar between patients with or without diabetes, measures of severity including greater clinical attachment loss and pocket probing depths are greater in patients with diabetes. Patients with diabetic complications, most specifically diabetic neuropathy, appear to have poorer oral health, including periodontitis, than those without neuropathy. However, there is little evidence that the presence of periodontitis: a) promotes development of Type 2 diabetes and b) adversely affects glycaemic control and diabetes complications in patients with diabetes.

In summary, the authors found that while there is strong evidence that diabetes is a recognised risk factor for periodontitis, more research was needed to ascertain the impact of periodontitis on the development and progression of diabetes.

2. Periodontal therapy and glycaemic control
One high quality Cochrane systematic review provided evidence that in patients with Type 2 diabetes, intensive periodontal therapy involving scaling and root planning reduced HbA1c (a marker of glycaemic control) by 0.29% (3.4 mmol/l) for up to three months; however, after six months there was no evidence that this reduction was sustained. Modest improvements in glycaemic control, as demonstrated by a reduction in Hb1Ac, were supported by seven other moderate quality systematic reviews.

One of the reviews reported evidence that after three months follow-up, periodontal treatment substantially lowered Haemoglobin A1c (HbA1c), compared with no treatment (-0.36%, 95%CI: 0.52% to 0.19%, P <0.0001). These findings were accompanied by substantial and statistically significant reductions in pocket probing depth (PPD) and clinical attachment loss (CAL) between study groups (PPD 0.42 mm, 95%CI: 0.60 to 0.23, P <0.0001; CAL 0.34 mm, 95%CI: 0.52 to 0.16, P = 0.0002). Consistent with the 2015 Cochrane review, there was no substantial change of HbA1c levels after six months.

In summary, it was found that there was merit in performing periodontal therapy in patients with Type 2 diabetes with regards to a short term improvement in metabolic control. Further research was needed to demonstrate that this benefit is sustained over longer follow-up and translates into reduction of diabetes complications.

3. Periodontal therapy and systemic/surrogate markers
One high quality review suggested that periodontal treatment reduced markers of systemic inflammation in patients with diabetes ie: serum levels of TNF-α and CRP. Another review reported no significant improvements in lipid fractions (total cholesterol, triglycerides and high and low density lipoprotein cholesterol [TC, TG, HDL, or LDL]) in patients with diabetes and chronic periodontitis who received scaling and root planing (SRP).

Lastly, five different reviews suggest that different types of periodontal treatment: surgical or non-surgical, with or without the use of adjunctive antibiotics, antiseptics, or oral hygiene instructions do not appear to produce different effects on glycaemic control in patients with diabetes.

4. Tooth loss and diabetes
Patients with diabetic complications, most specifically diabetic neuropathy, appear to have more tooth loss than those without neuropathy. This finding is consistent with the view that diabetes and its complications are associated with poorer oral health.

5. Caries and diabetes
Conflicting evidence on the association between diabetes and increased prevalence of caries was found. Greater levels of dental plaque were noted in patients with diabetes and this may have implications for future risk of caries. Furthermore, children with Type 1 diabetes are at increased risk of periodontal diseases as evidenced by greater dental plaque levels, gingival inflammation and bleeding.

6. Dental implants and diabetes
There is limited evidence that poor metabolic control is associated with peri-implant disease and weak evidence of higher marginal bone loss around dental implants in patients with diabetes with unspecified metabolic control. There is equivocal evidence that patients with diabetes have higher failure rates of dental implants and no evidence that diabetes is a contraindication to dental implant placement; however, some evidence supporting a delay in implant osseo-integration based on glycaemic control, was identified.

7. Oral surgery and diabetes
While there is evidence that people with diabetes are more likely to suffer complications of surgery in other areas, specific evidence that diabetes is associated with post-operative complications in the oral cavity is lacking.

8. Oral squamous cell carcinoma and diabetes
A high quality systematic review suggests that Type 2 diabetes is associated with an elevated risk of oral cancer and precancerous lesions. Patients with Type 2 diabetes have a higher case mortality on diagnosis of oral cancer, independent of tobacco, alcohol and obesity factors with a relative risk of 1.41(95%CI: 1.16–1.72) when comparing patients with diabetes to people without diabetes, with no evident heterogeneity among studies.
9. Saliva and diabetes
Patients with diabetes complications, most specifically diabetic neuropathy, appear to have greater mouth dryness than controls. There is limited evidence on the role of diabetes in increasing the risk of salivary dysfunction. There is some recent, limited and weak, evidence that salivary protein markers may be used to monitor glycaemic control accurately as a less painful alternative to capillary blood glucose measurements.

CONCLUSIONS
The evidence reviewed to form the conclusions for this rapid review demonstrated that there are oral manifestations of diabetes, including effects on oral health, notably periodontitis, oral cancer risk, and that diabetes may affect the success of dental implants. More evidence is required before advising clinicians of any contraindications to perform implants in diabetic patients. There is strong evidence of Type 2 diabetes being a risk factor for periodontal diseases and weak evidence in relation to Type 1. There is weak evidence in relation to dental caries experience in children. Limited evidence exists of periodontitis being a risk factor for diabetes; however, there is a growing body of evidence that professional periodontal treatment (that is, scaling and root planning as a minimum) results in a modest improvement in glycaemic control in the short-term but this is not sustained beyond three months.

IMPLICATIONS FOR PRACTICE
The current evidence suggests a number of associations between oral diseases and diabetes. There is limited evidence to support major changes to medical or dental therapy; however, regular periodontal/oral care may benefit glycaemic control in patients with periodontitis and diabetes. At present, diagnosis of diabetes should not require a change to dental therapy, such as restricting use of dental implants. Greater awareness of the impact of diabetes on oral health and vice versa is needed among medical and dental health professionals.

Reference


Middha M, Sangwan P, Tewari S, Duhan J.

Pain is a common adverse effect of endodontic treatment. Postoperative pain is usually attributed to mechanical, chemical and microbial causes.1 The bacterial flora is also primarily responsible for pulpal and periradicular diseases. Thus, eradication of bacterial population from the root canal or at least its significant reduction is essential for the successful management of endodontically involved teeth.1

Mechanical instrumentation techniques, in isolation, are incapable of rendering the root canals free of bacteria. The intricacies of the root canal system hinder its complete debridement as these areas are inaccessible to mechanical instrumentation and continue to harbour bacteria, necrotic tissue and debris. Thus, irrigation forms an integral part of chemo-mechanical preparation by facilitating the removal of bacteria, debris and necrotic tissue, especially from areas beyond the reach of root canal instruments.1 Sodium hypochlorite is by far the most widely accepted root canal irrigant because of its pronounced antimicrobial activity and ability to dissolve organic matter, but its efficiency in root canals is limited by a number of factors. First, conventional syringe irrigation techniques deliver solutions no more than 0–1.1 mm beyond the needle tip, thereby limiting irrigant penetration.1 Canal intricacies further limit the penetration of irrigant solution.1 Also, vapour lock that results due to air entrapment in the apical third of root canals hinders the exchange of irrigants and affects their debridement efficacy1 and studies have demonstrated that root canals still have detectable levels of cultivatable bacteria following chemo-mechanical procedures using sodium hypochlorite as an irrigant.1 As a consequence, various supplementary approaches have been proposed to improve the distribution and exchange of root canal irrigants. One such technique is ultrasonic activation of the root canal irrigant.

There are two methods of delivery of the irrigant during ultrasonic activation: continuous and intermittent flush. During intermittent flush, a syringe is used to inject the irrigant into the root canal, after which the irrigant is activated by an ultrasonically oscillating instrument. Nascent chlorine, which is the active component responsible for tissue dissolving and antimicrobial action of hypochlorite, is consumed rapidly in such a case.1 Further, the amount of irrigant that is activated is small, thereby limiting its debridement efficacy.1 It is, therefore, conceivable that those methods of delivery which provide continuous replenishment of root canal irrigant may be more efficient. Middha and colleagues from India1 reported on a randomized controlled trial that sought to compare postoperative pain after the use of continuous ultrasonic irrigation (CUI) and of syringe irrigation (SI). The null hypothesis tested was that there is no significant difference in postoperative pain with the use of either of the irrigation protocols.

MATERIALS AND METHODS
Patients with mature permanent, mandibular molars with non-vital pulps and radiographic evidence of apical periodontitis were included. Exclusion criteria included patients younger than 18 years of age, pregnant, diabetic, immunocompromised, previously accessed teeth, teeth having subgingival caries, teeth which were difficult to isolate,
history of antibiotic consumption within past month, history of analgesic intake within the past 24 h or teeth in which vital tissue was encountered on accessing the pulp chamber.

Patients were randomly assigned to one of the two groups based on the irrigation protocol: continuous ultrasonic irrigation and syringe irrigation. An equal proportion allocation ratio was followed, and envelopes containing concealed codes were assigned sequentially to the eligible patients. It was ensured that both the patient and the operator were unaware of the treatment protocol assigned until completion of chemo-mechanical preparation.

Endodontic procedure in all the patients was performed by a single operator using a standard protocol, under local anaesthesia and with rubber dam isolation. Coronal enlargement was performed with low-speed Gates-Glidden drills of size 1–3 to obtain straight-line access to the apical third of root canal. The working length (WL) was determined with an electronic apex locator at a length at which the flashing bar was between ‘APEX’ and ‘1’. It was then confirmed radiographically to verify that the file tip was within 0.5–1.5 mm of the radiographic apex. The canals were enlarged three sizes larger than the first apical binding file at the WL with a 0.02 taper stainless steel hand files, followed by the step-back technique with each successively larger file placed 0.5 mm coronal to the previous one. Canal patency was maintained by passing a size 10 stainless steel file 0.5–1.0 mm beyond the WL. In both the groups, the canals were irrigated with 5 mL of 5.25% sodium hypochlorite (NaOCl) solution after every hour in the event of pain. They were also instructed to take only one tablet, if needed, within the 0–4 hour time interval after the treatment and then one every eight hours in the event of pain. They were also requested to keep a record of their analgesic intake. The pain score chart was collected at the second appointment scheduled after one week.

In the CUI group, the Proula PiezoFlow (Dentsply) was used for activation of the irrigating solution according to manufacturer’s recommendations. The needle was operated using Satelec P5 Piezoelectric Ultrasonic Unit at power setting of five. The stopper on the PiezoFlow needle was set 1 mm short of binding in the canals, but no more than 75% of the working length. A syringe containing 15 mL of 5.25% NaOCl was attached to the Piezoflow activation needle and the inactive needle was inserted in the canal, and irrigant flow was started before activation. During activation, the needle was moved up and down passively in the canal, whilst maintaining the insertion depth to the stopper setting. In the SI group, canals were flushed with 15 mL of 5.25% NaOCl using a 27-gauge needle placed 2 mm short of working length.

After final irrigation, the canals were dried with sterile absorbent points and filled with calcium hydroxide paste using a lentulospiral. The tooth was then temporarily restored with Intermediate Restorative Material (IRM, Dentsply).

A visual analog scale (0–100 mm) was used to evaluate pain levels. The VAS was thoroughly explained to the patients, who were then instructed to place a mark on the horizontal VAS line corresponding to the level of preoperative pain before the administration of local anaesthesia. At the end of the first appointment, all patients were instructed to record the level of pain at days 1, 2, 3, 4, 5, 6 and 7 on the VAS pain score charts provided after the treatment. Each patient was prescribed Ibuprofen 400 mg with the instructions to take only one tablet, if needed, within the 0–4 hour time interval after the treatment and then one every eight hours in the event of pain. They were also requested to keep a record of their analgesic intake. The pain score chart was collected at the second appointment scheduled after one week.

RESULTS

All 70 patients (36 males and 34 females) who consented to participate in the study returned their VAS forms. Random allocation of subjects resulted in 35 patients (19 males and 16 females) in the CUI group and 35 patients (17 males and 18 females) in the SI group. The mean age of patients in the CUI group was 27.0 ± 5.1 years whilst it was 27.4 ± 6.4 years in the SI group. There were no significant differences regarding the patients’ age and gender (P=0.832) between the groups.

Pre-treatment pain prevalence was 82.8% with only 12 patients of 70 (seven in CUI group and five in SI group) reporting no pain prior to initiation of endodontic treatment. The statistical analysis did not reveal any significant difference in level of preoperative pain between groups (P = 0.604). The incidence of pain 24 hours following chemo-mechanical preparation was 41.4%, with less pain incidence reported in the CUI group (31.4%) as compared with the SI group (51.4%). There was a statistically significant difference in postoperative pain intensity only on the first postoperative day between the two groups although the mean pain levels were generally higher in the syringe irrigation group as compared to the ultrasonic group at all tested time intervals (Days 2, 3, 4, 5, 6, 7). The average pain score reported on day 1 (24 hours) was 5.82 SD 9.4 and 13.40 SD 15.5 in the CUI and SI groups respectively. The highest pain score recorded was 56 in the CUI group and 82 in the SI group whilst the lowest pain score recorded was nine in the CUI group and 11 in the SI group. Regression analysis revealed a significant association of mean postoperative pain at 24 hours with the irrigant protocol used and the level of preoperative pain, whilst no association was observed with patient’s age and gender. Overall, 20.0% of the patients (7 of 35) in the CUI group and 31.4% (11 of 35) in the SI group required analgesics for pain control (P = 0.274). Also, no significant difference was observed in the mean number of analgesic tablets consumed between the CUI (mean = 0.40 ± 0.88) and SI groups (mean = 0.68 ± 1.34) (P = 0.386).

CONCLUSION

The researchers concluded that although a statistically significant difference was observed between CUI and syringe irrigation on the first postoperative day following chemo-mechanical preparation, there was doubt whether this difference was clinically relevant.

IMPLICATIONS FOR PRACTICE

This study highlighted that although a statistically significant result was observed at day 1, this was not true for days 2 to 7 and the difference in the mean scores were not CLINICALLY relevant. By implication, these data suggests that although CUI will achieve lower pain scores than SI, from a clinical point of view, these differences may be too small to actually influence patient or clinician choice. Certainly, from a clinical aspect, both methods are equivalent in terms of the pain outcome.

Reference

GENERAL

The effect of different polishing systems on the surface roughness of a nanocomposite and a microhybrid composite. (p 249)

1. A surface roughness of below 0.2µm is necessary to prevent plaque accumulation.
   a. True
   b. False

2. Patients can detect a surface roughness of greater than 0.5µ with their tongues.
   a. True
   b. False

3. According to the results in this study, Dura-White Stones can be used to optimally finish and polish composite restorations.
   a. True
   b. False

4. Finishing of composite restorations:
   a. Results in a smoother composite surface
   b. Removes excess composite material
   c. Creates a smoother surface than a composite surface cured against a Mylar strip
   d. Is done without water coolant in a fast handpiece
   e. Results in a composite surface that will prevent plaque accumulation

5. The smoothest composite surface in this study was obtained when:
   a. The composite was polished with Enhance
   b. The composite was polished with Sof-lex discs
   c. The composite was finished with yellow stripe finishing diamond bur
   d. The composite surface was cured against a Mylar strip
   e. The composite was polished with Sof-lex Spiral Wheels.

The availability of the basic oral health care package in the Western Cape (p 258)

6. It is more likely that children with oral/dental disease will perform poorly at school.
   a. True
   b. False

7. Caries experience amongst six year old children in the Western Cape decreased between 2002 and 2015.
   a. True
   b. False

8. This study showed that only a third of clinics in the Province can offer the basic oral health care package
   a. True
   b. False

9. At Main clinics, a dentist was present about five times as frequently as at Satellite clinics
   a. True
   b. False

Mucoepidermoid carcinoma of the lower lip: review and a case report (p 262)

10. A biopsy of a suspect minor salivary gland neoplasm is crucial as more than 80% of these lesions are malignant in nature.
    a. True
    b. False

Localized “vertical relapse” following orthodontic correction in young growing patients with cleft lip palate. Case studies leading to a potential revised retention (p 266)

11. Bone grafting in growing cleft lip palate patients is to consolidate the segments on either side of the cleft and thereby make orthodontic alignment of the dentition within the cleft possible.
    a. True
    b. False

12. The best time to do bone grafts in cleft lip palate patient is:
    a. When the patient is 3 years old
    b. When the upper permanent canine has started erupting
    c. When the patient is 25 years old
    d. When the primary lip operation is done at 4 months after birth

13. To prevent or reduce vertical relapse of the dentition following orthodontic treatment in growing cleft lip palate patients the following retention strategy is recommended:
    a. A normal Hawley/Wrap-around retainer only
    b. A thermoform retainer only
    c. No retainers
    d. Both fixed upper bond-a-braid retainer and removable Hawley/ Wrap-around retainers

Managing sodium hypochlorite accidents: the reality of toxicity (p 271)

14. Identify the CORRECT statement:
    a. The hypochlorite ion irreversibly chlorinates enzymes, thereby terminating the metabolic activities of tissues or organisms it contacts.
    b. The hypochlorite ion irreversibly oxidizes antibodies, thereby terminating the metabolic activities of tissues or organisms it contacts.
    c. The hypochlorite ion irreversibly oxidizes enzymes, thereby terminating the metabolic activities of tissues or organisms it contacts.
d. The hypochlorite ion irreversibly oxidizes free radicals, thereby terminating the metabolic activities of tissues or organisms it contacts.

15. The volume of NaOCl that enters the tissues and the clinician’s reaction time to recognize and initiate treatment protocols have perhaps the most critical influence on tissue damage.
   a. True
   b. False

Application of Lasers in Orthodontics (p 276)
16. Identify the INCORRECT statement: Diode lasers:
   a. create an intense heat reaction
   b. have a much shallower depth of penetration than Nd:YAG lasers
   c. may be less likely to cause pulpal damage,
   d. are the least expensive and most portable of lasers of all wavelengths
   a. True
   b. False

MaxilloFacial and Oral Radiology case 152 (p 275)
17. Adenocarcinoma most commonly involves the parotid salivary gland.
   a. True
   b. False

18. A break in the duct and leakage of contrast medium is a sialographic sign of malignancy.
   a. True
   b. False

Clinical windows (p 284)
19. In the systemic review, there is little evidence presented that the diagnosis of periodontitis promotes the development of type 2 diabetes
   a. True
   b. False

20. The Clinical implications for this randomised controlled trial (RCT) suggest that continuous ultrasonic irrigation (CUI) is superior to syringe irrigation (SI) and should be the first choice for clinicians.
   a. True
   b. False

21. Over-servicing is always intentional and applied with forethought.
   a. True
   b. False

22. Deliberate over-servicing usually involves the more complex clinical procedures.
   a. True
   b. False

23. Accurate records should highlight:
   a. that the problems had been identified;
   b. that the necessary investigations needed to make a proper diagnosis had been carried out;
   c. that a definitive treatment plan had been formulated with no further options
   d. that any associated risk factors had been identified and presented to the patient.
   a. True
   b. False

24. In the case of possible under-servicing, the following considerations apply: Core ethical values and standards of good practice include:
   a. would it be unethical not to do this treatment
   b. could such inactivity result in any harm?
   c. will the treatment benefit the patient?
   d. under these conditions there is no need to educate the patient as to the risks, benefits and consequences.
   e. Is the decision to treat being governed by financial incentives?
   a. True
   b. False

25. Assessing need and suitability of treatment always carries with it an element of subjectivity as it is a complex issue based on differing opinions, dental and patient-related factors.
   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.

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Please supply 5–8 questions related to your article, at least three of which should be in the multiple choice format. Answers must be either True or False or, if multiple choice, have only one correct answer. Please provide answers to the questions.

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