Carp were introduced into South Africa in the late 1700's. The grass carp (Ctenopharyngodon idella) is a popular angling target. The teeth are at the back of the mouth, aligned in three rows on either side, three teeth in inner row, one tooth in outer two rows. A tough calcified pad lies above the teeth and food is crushed against it. 

(Goldfish are members of the carp family and have such teeth!)

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**CASE REPORT**

116 Adolescent caries management: an interdisciplinary approach
New LISTERINE® Advanced White
Helping give oral health a brighter future

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Advance Intelligence

The eagle-eyed amongst us would have observed that the Journal has been tardy in publishing the new membership of the Board and the Association committees. This was drawn tactfully to our attention by a kind member of the Board and we hastened to ensure that the correct membership now appears on our first page. Sincere apologies to all concerned.

On a more personal level apologies have also been rendered to several of my neighbours who note that my practice of feeding two Hadada Ibis (Bostrychia hagedash) have so encouraged the birds to remain in our vicinity that their raucous cries and abundant droppings are a daily experience…and, so claim my neighbours, a trial and a burden! I have to confess that cleaning up after their visitations is a chore, clearly expected by my wife to be my responsibility (but in fairness, she does undertake this task without complaint!). In compensation I find great pleasure in enjoying the luminous wings of these striking birds…a bronze sheen seen only in sunlight and at close range. Every chance to have that close inspection, for both male and female will take cheese or bread directly from my hand. How intriguing the physiology of their feeding! That fearsome beak is handled so dexterously that the morsel of food is removed from my palm with only a whisper of touch. Then there are the challenges when I throw a piece of cheese onto our tiled verandah area. The beak is used with exquisite sensitivity, with absolute accuracy even for small fragments of crumbs… and, the most amazing feature, without impacting on the hard surface, just delicately gathering the crumb, a moment of testing, then the tongue action transporting upwards (the head is still down toward the ground) and the swallow. I tried alternative foods, fruit for example…and an immediate rejection after a momentary holding of the food at the very tip of the beak.

I learn that it is in fact right there, at the tip of the beak, that most of the sensory input is gathered by…what else would it be called but the beak tip organ? Altogether a highly sensitive tactile and chemosensory organ. Located here in the beak of the ibis are sensory cells numbering in the hundreds per square millimetre. Important are the corpuscles of Herbst, which are similar to the Pacinian corpuscles of mammals. Also present are taste buds and other sensory receptors. The beak is a marvel of information-gathering efficiency!

How invaluable will be a similar function for the new Committees…a conduit into the far reaches of membership, seeking proprioceptive data on the state of the Association. Efficiency in information gathering is crucial to the success of any committee. That is why the SADA constitution provides for wide representation across the breadth and width of the organisation. Unlike the probing beak of the ibis, however, which relies on gathering data itself, our Committees should have the added advantage of receiving input directly from members who play their role in ensuring that their representatives are kept fully in the know. At the recent round of Association Committee meetings it was clear that the member on the ground is fortunate that there are those who are prepared to give time and energy to the efficient running of the Association. In turn, the elected member should have the confidence to know that his/her electorate stand ready to play their part.

The Journal is at the vanguard in the information seeking and gathering endeavour and the content this month reflects the broad canvas of contemporary dentistry: How best to deal with staining of dentures, through to the assessment of restorative materials, to aspects of oral and dental disease and a suggested improvement in the tracking of the clinical performance of students, supported by case reports which will add to our clinical acumen.

We should study these contents and peruse the Board and Committee membership lists as they now appear in the Journal and recognise that here is our Beak Tip Organ!
Cyril Northcote Parkinson was a Naval Historian who wrote some 60 books and became something of a guru on business philosophy. He is best known for his Law: “Work expands so as to fill the time available.” And so it may be for the projected National Health Insurance for South Africa. The recently circulated document sent by the Association to members is Version 40 of the proposal! This is described in our Association Communiqué of 29th March 2016 as the White Paper on NHI. Since we already have had the Green paper, one wonders how many folk will view the document as being Red… there are yet so many issues to be resolved. Credit must be given to all those whose work has contributed to the formulation of the scheme, which has the laudable ambition of working “Towards Universal Health Coverage.” There has been dedication and commitment and there is no doubt of the enthusiasm of the Minister of Health who is summoning every energy to overcome obstacles to the inception of NHI.

So it does behove us to have read the (red) document. Members are assured in the March Communiqué that SADA is carefully considering and evaluating the document and that a submission shall be prepared to meet the 31 May deadline. However, the potential impact on the profession, our practices and our concepts of the delivery of oral health care is such that every member should take the time to consider the NHI paper in some detail.

Mention is made in the SADA communiqué of the concern of members regarding the future of their practices, together with the identification of the minimal provision for Oral Health and the possible confusion on the option of additional cover through Medical Schemes. These and other issues shall receive due attention by the Association and although worth emphasising may be best left to the keen eye and nose of the relevant SADA committees, who will value your input, comments and advice.

A delving into some of the statistical challenges facing the attainment of Universal (Oral) Health is instructive, and not a little concerning. The White paper records in Section 6.1.2 some pertinent data. As part of a pilot scheme conducted in 2015, the Department of Health deployed 70 mobile clinics to provide general, eye, audiology, and oral, health services to school children. A total of 201, 770 learners from Grade 1 up to Grade 10 attended these clinics. Speech problems were identified amongst 1.1%, TB as a probable infection amongst 4%, eye care was needed by 21%, and ORAL HEALTH CARE was required by 66% or 133,947 learners in the sample! There need be no argument or debate on acknowledging the greater threat to health posed by TB and other serious diseases but the proportion of children needing dental attention absolutely screams for recognition.

The question is whether the NHI planners are seeing, or hearing, these statistics. According to the Government Statistical Report 2015, there are some 12, 883,888 learners attending 30, 027 institutes and being taught by 447,149 educators in South Africa. (The burning issues affecting schools in Limpopo has now sadly reduced the number of schools.) Whilst educators will have to accept the teaching of Oral Hygiene as a regular discipline, the delivery of oral care must rest with the dental team. At present the HPCSA lists 6035 Dental Practitioners as being registered. If we assume all those to be in practice, which of course they are not, we have each dentist being responsible for the oral care of 2135 learners. The actual number of dentists in practice is probably around 4,500, which means each should see 2863 learners. These are of course simplistic statistics which do not take into account many mitigating factors such as the levels of need, the possibilities of the role of other members of the dental team, financial circumstances and so on. Using the same basic figure of 4,500 in a population of 53 million, there are 118,000 patients for every practicing dentist in South Africa. Greece has an astounding 125 dentists, the United Kingdom 45, Germany 83, all per 100, 000 inhabitants.

In 2013, Dr Johan Smit, the Director, Oral Health Services, made these comments: “Public oral health services need more primary oral health care workers, like dental therapists, oral hygienists and dental assistants, to deliver the high priority oral health promotive and preventive, as well as basic curative services. This is to address the needs of the population as determined by epidemiological surveys.”

The FDI 20/20 Vision report observes “There is broad recognition that oral health shares common risk factors with other non-communicable diseases and that oral health cannot be dealt with in isolation from other health issues.” These are the dilemmas exposed by the White paper and with which the Association is currently grappling. Are the aims and objectives of the White Paper attainable, laudable though they may be?

Most certainly the issues surrounding Oral Health in South Africa are pressing and deeply challenging, perhaps deserving of greater mention in the White Paper.

On a more immediate note, the Association has worked to the benefit of members in entering into a joint venture with Easy Practice (Communique 2016.017), has issued explanatory notes regarding Dental Codes (Communique 2016.022) and has provided highly relevant data regarding quality control tests for radiographic units (Communique 2016.025).

An active time for the Association, may we say, as always!
**ABSTRACT**

**Aim:** The purpose of this in-vitro study was to compare the sealing ability of White ProRoot® MTA, MTA Plus™, Biodentine™ and Permite Amalgam when used as root-end filling materials.

**Materials and methods:** 120 single rooted, extracted teeth were endodontically treated. The apical 3 mm of each root was resected, and 3 mm deep root-end cavities were prepared. Specimens were divided into four groups (n=30) and filled with the following materials: ProRoot® MTA, MTA Plus™, Biodentine™, and Permite Amalgam. Specimens were submerged in Indian Ink for 48 hours, and sectioned horizontally in one millimetre increments from the apical end. Dye penetration was measured using a stereomicroscope.

**Results:** Data for different groups was summarised as percentages. Pairwise comparisons between the calcium silicate materials to amalgam were done at the 0.017 level of significance, using Fisher’s exact test. Amalgam showed significantly more leakage than the calcium silicate materials (ProRoot® MTA, MTA Plus™ and Biodentine™) (p<0.001). No significant differences in sealing ability were found among the calcium silicate materials.

**Conclusion:** Amalgam should be regarded as unsuitable for use as a root-end filling material. Calcium silicate cements should be recommended as the material of choice for root-end filling.

**INTRODUCTION**

Periapical endodontic surgery may be indicated when orthograde retreatment of failed endodontic therapy is unsuccessful, not feasible or contraindicated. The sequence of procedures during the surgery is: exposure of the involved apex, root-end resection, root-end cavity preparation and placement of a root-end filling. The root-end filling is necessary to provide a hermetic seal, preventing the egress of micro-organisms from the root canal system into the peri-radicular tissues.

The ideal root-end filling material should be: non-toxic, non-carcinogenic, non-corrosive, non-staining to peri-apical tissues, biocompatible with host tissues, able to stimulate the regeneration of the periodontium, insoluble, dimensionally stable, unaffected by moisture, adherent to dentine, radiopaque, easy to use, and have a long shelf life. Various materials have been suggested and tested in the quest to fulfil all these ideal requirements. Amongst those proposed are: amalgam, gutta-percha, Cavit (3M ESPE, St Paul, Minnesota, USA), glass-ionomer cement, IRM (Dentsply/Maillefer, Ballaigues, Switzerland), Super EBA (Harry J. Bosworth Co., Skokie, Illinois, USA), composite resin, compomer, gold foil, Diaket (3M/ESPE, Seefeld, Germany), polycarboxylate cements, and more recently Mineral Trioxide Aggregate (MTA).

Dental amalgam was first used as a root-end filling material by Farrar in 1884, and has since been the most widely used retrograde filling material, serving as a standard to which other materials are compared. The advantages of amalgam are that it is: inexpensive, readily available, easy to manipulate, radiopaque and insoluble in fluids. The disadvantages include: initial microleakage, electrochemical corrosion, induction of inflammation of adjacent peri-radicular tissues, amalgam tattoo formation, the need for an undercut in cavity preparation, zinc toxicity, delayed expansion, and concerns over the introduction of mercury into the peri-radicular tissues. In 1991, Friedman identified amalgam as still being the material of choice for retrograde filling. However, newer materials have since been developed, challenging this role of amalgam. According to Chong and Pitt Ford (2005), the use of amalgam as a root-end filling should now be confined...
to history. ProRoot® MTA (Dentsply/Maillefer, Ballaigues, Switzerland) was developed for use as a root-end filling material at Loma Linda University by Professor Mahmoud Torabinejad and colleagues in the early 1990’s. The first description of MTA appeared in the scientific literature in 1993. In 1998 the United States Food and Drug Administration (FDA) approved MTA for use in endodontic treatment. Mineral Trioxide Aggregate can be described as a hydraulic cement, for it setting is primarily dependant on hydration reactions and once set it is stable underwater. This is in contrast to the predominantly acid-base reactions of other dental materials. The main constituent of MTA is calcium silicate. The expiration of the patent on ProRoot® MTA has resulted in the emergence of several variants, and a generic term has been proposed to classify this category of material. The terms ‘hydraulic silicate cements’ and ‘calcium silicate cements’ have been proposed, with the latter being more popular.

According to the patent, ProRoot® MTA is a Type 1, ordinary Portland cement. The constituents of MTA are: 55% tricalcium silicate, 20% dicalcium silicate, 10% tricalcium aluminate, 10% tetracalcium aluminoferrite and bismuth oxide (for radio-opacity). The cement is prepared by mixing the powder with sterile water using a 3:1 powder to liquid ratio. Hydration of ProRoot® MTA results in the formation of calcium hydroxide and a calcium silicate hydrate gel, and this solidifies in approximately 165 minutes. Grey ProRoot® MTA and white ProRoot® MTA were introduced to the market in 1998 and 2002 respectively. White ProRoot® MTA has significantly less (90,8%) iron than grey ProRoot® MTA, and was intended to address the cosmetic concerns of the potential of tooth discoulouration associated with grey ProRoot® MTA.

The novel MTA material, MTA Plus™ (Prevest Denpro Limited, Jamu, India) has a finer particle size than ProRoot® MTA. The MTA Plus™ kit contains a powder and is supplied with a proprietary salt-free polymer gel and water, either one of which can be used as mixing components. The finer particle size improves handling and ease of placement, and the purpose of the gel is to add an anti-washout property to the material. Washout being defined as the tendency of a cement to disintegrate upon early contact with blood and other fluids. As it is necessary to irrigate the osteotomy site prior to closing a periapical flap to avoid complications, one of the drawbacks of MTA is a tendency to washout. The final irrigation and resumption of blood flow to the surgical area may then result in a loss of some of the material placed in the root-end cavity. Washout resistance is an important quality of a root-end filling, as a loss of material would compromise the apical seal.

An X-ray diffraction analysis of the unhydrated powder of MTA Plus™ demonstrates that its components are tricalcium silicate, dicalcium silicate and bismuth oxide. Upon hydration of MTA Plus™ powder with the anti-washout gel or water, calcium silicate hydrate forms. The powder: liquid ratio for standard mixing is 3:1, however the amount of gel may be increased to modify the rheological properties (the flow characteristics) and setting time of the cement. MTA Plus™ when mixed with water took 65 minutes longer to set than when MTA Plus™ was mixed with the anti-washout gel (180 vs 115 minutes).

Since January 2011, Biodentine™ a synthetic tricalcium silicate based cement has been commercially available and is marketed as a ‘bioactive dentine substitute’. The production of Biodentine™ is based on ‘Active Bio-silicate Technology™’, which results in the production of pure tricalcium silicate that is free of metallic impurities. It has a powder component which comes in a capsule and a liquid packaged in a pipette. The powder is made up of tricalcium silicate (main core material), dicalcium silicate (second core material), iron oxide (colouring agent), zirconium oxide (radiopacifier) and two filler materials, calcium carbonate and calcium oxide. The liquid consists of a hydrosoluble polymer (water reducing agent) and calcium chloride (setting accelerator). The liquid is mixed with the powder within the capsule in a triturator for thirty seconds at a speed of 4000-4200 rotations per minute. The hydration reaction results in the formation of a calcium silicate hydrate gel and calcium hydroxide. According to Camilleri, Sorrentino and Damidot (2013), the calcium carbonate acts a nucleation site for the calcium silicate hydrate; and as a result there is a shorter induction period and an initial set within 12 minutes. The final setting time of Biodentine™ was found to be 45 minutes.

Microleakage can be defined as the passage of bacteria, fluids and chemical substances between the root canal filling material and the tooth. The various methods used to examine the microleakage of MTA are dye penetration, fluid filtration, bacterial leakage and protein leakage.

The purpose of this in-vitro study was to compare the sealing abilities of White ProRoot® MTA, MTA Plus™, Biodentine™ and Permite Amalgam when used as root-end filling materials.

**MATERIALS AND METHODS**

One hundred and twenty single-rooted extracted human teeth were collected from the out-patient dental extraction clinic of the Oral and Dental Hospital, School of Dentistry, Faculty of Health Sciences, University of Pretoria. Every aspect of this research project was conducted in line with the ethical and safety standards for handling human tissues and conducting laboratory research, as prescribed by South African law: the Health Profession Act 56 of 1974 (South African National Health Bill, 2003). The study was approved by the Research Ethics Committee, Faculty of Health Sciences, University of Pretoria, under protocol number 138/2011.

The teeth were stored immediately after extraction in phosphate buffered saline (PBS) (Sigma-Aldrich, Johannesburg, South Africa) at room temperature. The experiments were conducted two weeks later. The prerequisites for the sample selection were similar to those used by Pichardo et al. (2006):

1. Root formation should be complete.
2. There should be a single, straight root canal
3. No root canal therapy should have been previously performed on the teeth.
4. The teeth should not have any fractures.
5. There should be no root caries or root resorption.

All the above-mentioned properties were verified radiographically except for the absence of fractures (point 4), which was done using a surgical operating microscope (D.F. Vasconcellos, São Paulo, Brazil).

The crowns of all teeth were sectioned with a flat-ended, cylindrical diamond bur (Komet, Lemgo, Germany) driven in a high speed hand piece (W&H, Bürmoos, Austria). The bur was held perpendicular to the long axis of the tooth.
and the cut made to render a standard root measurement of 18 mm, as suggested by Pichardo et al. 2006.38

All the root canals were prepared to within 0.5 mm of the apical foramen with ProTaper Universal (Dentsply/Maillefer, Ballaigues, Switzerland) rotary instruments using the X-Smart Plus rotary motor (Dentsply/Maillefer, Ballaigues, Switzerland), according to the manufacturer’s instructions. A size 15 k-file (Dentsply/Maillefer, Ballaigues, Switzerland) was used to establish patency of the root canals. Glyde Root Canal Conditioner (Dentsply/Maillefer, Ballaigues, Switzerland) was used as a lubricant on the files prior to insertion into the canals. A 6% sodium hypochlorite solution (Nordiska Dental, Angelholm, Sweden) was used for irrigation between rotary instrumentation. The canals were prepared with ProTaper Universal rotary files (Dentsply/Maillefer, Ballaigues, Switzerland), up to a size F3 instrument. A final irrigation of the canals was performed with 17% EDTA (Topclear, Dental Discounts, Johannesburg, South Africa). The canals were dried with F3 ProTaper Paper Points (Dentsply/Maillefer, Ballaigues, Switzerland). All the prepared root canals were obturated by applying the continuous wave, warm vertical condensation technique using the Calamus Dual Obturation Unit (Dentsply/Maillefer, Ballaigues, Switzerland). The coronal access cavities were sealed with Fuji IX glass-ionomer restorative material (GC Corporation, Tokyo, Japan). The specimens were then stored in a single sterile plastic container filled with PBS solution at room temperature for 48 hours.

The apical 3 mm of all the specimens were resected perpendicular to the long axis of the tooth using a straight carbide fissure bur (Komet, Lemo, Germany) on a high speed hand-piece. Root-end cavities were prepared on all specimens to a depth of 3 mm using an ultrasonic ProUltra Surgical Tip (Dentsply/Maillefer, Ballaigues, Switzerland) on an NSK Ultrasonic Scaler Unit (NSK, Nakanishi, Japan). The ultrasonic tip was used in a brushing motion with light pressure, and a cylindrical cavity was created parallel to the long axis of the root.

The entire surface of every specimen, except for the resected apical portion, was coated with two layers of clear nail varnish to seal all other possible portals of communication with the root canal.

The 120 specimens were randomly divided into four groups (n=30) and treated as follows:

**Group 1: White ProRoot® MTA** (Dentsply/Maillefer, Ballaigues, Switzerland) (n=30)

The material was hand-mixed according to the manufacturer’s instructions and placed into the root-end cavity preparation, using the MAP System (Dentsply/Maillefer, Ballaigues, Switzerland).

**Group 2: MTA Plus™** (Prevest Denpro Ltd., Jamu, India) (n=30)

The material was hand mixed according to the manufacturer’s instructions and placed into the root-end cavity preparation, using the MAP System (Dentsply/Maillefer, Ballaigues, Switzerland).

**Group 3: Biodentine™** (Septodont Ltd., Saint Maur des Fausse’s, France) (n=30)

The material was mixed in an amalgamator (TPC Advanced Technology, California, USA) according to the manufacturer’s instructions and placed into the root-end cavity preparation, using the MAP System (Dentsply/Maillefer, Ballaigues, Switzerland).

**Group 4: Amalgam** (Permite, SDI, Victoria, Australia) (n=30)

The material was mixed in an amalgamator (TPC Advanced Technology, California, USA) according to the manufacturer’s instructions and placed into the root-end cavity preparation, using a retrograde amalgam carrier (Medesy, Pordenone, Italy).

Each group of specimens was then immersed in Indian ink dye (Winsor and Newton, London, England), and remained immersed in their individual, sealed, sterile plastic containers for 48 hours at 37°C. The specimens were then removed from the dye reservoir, and excess dye was rinsed off with distilled water for 15 minutes. The apical end of each specimen was sectioned transversely in 1 mm increments with a wafering blade in an Isomet™ low speed saw (Buehler, Lake Bluff, Illinois, USA) under continuous water irrigation. This rendered three 1 mm slices of each root-end which were then packaged in labelled, sealed packets, identifying each sample as being: 1 mm, 2 mm or 3 mm from the apex.

The sections were then mounted on microscopic glass slides, and examined under a stereo microscope (Carl Zeiss, Jena, Germany) by two independent, blinded and calibrated examiners. The extent of dye penetration was measured to the nearest millimetre based on the presence of visible dye between the root-end filling and dentinal wall interface.

Data was summarized in terms of percentage for the outcome vector (no leak; 1 mm leak; 2 mm leak; 3 mm leak). Furthermore, pairwise comparisons between each of the new generation filling materials and amalgam were done at the 0.017 level of significance using Fisher’s exact test. The latter test could also be used at the 0.05 level of significance to assess the four filling materials in a single analysis.

**RESULTS**

The measurement of the depth of dye penetration between the root-end filling material and the dentinal wall interface was of note.

**Group 1: Dye penetration of White ProRoot® MTA specimens**

In this group, 26 specimens showed no leakage, four specimens leaked to a depth of 1 mm, and only three specimens leaked to a depth of 2 mm (Figure 1a).

**Group 2: Dye penetration of MTA Plus™ specimens**

Twenty two of the specimens in this group showed no leakage, eight specimens leaked to a depth of 1 mm, and three specimens leaked to a depth of 2 mm (Figure 2a).

**Group 3: Dye penetration of Biodentine™ specimens**

No leakage was observed in 24 specimens of this group, six specimens leaked to a depth of 1 mm, and four specimens leaked to a depth of 2 mm (Figure 3a).
Group 4: Dye penetration of Permite Amalgam specimens
All 30 of the specimens in this group showed leakage to a depth of 1mm, 27 specimens leaked to a depth of 2mm, and 12 specimens leaked to a depth of 3mm (Figure 4a).

The results of all the specimens from the different groups combined before statistical analysis are illustrated by Figure 2. The specimens from the Permite Amalgam group showed the most leakage while the White ProRoot® MTA group showed the least amount of leakage.

Statistical analysis
The outcomes of the failure vector are reported for each treatment group in Figure 3. Amalgam displayed significantly greater leakage than any of the calcium silicate root-end filling materials (ProRoot® MTA, MTA Plus™ and Biodentine™).

The differences are very clear if the leakage outcome is simplified as present or absent. Then it can be noted that leakage of the amalgam samples was 100% (30/30), and that 20% (6/30) of Biodentine™ samples, 13.3% (4/30) of ProRoot® MTA samples while 27.6% (8/30) of MTA Plus™ samples leaked. It is also important to note that none of the calcium silicate retrograde-filled teeth demonstrated leakage up to 3mm. In contrast, 40% (12/30) of the amalgam-filled teeth showed leakage up to the 3mm level.

Furthermore, no significant differences were found among the calcium silicate cements, namely Biodentine™ vs. ProRoot® MTA (p = 0.776), Biodentine™ vs. MTA Plus™ (p=0.667), and ProRoot® MTA vs. MTA Plus™ (p = 0.350).

Discussion
The purpose of this in-vitro study was to compare the sealing ability of root-end fillings. White ProRoot® MTA, MTA Plus™, Biodentine™ and Permite Amalgam were compared by measuring the linear dye penetration of Indian ink dye at the interface between the root-end filling and the dentinal wall. The achievement of a hermetic seal by a root-end filling is a critical factor that impacts on the long-term success of endodontic surgery.37

Microleakage is an estimate of the quality of the seal, and can be measured by allowing a tracer to penetrate a filled root-end cavity.38 Commonly used tracers include dyes, radioisotopes, bacteria and bacterial by-products.39 The dye-immersion technique was introduced by Grossman in 1939, and is widely used because it is easy to perform, reproducible, safe, inexpensive, quantifiable and dyes are readily available.39,40 This technique is a passive method that depends on the phenomenon of capillarity, whereby the dye penetrates any space between the root-end filling and the dentinal wall. The achievement of a hermetic seal by a root-end filling is a critical factor that impacts on the long-term success of endodontic surgery.37

Chong et al. (1995) compared the penetration of tracers and other assessment methods of the sealing of root-end fillings. The findings of their experiments showed that bacterial penetration and Indian ink dye penetration yielded similar results.44
In the present study, White ProRoot® MTA, MTA Plus™ and Biodentine™ showed significantly better sealing ability when compared with Permite Amalgam. There were no statistically significant differences in sealing ability between the three calcium silicate cements.

Amalgam has been considered as the material of choice for root-end filling for over a century, despite the many disadvantages of its use. Most materials that have been developed or considered for root-end filling have been compared with amalgam. The use of a cavity varnish in conjunction with amalgam has been shown to improve sealing ability. Vertucci and Beatty (1986), however, found no significant difference in apical dye penetration, whether cavity varnish was used or not. In the present study, no cavity varnish was used in order to obtain an accurate appraisal of the sealing ability of the amalgam alone. An additional factor that improves the sealing ability of amalgam is the formation of corrosion products between the material itself and the dentine wall over a period of time. Tronstad et al. (1983) found that corrosion products start to occupy the gap between amalgam and dentine within seven days. The generation of corrosion products is however undesirable, especially in the peri-radicular region. In the present study, a high copper non-Gamma 2 Amalgam was used because it undergoes minimal corrosion.

ProRoot® MTA was found to have a significantly superior sealing ability to amalgam in the present study. The application of MTA in endodontics was first investigated in 1993 by Torabinejad, Watson and Pitt Ford (1993) who measured the penetration of Rhodamine B dye in longitudinally sectioned teeth by confocal microscopy. The results showed that MTA leaked significantly less than both amalgam and Super EBA (Harry J. Bosworth Co., Skokie, Illinois, USA). Methylene Blue dye penetration in longitudinally sectioned samples was not significantly different when the root-end fillings of amalgam, Super EBA, IRM and MTA were tested, either with or without blood contamination. Furthermore, MTA was found to have significantly less dye penetration in the presence or absence of blood than amalgam, Super EBA or IRM.

Mineral Trioxide Aggregate was found to have a superior seal to amalgam and Super EBA by Aqrabawi (2000), when the penetration of 1% methylene blue dye was measured on longitudinally sectioned samples. Davis et al. (2003), measured the linear penetration of Indian ink dye in teeth that had been decalcified, rendering them transparent. Mineral Trioxide Aggregate, Super EBA and amalgam (Tytin, Kerr Corporation, Michigan, USA) were used by Davis et al. (2003) as root-end fillings after the root-end cavities were irrigated with saline, citric acid or oxycycline. It was found that amalgam leaked significantly more than MTA and Super EBA, irrespective of the irrigant used, but there was no statistically significant difference in leakage between MTA and Super EBA. Pereira, Cenci and Demarco (2004) evaluated the microleakage allowed by amalgam (GS-80, Southern Dental Industries, Victoria, Australia), MTA, Super EBA and Vitremer (3M ESPE, St.Paul, Minnesota, USA) by measuring linear dye penetration in transversely sectioned apical slices. They found that MTA leaked significantly less than Vitremer and Super EBA, and amalgam leaked significantly more than all the other tested materials. The present study concurs with other dye penetration studies in the finding that amalgam displays significantly more microleakage than ProRoot® MTA.

Biodentine™ and MTA Plus™ are relatively new calcium silicate materials. The current study is the first to investigate the sealing ability of MTA Plus™ as a root-end filling, Kokate and Pawar (2012), compared the efficacy of the marginal seals of Biodentine™, MTA and glass ionomer cement in root-end fillings, by examining the penetration of 1% Methylene blue in longitudinally sectioned samples with stereomicroscopy. It was found that Biodentine™ displayed significantly less leakage than MTA and glass-ionomer cement, with glass-ionomer cement exhibiting the most microleakage. Ravichandra et al. (2014) examined the marginal adaptation of Biodentine™, MTA and glass-ionomer cement as root-end fillings by measuring the area stained by Rhodamine blue dye in transverse sections using confocal laser scanning microscopy. The study revealed that Biodentine™ showed the lowest marginal gaps and the best marginal adaptation, followed by MTA. The largest marginal gaps were found with glass-ionomer cement. The results of the present study differ from those of Kokate and Parvar (2012) and Ravichandra et al. (2014), for no significant differences were found between the sealing abilities of Biodentine™ and MTA. A possible reason for the different outcome could be related to the sample size of the previous studies. Both used a sample size of 10 specimens per group while in the present study, 30 specimens were used per group. Other possible differences may be attributed to the fact that different types of dyes were used. Furthermore, Kokate and Pawar (2012) sectioned their specimens longitudinally while in the present study, specimens were sectioned transversely. Another possible factor is that Ravichandra et al. (2014) used confocal laser scanning microscopy to assess the specimens while in the present study stereomicroscopy was used. The phenomenon of hydroxyapatite formation over MTA, MTA Plus™ and Biodentine™ when immersed in simulated body fluids such as PBS is well documented. In the present study the specimens were stored in PBS-moistened gauze after placement of the retrograde fillings. A suggested hypothesis is that the bioactivity of the calcium silicate cements during storage possibly improved their sealing ability due to chemical bonding of hydroxyapatite crystals to the radicular dentine. Amalgam does not bond to dentine, and is reliant for its retention on the preparation of an undercut in the root-end cavity.

In the clinical scenario, MTA Plus™ and Biodentine™ may have certain advantages over ProRoot® MTA. MTA Plus™ mixed with anti-washout gel would prevent the loss of the material from the root-end cavity when the surgical site is rinsed, or when blood flow resumes. This would probably improve the sealing ability of MTA Plus™, as more filling material would be retained within the root-end cavity. Due to the addition of the setting accelerator, calcium chloride, Biodentine™ reaches an initial set within 12 minutes. This allows the operator to visually observe that the root-end filling material has set prior to closure of the surgical site. This would not be possible with MTA Plus™ or ProRoot® MTA due to the significantly longer setting times of these materials. Further studies are indicated to verify the advantages that MTA Plus™ and Biodentine™ may have over ProRoot® MTA, with regard to sealing ability when used in-vivo.

CONCLUSIONS

Within the limitations of the present study the following can be concluded:

1. Calcium silicate cements showed a significantly better sealing ability than Permite Amalgam when used as root-end filling material (p<0.001).
There was no significant differences in the sealing abilities of White ProRoot\textsuperscript{TM} MTA, MTA Plus and Biocement\textsuperscript{TM} (p<0.001).

Based on the findings of the present study, amalgam should be regarded as unsuitable for use as a root-end filling material.

Based on the findings of the present study, calcium silicate cements should be recommended as the material of choice for root-end filling.

References:
The whitening effect of four different commercial denture cleansers on stained acrylic resin

ABSTRACT

Denture hygiene and denture cleansers are very important for their antimicrobial effect and also in removing stain from the dentures. The purpose of this study was to determine the effectiveness of Steradent, Corega, Dentalmate and Fitty Dent in improving the colour of stained, polished-and unpolished, acrylic specimens and to determine which colour component should be the visual impression factor. Samples of stained acrylic specimens were severally exposed once to one or other of the denture cleansers. The colour components (L*, a* and b*) of the specimens were measured with a spectrophotometer before and after exposure to one of the four products. In general there was only a slight non-significant improvement (p>0.05) in the yellowness (a*) and redness (b*) of the acrylic samples as a result of a single treatment with any of the four stain removal products. However, the L* value was mainly negatively influenced. The differences (ΔE*ab; ΔL*; Δa* and Δb*) between before and after treatment for any one of the four products were also not statistically significant on a 5% level (Kruskal Wallis non-parametric test).

Conclusion: A small improvement of the yellowness and redness could be seen even after a single treatment. This was found for all four commercially available denture cleansers on polished and on unpolished specimens. From the relative magnitudes of L*, a* and b* which contribute to the overall colour value (ΔE*ab) it was statistically confirmed that the brightness/lightness component (L*) should be the visual impression factor.

INTRODUCTION

The hygienic maintenance of dentures by the use of denture cleansers is important for the general oral health of patients and to ensure an odour free appliance. The microporous surface of an acrylic resin denture base material provides an environment that supports microorganisms. Microbial plaque on dentures has the potential to be harmful to both the oral mucosa and to the general health, therefore cleaning and the maintenance of the dentures are essential. Denture cleaning is necessary to remove extrinsic stain and soft and hard deposits from dentures. An ideal denture cleanser should be simple to use, effectively remove organic and inorganic matter from denture surface, have bactericidal and fungicidal properties, be compatible with all denture base materials and be economical. Cleaners are also expected, importantly, to remove stains from dentures to improve their colour. Dental students at the University of the Western Cape (UWC) provide, on average, some 500 dentures to patients annually. On delivery, oral hygiene instruction and specific details on the care of the prostheses are given to the patients by the students. An instruction sheet detailing denture hygiene is handed to the patients to reinforce the message and four denture cleansers are recommended. Extrinsic staining of acrylic dentures can be a major problem for many individuals especially those who smoke tobacco products or consume large quantities of tea, coffee, cola or red wine. Steradent denture cleanser powder, Corega denture cleaner tablets, Dentalmate denture cleaner tablets and Fitty Dent denture cleanser tablets are the denture cleansers recommended at UWC and are currently commercially available amongst several other competing brands, some claiming to have superior stain-removal properties.

Denture cleansers may be divided into two groups: paste and immersion types. The complex composition of cleaning pastes with their abrasives, humectants, detergents and flavouring provides a variety of potential effects on the denture surface. The roughness of materials might affect plaque formation or inhibit its removal. Immersion type denture cleansers contain no abrasive particles; and the only means of abrading the denture surface would therefore be during the brushing phase before or after soaking. Information on the efficacy of the different types of cleansers and the effectiveness of individual additives...
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in removing stain can be difficult to establish because of alterations in formulations of existing products or the introduction of new brands.\textsuperscript{3, 6} The rate at which deposits accumulate on dentures varies between individuals and can be affected by factors such as dietary intake, saliva composition, surface texture and porosity of the denture base material, the duration for which the dentures are worn and the denture–cleaning regimen adopted by the wearer. Sterilization by immersing dentures leaves the surface roughness of the denture resin unchanged and therefore possibly less susceptible to plaque accumulation. One of the main cleaning chemicals in immersion type cleansers is sodium hypochlorite. These types of cleansers can lead to deterioration of the denture base material, such as bleeding of acrylic resin, corrosion of metal and decomposition of temporary and soft lining material.\textsuperscript{4}

Effervescent tablets are classified as chemical soak-type products and when dissolved in water the sodium perborate readily decomposes to form an alkaline peroxide solution. This peroxide solution subsequently releases oxygen thereby enabling a mechanical cleaning by the oxygen bubbles in addition to the chemical action.\textsuperscript{6}

It is of clinical importance to determine whether denture cleansers alter the properties of acrylic resins. Denture base polymers are susceptible to colour-shifting if the cleaning solutions are not used correctly. The whitening effect may relate to a high temperature of the water used in the treatment.\textsuperscript{6} Whitening of the denture colour has also been correlated with the regular use of chemical denture cleansers.\textsuperscript{3} Irregularities and porosities present on denture surfaces offer a favourable niche to retain stain and microbial plaque.\textsuperscript{6}

The purpose of this study was to determine the relative effectiveness of Steradent denture cleanser powder, Corega denture cleanser tablets, Dentalmate denture cleanser tablets and Fitty Dent denture cleanser tablets in the colour improvement of stained, polished- and unpolished, acrylic specimens and to determine which colour component should be the visual impression factor.

MATERIALS AND METHODS
 Sample disc specimens were prepared using heat cure acrylic resin. Identical rectangular wax discs were constructed from a silicone mould, invested, the wax boiled out, replaced by pink acrylic resin and the sample cured as for denture processing. Some of the discs were finished and polished as is routinely done in denture construction\textsuperscript{6} and the rest of the acrylic specimens were finished but not polished (as in the fitting surfaces of dentures). The specimens were washed in distilled water to remove any debris. Specimens in groups of 10 (five polished surface and five specimens not polished, n=40) were used for each product in the study. A staining broth was prepared as described by the American Dental Association,\textsuperscript{7} comprising a mixture of coffee, tea, mucin powder, sterilized trypticase soya broth, FD&C Red and Yellow colour along with red wine and a 24-hour culture of Micrococcus luteus (Table 1).

The specimens were first placed in artificial saliva (Table 2; Cipla Medpro, Bellville, RSA) for 2 minutes to form an initial pellicle layer to facilitate the uptake of the stain, and then washed with distilled water. The specimens were then soaked in the prepared staining solution for 48 hours, after which the uptake of the stain was visible with the naked eye. They were removed from the staining solution, washed in distilled water and allowed to air dry. The colour components (L*, a* and b*) of each specimen were measured before soaking and after being soaked in the cleansers (Table 3). This was done with a spectrophotometer (Konica Minolta, CM-2600d) and the data were recorded.

Each denture cleanser solution was mixed as per manufacturers' directions. Corega denture cleanser tablets (Glaxo Smith Kline South Africa (Pty) Ltd), Fitty Dent denture cleanser tablets (Fitty Dent International GMBH) and Dental Mate denture cleanser tablets (Die-Chem Pharmacies, RSA) were separately dropped into 250ml warm water to dilute. Steradent powder (1/4 capful) (Reckit Benckiser, RSA) was put in 250ml of warm water. Specimens were soaked in the various denture cleanser solutions for periods according to the directions supplied by the respective manufacturers. Hence in the Corega denture cleanser tablet solution, specimens were soaked for 3 minutes, those in the Fitty Dent denture tablet solution were soaked for 5 minutes, and those in the Dental Mate denture cleanser solution were soaked until the effervescing solution changed from blue to clear. Specimens in the Steradent denture cleanser powder solution were soaked for 10 minutes. As the intent of the tests was to evaluate the change in colour, if any, effected by the different treatments, no control group, such as water, was used. Each of the specimens was then rinsed thoroughly for one minute with distilled water and air-dried. The colour change as a result of the removal of the stain was measured using the above mentioned spectrophotometer.
The composition of the dental cleansers is given in Table 3.

The spectral distributions of the acrylic samples were compared by determining the three dimensions of their L*a*b* colour space. In the three dimensional space, ΔL* represents the brightness/whiteness dimension, Δa* the dimension of the opponent colours green/red and Δb* the dimension of opponent colours blue/yellow.

The L*a*b* space consists of coordinates that vary in a finite range. For example, brightness/whiteness could range between zero and 100 where zero would be pitch dark and 100 maximum white/bright. Figure 1 demonstrates the colour space of the L*a*b* system.

To gain insight as to which of the three different components (ΔL*, Δa* and Δb*) would determine the visual impressions of the total colour change (ΔE*ab) the inter-relationships between the three deltas was further investigated using a two dimensional principal component analysis (CATPCA).

### RESULTS

Delta E (total colour difference) values for all four products were calculated using the following formula:

\[ \Delta E_{ab}^* = \left[ (\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2 \right]^{1/2} \]

Where: L* indicates (-)darkness/lightness(+), a* (-)green/red(+) and b* (blue/yellow(+). These are the chromaticity coordinates.

In general, there was only a small and insignificant improvement (p>0.05) in the overall colour (ΔE*ab) of stained specimens as a result of a single treatment with any one of the four stain removal products. Since the sample sizes were small (n=10) the Kruskal Wallis non-parametric Test was used. The differences between the three colour components (ΔL*, Δa* or Δ b*) before and after treatment of the stained samples for any one of the four products were also small and not statistically significant on a 5% level. There was also no significant difference between non-polished (stained) and polished (stained) in ΔE*ab; ΔL*; Δa* or Δb* (Kruskal Wallis non-parametric test).

The overall mean ΔE*ab (colour improvement) for the four different products on the polished specimens was 2.46 (sd=2.11). For the non-polished specimens the overall mean ΔE*ab was 2.58 (sd=3.0) and the performance of the four products also did not differ significantly (p<0.05).

The results of a two dimensional principal component analysis (CATPCA) with ΔL*, Δa*,Δb* revealed that it was not the difference between Δa* and Δb* but the difference between one of these components and ΔL* that is crucial to the visual impression.

This is apparent from Figure 2 which shows that ΔL* largely contributes to dimension 2 whereas Δa* and Δb* dominate dimension 1. This and the high correlation between Δa* and Δb* suggest that changes in ΔL* will be prominent in the spectral distribution of the cleansers used in this study.

<table>
<thead>
<tr>
<th>Steradent (powder or tablets)</th>
<th>Corega (tablets)</th>
<th>Dentalmate (powder)</th>
<th>Fitty Dent (tablets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium sulphate</td>
<td>Sodium perborate</td>
<td>MaltrinM-200</td>
<td>Sodium perborate</td>
</tr>
<tr>
<td>Potassium caroate</td>
<td>Potassium caroate</td>
<td>Granular</td>
<td></td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>Sodium bicarbonate</td>
<td>Sodium bicarbonate</td>
<td></td>
</tr>
<tr>
<td>Citric acid</td>
<td>Citric Acid</td>
<td>Citric Acid</td>
<td>Potassium Monopersulphate</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>Sodium carbonate</td>
<td>Sodium carbonate</td>
<td>Trisodium Phosphate</td>
</tr>
<tr>
<td>Sulfamic acid</td>
<td>Sodium Hexametaphosphate</td>
<td>Soda Ash</td>
<td>Sulfamic acid</td>
</tr>
<tr>
<td>Sodium lauryl sulfate</td>
<td>Sodium lauryl sulfoacetate</td>
<td>Sodium lauryl sulfoacetate</td>
<td>PVP</td>
</tr>
<tr>
<td>Flavour</td>
<td>Sodium Benzoate</td>
<td>Sodium Tripolyphosphate</td>
<td>TAED</td>
</tr>
<tr>
<td></td>
<td>PEG-180</td>
<td>PEG-8000</td>
<td>PEG-240</td>
</tr>
<tr>
<td></td>
<td>PVP/VA Copolymer</td>
<td>Carbowax 8000</td>
<td>Silica</td>
</tr>
<tr>
<td></td>
<td>Subtilis</td>
<td>Mint flavour</td>
<td>Sodium Methyl Oleyl Taurate</td>
</tr>
<tr>
<td></td>
<td>Sodium Stearate</td>
<td>Green Lake Blend</td>
<td>Cellulose- Lactose</td>
</tr>
<tr>
<td></td>
<td>Aroma</td>
<td>Magnesium Stearate</td>
<td>Colour Cl.42090</td>
</tr>
<tr>
<td></td>
<td>Limonene</td>
<td>Tetrasodium EDTA Dihydrate</td>
<td>Aroma</td>
</tr>
<tr>
<td></td>
<td>CL73015, Cl19140, Cl 42090</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
whereas the relative differences between $\Delta a^*$ and $\Delta b^*$ will have only a marginal effect.

Category values of the deltas are in decimals but for readability purposes are presented here as integers. The two-dimensional solution with eigen-values $d_1=2.16$, $d_2=0.673$ explained 94.4% of the total variance.

**DISCUSSION**

There are a number of factors which could influence the determination of the whitening capability of a denture cleanser i.e.: the type of stain initially used, the stained product, the number and time of treatment with denture cleansers and the way the effect of stain removal was measured.

A small improvement in the colour of the stained resin (Table 4) was found as a result of only one treatment, whether polished or not polished. In general, the $L^*$ values indicated a deterioration but there was a small improvement in the $a^*$ values (less positive) (Table 4) for the non-polished as well as polished samples indicated an improvement in the colour (less reddish), as did also the $b^*$ values (less yellowish). No significant differences in the whitening abilities of these denture cleansers were found when the specimens were soaked once in a denture cleanser (short periods as mentioned). However, it could be expected that multiple treatments (longer treatment periods) may result in a significant colour improvement as a consequence of repeated or prolonged exposures (Table 4). It was recently stated that discoloration of three different denture resins did occur when subjected to different staining agents (coffee, cola, grape juice) but also that the colour of the resins was subsequently improved by the denture cleansers.11 However, in contrast to our study the specimens were soaked for 12 hours in denture cleansers after staining. In another study12 where acrylic denture teeth (shades A1, B1, C1) were exposed for 10 hours daily over 48 weeks to various denture cleansers, clinically acceptable colour changes (delta $E^*$ explained for 10 hours daily over 48 weeks to various denture cleansers, clinically acceptable colour changes (delta $E^*$ of 3.5) were reported. Imirzalioglu et al11 reported a clinically observable colour shift (delta $E < 3.7$) as a result of exposure to tea, coffee and nicotine for days. Unlu et al12 also reported the whitening effect of four different types of agents on six different types of acrylic resins. However, none reported any of the components ($L^*$, $a^*$, $b^*$) separately but considered only the total colour change.

Table 4: The mean $L^*$, $a^*$ and $b^*$ values of non-polished and polished samples before and after treatment with the four different stain removers.

<table>
<thead>
<tr>
<th>Denture cleansers</th>
<th>Non-polished stained (n=5)</th>
<th>Polished stained (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before treatment</td>
<td>After treatment</td>
</tr>
<tr>
<td>Corega</td>
<td>$L^*$</td>
<td>50.26</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>18.16</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>9.16</td>
</tr>
<tr>
<td>Dentalmate</td>
<td>$L^*$</td>
<td>48.04</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>17.68</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>7.38</td>
</tr>
<tr>
<td>Fitty Dent</td>
<td>$L^*$</td>
<td>48.00</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>16.76</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>8.11</td>
</tr>
<tr>
<td>Steradent</td>
<td>$L^*$</td>
<td>48.18</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>17.56</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>7.70</td>
</tr>
</tbody>
</table>

If it is assumed that the degree of stain removal could also give an indication of the whitening improvement, it is valid to compare the present results with the findings of previous studies. In a recent article12 the stain removal ability of eight denture cleansers on acrylic resin was determined. In agreement with our results on whitening the authors concluded that all denture cleansers had a capacity to remove stain. However, they measured the optical density change of the stain remover and not the direct colour change on the specimen as we did. In agreement with our results, they found a change for most cleansers (except one) after only one cycle process of 1 minute and also an increase in improvement with increasing numbers of cycles (up to 5 times). Furthermore, they stained the acrylic resin with chlorhexidine and tea whereas we used the staining broth recommended by the American Dental Association12 which included many different products namely: a mixture of coffee, tea, mucin powder, sterilized trypticase soya broth, FD&C Red and Yellow colour along with red wine and 24-hour culture of Micrococcus luteus. Thus, it could be expected that our staining should be more intense and difficult to remove but it does simulate the in vivo situation more closely. Also in agreement with our results, another study12 concluded that all the commercial denture cleansers removed stain. However, in that instance the tests were done on polystyrene plates and not acrylic and the investigators used chlorhexidine and tea as staining solution.

Our specimens were placed in artificial saliva to build up an initial pellicle layer to more closely mimic the clinical scenario. All four denture cleansers are readily available in South African shops and pharmacies. All the denture cleansers contain various ingredients with the most common being sodium bicarbonate, which acts as a buffer and provides an alkaline environment. The alkaline substances most frequently employed in denture cleansers are the phosphates, carbonates and silicates.23 All four denture cleansers in our study contain some of these alkaline substances (Table 3). The pH values of all our products were measured: Corega...
7.9. Fitty Dent 9.1, Dental Mate 8.5 and Steradent 6.4. Steradent has the lowest and slightly acidic pH and the three other products have alkaline values, with Fitty Dent the highest. Differences in the pH values of cleansing solutions were reported to play a role in the whitening effect of acrylic resins.² Alam et al.³ concluded that a denture cleanser containing sodium percarbonate (sodium carbonate peroxide) and sodium lauryl sulphate was particularly effective in stain removal via a chemical action. Corega, Dental Mate (Dischem) and Steradent all contain sodium lauryl sulphate (soap) (Table 3), Corega and Fitty Dent contain sodium perborate. Steradent, Dentalmate and Corega all contain citric acid and sodium bicarbonate (Table 3); citric acid may assist with stain removal and sodium bicarbonate is recognized as a whitening agent.³

In this study, some of the specimens were smoothed and polished, but in a previous study it was suggested that the texture and amount of porosity of the denture surface play a major role in retaining stain and microbial plaque. These surface defects may favour the initial formation of plaque by protecting the organisms from dislodgement and could make complete removal of plaque and stain by physical means difficult.⁵ However, the current study did not show a statistically significant difference, although it is accepted that there was only one short treatment.

An interesting question which now emerged is which of the three different colour components (ΔL*, Δa* and Δb*) would determine differences in the visual impressions of the total colour change (ΔE*ab).

The fact that the two-dimensional solution (Figure 2) explained 94.4% of the total variance would imply that the differences between Δa* and Δb* of the materials in this study would be difficult to detect when presented to subjects (the human eye) and that it is rather the brightness/lightness which would determine the differences of the visual impressions of E*ab’s.

CONCLUSION

A small improvement in the yellowness and redness could be seen even after a single treatment. This was found for all four different commercially available denture cleansers on polished or non-polished specimens. From the relative magnitudes of L*, a* and b* which contribute to the overall colour value (ΔE*ab), it was shown that the brightness/lightness component (L*) should be the visual impression factor.

CLINICAL RELEVANCE

A slight improvement on the yellowness and redness could be seen after even a single treatment with any of the four different commercially available denture cleansers.

References

8. Minolta, Precise color communication, Minolta, Co., Ltd., Osaka, Japan, 1994: 9042-4930-02 IHCAJ.
Salivary Creatine Kinase MB in myocardial infarction

SUMMARY

Introduction: Most biomarkers in the blood and urine can also be detected in salivary samples.

Aims and objectives: To determine the relationship between serum and salivary levels of Creatine Kinase MB in patients with acute myocardial infarction.

Design: In a case-control study, forty-one patients diagnosed with myocardial infarction and forty-two age- and sex-matched controls were enrolled.

Methods: Saliva sampling by the spitting method was performed 12 to 24 hours after myocardial infarction, and in controls, between 9am and 12 noon. Salivary Creatine Kinase MB levels were measured by the photometric method. Mann Whitney U test and Spearman coefficient were used to analyze the data.

Results: There was no significant difference between patients with myocardial infarction and the controls in terms of the salivary levels of creatine kinase MB (case: 24 U/l vs. control: 19.5 U/l, p=0.30). Patients showed no significant difference in median levels of salivary creatine kinase MB in terms of sex (p=0.69) and previous history of myocardial infarction (p=0.31). In all patients there was a weak positive relationship between serum and salivary levels of creatine kinase MB (rs=0.14, p=0.39).

Conclusions: Salivary creatine kinase MB level cannot be an indicator for diagnosis of myocardial infarction.

Keywords: Creatine Kinase MB, saliva, myocardial infarction

INTRODUCTION

Acute myocardial infarction (AMI) is considered as the leading cause of death and disability in many countries. In Iran (place of the present study), about 138,000 deaths occur annually due to coronary heart disease of which MI accounts for about half. Early diagnosis of MI with high accuracy is a medical priority, saving lives and reducing treatment costs. According to the recent guideline set forth by the ESC/ACCF/AHA/WHF Task force for the definition of myocardial infarction, the main criteria for diagnosis of AMI are: detection of rise and/or fall of cardiac biomarkers (preferably troponin) with at least one value above the 99th percentile of the upper reference limit, together with evidence of myocardial ischemia based on one of the following: ECG changes indicative of a new ischemia, development of pathological Q waves, imaging evidence of new loss of viable myocardium or new regional wall motion abnormality. The Task Force has emphasised the importance of cardiac biomarkers as a necessary prerequisite for the diagnosis of MI. Although troponin has been recommended as the preferred biomarker, creatine kinase MB (CK-MB) was proposed as the best alternative where troponin assays are not available. In the 1960’s serum CK-MB was demonstrated as a highly specific marker of MI. In the 1970’s, CK-MB considered as a standard for the diagnostic and quantitative assessment of MI. In a recent study focused on early detection of MI by using cardiac biomarkers, the sensitivity and specificity of the CK-MB isoforms were measured as 95.5% and 93.9%, respectively. In 1980s, the use of CK-MB markers revolutionised the diagnosis of acute MI which turned out to be more specific than an accurate clinical history and myoglobin, and more reliable than ECG pattern recognition. As a consequence, CK-MB became the gold standard for the identification of cardiac injury. Myocardial necrosis gives rise to appearance of different proteins released into the circulation from the damaged heart cells. CK-MB levels rise within 3-5 hours of injury and reach a peak in 24 hours. In recent years, there has been an increasing interest in salivary-based analyses because saliva offers increased flexibility, cost effectiveness, convenience, and is less invasive compared with serum sampling. Most of biomarkers in the blood and urine can also be detected in salivary samples.
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* superBright LED generator
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to the recent findings from the National Institutes of Health, proteomic studies have shown more than 1,000 proteins and 19,000 unique peptide sequences in saliva. However, the clinical application for salivary diagnostics in the evaluation of systemic diseases has remained elusive. Having regard to the relatively high incidence of cardiovascular diseases in Iran and recognizing the importance of early diagnosis and monitoring to the prognosis of patients, this investigation was aimed at comparing salivary CK-MB between MI patients and healthy individuals. The study sets out to determine the correlation between serum and saliva levels of CK-MB in MI and in healthy patients. Further, the possible role of gender and a previous history of MI on levels of salivary CK-MB in MI patients will be considered.

METHODS

This case-control study was performed in Baghiatollah Hospital, Tehran, Iran. The group constituted of 41 patients (28 (68.2%) men, 13 (31.8%) women, aged 27-89 years) admitted to the emergency department with a typical ischemic chest pain, electrocardiographic ST segment elevation, and a rise in serum biomarkers of MI. Forty two (29 (69%) men, 13 (30%) women, aged 27-88) age and sex-matched individuals with no history of heart disease selected from hospital staff or persons who accompanied patients were enrolled as a control group. People with oral lesions or with muscular trauma were excluded from the study.

The study received approval by the Institutional Review Board (IRB) of the Shahid Beheshti University of Medical Sciences, (#3219,Oct.2013). Before saliva sampling, all persons received detailed information about the aim of the study and collection protocol in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments. Informed written consent was obtained from all participants whose identity remained anonymous.

They were asked to avoid eating, drinking, smoking and brushing teeth for at least two hours before sampling. One minute after mouth rinsing with tap water, the participants swallowed all their oral fluid, and thereafter, they expectorated 2-3ml of resting whole saliva into a dry, pre-weighed plastic tube. The saliva sample weight was calculated as the difference in the weights of the dry and the filled tubes. The salivary flow rate could then be determined. The tubes containing the saliva samples were centrifuged at 3800g for 10 minutes and then were stored at a temperature of -70°C for later analysis of CK-MB.

<table>
<thead>
<tr>
<th>Group</th>
<th>Salivary flow rate (ml/min)</th>
<th>Level of CK-MB (U/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case</td>
<td>0.93 ± 0.35</td>
<td>24</td>
</tr>
<tr>
<td>Control</td>
<td>0.81 ± 0.21</td>
<td>19.5</td>
</tr>
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</table>

The tests were all done in the same laboratory using the same standardized procedures. The times of collection of samples for serum and for salivary CK-MB testing were matched as closely as possible. Salivary CK-MB levels were measured by a photometric method using a Pars-Azmoon commercial kit (Tehran, Iran).

The Mann-Whitney U test was used to compare the salivary CK-MB levels in the MI patient and the control groups. The data was also examined to determine whether gender and previous history of MI (positive and negative) had an influence. A Spearman test was used to analyze the correlation between serum and saliva levels of CK-MB in MI patients. Results were considered statistically significant if p < 0.05. Analyses were performed using SPSS software version 16.

RESULTS

There were no statistically significant differences in the data between study groups in terms of age, sex, and unstimulated whole salivary flow rate (Table 1).

As salivary CK-MB levels between the case and the control groups were not normally distributed, the median of variables was used for statistical analysis by means of a Mann-Whitney U test. There were no significant differences between MI patients and healthy controls in terms of salivary CK-MB levels (p = 0.30) (Table 1).

In the MI patient group, there were no significant differences in median levels of salivary CK-MB in terms of gender (28 men, CK-MB: 21 U/l vs. 13 women, CK-MB: 24 U/l, p = 0.69).

The same finding was also obtained in terms of the previous history of MI in the group of affected patients. (14 positive history, median CK-MB level: 12.5 U/l vs. 27 negative history, median CK-MB level: 24 U/l, p = 0.31). The mean serum CK-MB level in the MI case group was (76.4 ± 64.1 U/l).

According to Spearman’s r-correlation test, only very weak correlations and no statistically significant differences were found between serum and salivary levels of CK-MB in patients with MI for both men (r = 0.17, p = 0.38) and women (r = 0.43, p = 0.14). Similar results were seen when the genders were pooled (r = 0.14, p = 0.39).

DISCUSSION

Plasma has been described as the main source of salivary secretions and it is therefore possible that any changes in the CK-MB level in blood could lead to a similar modification in the salivary content of this biomarker of necrosis. Hence it could be surmised that salivary CK-MB

<table>
<thead>
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<th>Table 1: Distribution of study variables in case and control groups</th>
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<tr>
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<tr>
<td>Case</td>
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<tr>
<td>Control</td>
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<tr>
<td>P value</td>
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</tbody>
</table>

* Student’s t-test **Chi-square test †Mann-Whitney U test
The results demonstrated no significant differences between case and control group in terms of salivary CK-MB levels, an outcome in agreement with previous similar studies. Although CK-MB and troponin are excellent serum biomarkers of AMI, they did not demonstrate discriminatory capacity in unstimulated whole saliva for the identification of AMI. Salivary CK-MB levels were found to rise only about 0.4-fold above baseline at 16 hours post-septal ablation. It was also noted that salivary CK-MB drifted upward early, returned to baseline levels, and remained thereafter below healthy control level at all time points. In somewhat stark contrast, another case control study on 30 MI patients concluded that in comparison with healthy controls patients with MI had an about 8-fold increase in salivary CK-MB level.

These differences in results might be related to variations in sample size, demographic characteristics of patients, study design and methodology in detection of CK-MB. For example, the immuno-inhibition method, which was used in a similar study, is described as a method of low efficacy to detect salivary and serum CK-MB. According to current results, sex and previous history of MI did not affect salivary CK-MB levels. No evidence was found in the literature indicating the effect of these two variables on salivary CK-MB levels in MI patients. However, a higher percentage of serum CK-MB alterations and positive ECG were found in men than women. In addition, despite the fact that age and sex are regarded as predisposing factors for heart disease; they had no significant effect on cardiac biomarkers such as troponin concentrations in saliva and blood in MI patients.

Contrary to Mirzaii-Dizgah et al. who found a strong correlation between serum and salivary levels of CK-MB, the present study revealed a very weak correlation. There were some limitations to the study. Sequential measurements of salivary CK-MB were not possible, as participants declined this procedure. There is little evidence in the literature regarding the alteration of salivary CK-MB levels during episodes of MI, and no data about the timing of CK-MB levels rising in salivary secretion after the onset of MI was discovered.

As patients with suspected, but not established MI, were not included in this study, no judgment regarding salivary CK-MB levels in patients with unstable angina could be established.

**CONCLUSIONS**

This study has not shown that alteration of salivary CK-MB levels could be a possible indicator in the diagnosis of myocardial infarction. However, in the light of contradictory evidence, further studies are warranted to clarify this finding.

**Acknowledgements**

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**Conflicts of interests:** No conflicts of interests declared.

**References**

Abstract

Adolescent caries is a new and growing challenge in restorative dentistry. Dental aesthetics has become a popular topic in all the disciplines in dentistry. When a makeover is planned to enhance the aesthetic appearance of the teeth of a patient, the clinician must have a logical diagnostic approach that results in the appropriate treatment plan. With some patients, the restorative dentist cannot accomplish the correction alone, but may require the assistance of colleagues in other dental disciplines. This case describes a unique approach to interdisciplinary dental diagnosis, beginning with aesthetics but encompassing function, structure and biology to achieve an optimal result. Providing education about risk factors for dental caries, such as consumption of sugars and poor oral hygiene, together with the introduction of preventive strategies, not only assists in meeting the special oral needs of the adolescent population, but also helps in the establishment of lifelong healthy habits.

Key words: Adolescent caries, interdisciplinary approach, interdisciplinary management

Introduction

Globally the prevalence of dental caries in permanent teeth is approximately 50% in 12- to 15-year-olds and 78% in 17-year-olds. Adolescence marks a period of significant caries activity for many individuals. Current research suggests that the overall caries rate is declining, yet remains highest during adolescence. The same factors that influence caries risk in children still exist throughout adolescence. Health care providers should be mindful of the following risk factors for caries: a) inadequate access to fluoride b) Poor oral hygiene c) Frequent access to sugars d) Previous caries experience e) Reduced salivary flow f) Infrequent professional dental care.

Changes in the frequency, distribution, and rate of progression of dental caries demand a re-evaluation of the treatment paradigm. Treatment of the adolescent patient can be multifaceted and complex. This case report explains the successful management of adolescent caries in a 17 year old patient, based on an interdisciplinary approach. Coordinated endodontic, periodontal and prosthodontic treatments, with careful consideration of patient expectations, requests and financial status, were critical for a successful outcome and patient satisfaction.

Case Report

A 17 year old male patient reported to the Department of Conservative Dentistry and Endodontics with the main complaint of decayed teeth. On intra-oral examination,
deep carious lesions were seen in the maxillary anterior, premolars, first molar and mandibular first molar teeth (Figure 1a and b). In addition, a gingival polyp in relation to 24, 26 and a pulp polyp in relation to 46 were observed (Figure 3 a and b). No other significant changes were seen in soft tissue. The patient's medical history was non-contributory.

The patient had the habit of frequent intake of chocolates (sucrose) and of taking milk and biscuits just before going to sleep. He used to brush once a day in the morning and practised no other form of oral hygiene measures. Orthopantomograph examination revealed carious lesions involving the pulp in relation to 16, 24, 46 and carious lesions approaching the pulp with respect to 15, 12, 11, 21, 23, 26 and 36 (Figure 2). Vitality tests (electric and thermal tests) gave a negative response in relation to all above-mentioned teeth.

The clinical and special investigation findings were collated and, following discussion with other specialties (Periodontics and Prosthodontics), the following treatment was planned:
- Oral prophylaxis
- Excision of gingival and pulp polyps.
- Root canal therapy
- Crown lengthening procedure
- Post Endodontics restorations

The treatment procedures were explained to the patient and informed consent was obtained. Oral prophylaxis followed by excision of gingival and pulp polyps was carried out in Department of Periodontics. Multiple visit root canal treatment was carried out, per quadrant under rubber dam isolation. Calcium hydroxide was used as an intra-canal medicament (Figure 4). The access cavities were restored with composite resins.

Crown lengthening is a surgical procedure which removes periodontal tissue to increase the clinical crown height and re-establish the biological width. In this case, the procedure contributed to meeting both restorative objectives and the aesthetic demands of the patient. Whenever crown lengthening is planned, the biological width must be considered, for if it is encroached upon, periodontal destruction may follow, leading to gingival recession. Crown lengthening procedures were carried out on teeth 24 and 46 in the Department of Periodontics (Figure 5a and b). A prefabricated threaded metal post was placed in both 24 and 46 to increase crown structure for crown placement.

The diagnostic casts were made from impressions taken in alginate. Orientation relation was recorded using face bow transfer, whilst centric relation was recorded with putty bite registration paste (Figure 6). Since the patient was missing the 22, the crown of the 23 was modified to mimic the shape of the lateral incisor. Crown preparations were done with shoulder finish lines on 11, 12, 15, 16, 21 23, 24, 26, 46 and 36. Gingival foam cord was used for tissue retraction. Poly vinyl siloxane putty wash impressions were taken.

Temporisation was effected using self cure acrylic resin and cemented using non-eugenol cement. Definitive metal ceramic crowns were cemented using Type I Glass

Figure 4: Endodontic treatment completed in teeth: 11,12,16,15,21,23,24,26,36, and 46.
Figure 5: Crown lengthening done to increase the height of the clinical crown on 46 (a) and 24 (b).
Figure 6: Face-bow transfer.
Figure 7 (a and b): Permanent porcelain–fused to metal crowns cemented.
ionomer cement (Figure 7a and b). The appearance of the patient was markedly improved. He was instructed to reduce his sugar consumption, and to intensify his oral hygiene practices, i.e. brushing twice daily with fluoridated toothpaste. The need to brush before going to bed was emphasized and the use of 0.2% Chlorhexidine mouthwash twice a day for one month was prescribed.

**DISCUSSION**

Dental caries is one of the most prevalent oral diseases of public health concern affecting adolescents. Untreated caries can result in pain and adversely affect quality of life. Present studies suggest that dental caries is a multifactorial disease, involving micro-organisms, substrate, host, and factors related to the teeth and time. The World Health Organisation (WHO) defines "adolescents" as individuals between the age of 10 and 19 years. Adolescents are considered as an important target group for oral health promotional activities as behaviour and attitudes formed during adolescence may last into adult life. Most adolescents attend schools, therefore, it might be easy to organise and target preventative care for this age group.

Good communication with the patient and effective interdisciplinary treatment planning was critical to patient satisfaction in this example of aesthetic dentistry. Three specialties of Dentistry, namely, Endodontics, Periodontics and Prosthodontics were involved. Crown lengthening was done without osteoplasty because of the availability of sufficient biological width, allowing a consistent 3mm gain. The face-bow transfer recorded the relationship of the maxilla to the transverse horizontal hinge axis of mandible. Endodontic treatment was chosen over implants because of cost factors and the inherent limitations of implants. Dentists, dental hygienists, and related health professionals should be aware of the unique aspects of treating adolescents, and be willing and able to spend time on prevention and diet counseling. Preventive measures such as prescription-strength fluoride gels for home use, fluoride varnishes, and other interventions may need additional emphasis for those individuals exhibiting increased caries susceptibility.

**CONCLUSION**

This article illustrates the importance of proper and logical treatment planning as well as clear communication between the dental team and the patient regarding the outcomes of the planned dental treatment. Favourable aesthetics and a functional result can only be achieved if the clinician is communicating well with the patient, and plans a logical treatment sequence. The complexity of a case can be reduced if management is broken down into separate phases of treatment that can be addressed sensibly. For this patient, the treatment outcome exceeded his expectation. Certainly, his quality of life has greatly improved.

**References**

Comparison of a custom made electronic record book database with a traditional student record book for recording clinical procedural credits and continuous clinical assessments in Restorative Dentistry

**ABSTRACT**

**Introduction:** Comparison of a custom designed electronic record book database with a traditional student record book in Dentistry has not been documented.

**Aim:** To develop an electronic record book database (ERBD) to record and calculate continuous clinical assessment (CCA) marks of students in Restorative Dentistry and to compare the efficiency of the ERBD system with the traditional student record book (TSRB).

**Methods:** Data was obtained from 1276 dental procedures performed by fifty five consenting final year students. Clinical supervisors and students were calibrated to record credits and CCA marks on a designated assessment form. In practice, the recorded data were manually transferred to the TSRB on a daily basis. The ERBD was designed as an electronic Excel® spreadsheet which enabled daily automatic calculating and updating of credits and CCA marks for each student. After a month the times taken to transfer these data from the TSRB and the ERBD to electronic class lists were recorded in minutes and analysed using the Student’s t-test.

**Results:** Significant differences (p < 0.0001) between the times were recorded. Discussion: The administrative procedure was 14 times faster when the ERBD was used.

**Conclusion:** The ERBD was significantly more efficient than the TSRB.

**ACRONYMS**

| CCA: Continuous Clinical Assessment |
| e: electronic |
| ERBD: Electronic Record Book Database |
| TSRB: Traditional Student Record Book |

**INTRODUCTION**

The benefits and educational impact of a traditional paper-based student record book (TSRB) has been documented in the literature. In health sciences, it has been used as an educational tool for teaching and learning, and for recording undergraduate clinical procedures and assessments. Clinical experiences may be documented and the clinical performance of students monitored. Whilst there is no golden standard against which a TSRB can be compared, the following qualities have been suggested: it should be feasible, efficient, accurate, inexpensive, accepted by supervisors and students, record valid and reliable data, allow frequent educational interaction between supervisors and students and provide students with relevant feedback regarding their clinical progress and assessments.

This study, applicable to dental education, compares a custom-designed electronic record book database (ERBD) with a paper-based TSRB, to determine which is more efficient for recording, calculating and updating procedural credits and continuous clinical assessment (CCA) marks. There appears to be no similar study reported in the literature.

Restorative Dentistry at the University of Pretoria has made good use of the TSRB. Clinical progress is monitored periodically by calculating and updating the total procedural credits and average CCA marks. This is done usually twice during the academic year preferably when students are on vacation. There are several reasons that prevent more frequent collection of the TSRB from each student. The organizational process was extremely inefficient, resulting in failure. The academic staff have clinical, administrative,
teaching and research commitments during the year and perforce are obliged to manage the huge task of processing the TSRB data during vacations. Students are reluctant (only 30% comply) to submit their books for auditing, indicating that they prefer to be on vacation when the audit occurs to avoid immediate confrontation with their teachers. Clinical interventions are constantly being performed throughout the academic year and frequent collection of the TSRB would interfere with the favourable practice of an immediate recording of student performance.

Once the books are assembled, processing the data entails counting the total number of credits recorded on each page of the TSRB and calculating the average CCA marks. The exercise (employed by many academic institutions) is extremely inefficient due to the large number of clinical procedures, procedural credits and CCA marks recorded by each student. An innovative solution to reduce the workload associated with this arduous time-consuming administrative task would be to create and develop a faster and more efficient alternative. Hence the motivation and need for this study.

Therefore the aims of this study were to:
1. create and develop a custom designed ERBD to record and update the clinical procedural credits and to automatically calculate the CCA marks of final year undergraduate students in Restorative Dentistry.
2. compare the efficiency of the administrative process using the ERBD with that of the paper-based, traditional student record book (TSRB) method.

Efficiency

The definition of efficiency for the purpose of this study is the combined time (in minutes) to calculate:
1. the total number of procedural credits for each student,
2. the average CCA mark of each student and
3. the transfer of the total number of procedural credits and average CCA mark of each student to an electronic Class List spreadsheet in Microsoft® Excel.

The sequence will be referred to as the administrative process.

METHODS

This descriptive, cross sectional study utilized data obtained from 1276 undergraduate dental procedures (recorded on the assessment forms and the traditional student record books) performed during the month of February of the academic year by fifty five (n = 55) consenting BChD V students ranging in age from 18 to 24 years. To ensure reliability, clinical supervisors and students were calibrated in the recording of clinical procedures, procedural credits and CCA marks on an assessment form and in the TSRB. This took place at a calibration workshop before the commencement of the academic year. The times taken to create and develop the assessment form, the TSRB and the ERBD were outside the aims and were not considered.

Creation and development of the assessment form

A Restorative Dentistry assessment form for criteria referenced, student self assessment was created and developed in Microsoft® Word under the guidance of the module coordinator (responsible for coordination of the undergraduate module program and curriculum as well as all formative and summative assessment procedures). Validity and reliability were tested and proven.

Creation and development of the TSRB

The TSRB (Figure 1) was created and developed in Microsoft® Word by the collaborative efforts of clinical supervisors and students over several days. Each page listed a clinical procedure and the associated procedural code as well as a column for recording the procedural credits and the associated CCA mark.

The information (procedures, procedural codes and CCA marks) recorded on the assessment form was transferred to the TSRB (hand written by a clinical supervisor and witnessed by the student during a clinical session), on a daily basis. After a month each student was contacted telephonically or via e-mail with the request that they should submit their TSRB to the module coordinator on a specific day between 07:00-17:00. Books were delivered by individuals, or by small groups of students or were couriered, and full collection took place at a calibration workshop before the commencement of the academic year. The times taken to create and develop the assessment form, the TSRB and the ERBD were outside the aims and were not considered.

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Figure 1: An excerpt of the paper-based TSRB book used to record, calculate and update the procedural credits and CCA mark of each student.
### Figure 2:
An excerpt of the electronic spreadsheet of the class-list with the total procedural credits and average CCA mark of each student.

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### Figure 3:
An excerpt of an electronic spreadsheet of Student 1 used to record, calculate and update the procedural credits and CCA mark of each student.
approximately eight hours. The books were then arranged in alphabetical order according to the class list and preparations were made for data processing.

The module coordinator started a digital stopwatch once a TSRB was opened and the recording was stopped after the administrative procedure, as described above, was completed. This was repeated for each TSRB. The results for each student were calculated and transferred to an e-class list (Figure 2). The times in minutes for each procedure were recorded on an e-spreadsheet using Microsoft® Excel software and saved on a personal computer.

Creation and development of the ERBD
The ERBD was created and developed by the module coordinator on a personal computer using Microsoft Excel® software, basing the e-version on the format of the TSRB.

The process involved seven steps:

i) opening a Microsoft Excel® document,
ii) saving the student class list on the electronic spreadsheet,
iii) addition of the codes of the clinical procedures to the relevant cells
iv) addition of the mathematical formulae to the cells responsible for the appropriate calculations,
v) addition of the academic calendar days
vi) copying the master electronic spreadsheet to provide a spreadsheet for each student and
vii) the allocation of the student numbers to each electronic spreadsheet.

The process required less than an hour. The 55 spreadsheets were designed using a calendar format.

Average CCA mark
Rows on the spreadsheet recorded the day and date on which clinical procedures had been performed. Columns on the spreadsheet provided cells for the date-related recording of clinical procedures performed, the assessment mark allocated (0 to 5) and for calculations to derive the CCA percentage marks and progressive CCA percentage averages (Figure 3).

Total number of procedural credits earned
Total credits for each day were recorded in the cells of a dedicated Total column and enabled the automatic calculation of a monthly total, taking into account specific weightings for each procedure.

Compilation of the ERBD
Spreadsheets were prepared for each month with dates and days appropriately recorded (excluding weekends and holidays). The 55 spreadsheets formed the ERBD for the 55 students and was saved in a folder on the hard drive of the computer and backed up on a removable flash drive. To maintain anonymity e-spreadsheets were allocated student numbers and the ERBD workbook was password protected as a read-only document.

The procedural credits and CCA mark of each student was entered onto his/her dedicated e-spreadsheet (Figure 3), by the module coordinator on a daily basis. The total number of procedural credits and average CCA were automatically calculated and updated daily. During the month of this study the ERBD was e-mailed to supervisors and students every day for their reactions and comments.

Feedback from supervisors to students occurred via written e-mail using the university IT network service provider and feedback from students to supervisors was conveyed by written e-mail using the IT network service provider preferred by the student. After a month, the total number of procedural credits and the average CCA mark for each student were transferred to an e-class list (similar to the e-list in Figure 2), by the module coordinator, who started the digital stopwatch once the ERBD file was opened and stopped the digital stopwatch after the administrative procedure was completed for each e-spreadsheet, recording the time taken in minutes. The times necessary for the administrative procedures using the TSRB and when using the ERBD were recorded on a Microsoft® Excel e-spreadsheet and saved on a personal computer. The results were analysed using the Student’s t-test.

RESULTS
The study assessed the relative efficiencies of two systems of recording student performance by comparing the relative times taken to determine performance levels. The time taken to calculate and update the total class procedural credits and average CCA marks using the ERBD was 27.69 minutes (average = 30.21 seconds per student) compared with the 431.20 minutes (average = 7.48 minutes per student) taken using the TSRB. The ERBD process was 14 times faster than the TSRB.

These calculations were done automatically by the programmed ERBD. The information recorded on the assessment form and on the ERBD indicated that the total number of procedural credits and CCA marks recorded in the two systems did not differ significantly. The information recorded on the ERBD was accurate. The average procedural credits for the class was 23.2 credits and the average CCA mark was 57%.

The results for the comparison of efficiencies are illustrated in Figure 4 and Figure 5 as line charts on a logarithmic axis. The minutes were converted to seconds to emphasize the significant differences (p < 0.0001) between the times required to complete the administrative procedure of the calculation of the procedural credits and the CCA marks for each student. The line graphs clearly illustrate that the use of the ERBD for this purpose was notably more efficient than using the TSRB.

DISCUSSION
Properly constructed assessment tools that drive learning, including student record books, are effective educational tools,12,6,9 bringing structure and focus to the process of learning.1 Students in the new millennium (Millenials) prefer the use of innovative electronic technology for their assessment and learning.13-20 Electronic innovations in dentistry that encourage and motivate the learning process are essential to the progress of dental education6 especially those that encourage feedback during supervisor and student interaction.21-27 The paper-based TSRB makes it difficult to achieve effective feedback to students, restricting frequent or sufficient educational interaction between supervisors and students, without which remediation cannot be successfully accomplished.

The accessibility of the TSRB did not differ significantly from the ERBD. However the method of the submission protocol followed by the students was extremely inefficient and inconvenient for the module coordinator. It took approximately eight hours to collect every TSRB compared with the ERBD that was easily accessible in less than five
minutes on the computer and required a more convenient submission protocol. The assessment forms were handed by the supervisors after each clinical session directly to the module coordinator who entered the procedural credits and CCA mark onto the electronic spreadsheet of the ERBD. The ERBD updated the total credits and average CCA automatically. The relative complexity of the TSRB allowed the clinical progress and clinical performance of a student to be monitored only twice a year, delaying the identification of students who were underperforming. Therefore the time for intervention and remediation strategies was insufficient to allow supervisors to help students prepare adequately for future assessment evaluations.

Verbal interviews with all supervisors and students indicated that they preferred the ERBD. The system was seen to be feasible, accessible and allowing the administrative process of calculating and updating student procedural credits and CCA marks to progress efficiently. It could be e-mailed as an attachment, and students were enabled to interact electronically and frequently with supervisors about their procedural credits earned and CCA marks.

The e-communications allowed supervisors to provide students with specific reasons for the assessments which had been given. Blended learning opportunities were available and encouraged the process of communication without any hindrance of feeling intimidated. The ERBD also allowed the effective monitoring of student attendance of clinical sessions. Students who were absent from the clinical session without a valid explanation or prior notice were allocated a CCA mark of zero. Unacceptable attendance patterns of students could be identified and intervention strategies (student tutoring and discussion forums) implemented to prevent future problems. The zero CCA mark motivated students to present themselves at all clinical sessions.

Students performing below class average were also easily identified and intervention strategies and remediation by supervisors could be implemented early during the academic year. Intervention strategies included clinical guidance, practical exercises and group discussions to promote deeper learning. The ERBD allowed students to monitor their own progress and compare their progress to the progress of their colleagues. Allowing students to peruse the anonymous e-spreadsheets of their colleagues allowed them to experience self-reflection and self-realization. These experiences are essential for the promotion and encouragement of deeper learning amongst students and can influence changes in their behaviour. Changes that encourage students to drive the learning process may motivate them to achieve their required exit level outcomes and to graduate as competent clinicians.

Only one supervisor was responsible for entering all the procedural credits and CCA marks onto the ERBD and this may have contributed to the proven accuracy of the data, an essential requirement. These records are important in Dentistry because they contribute to the assessment of each student and determine whether they can and/or will achieve clinical competency.

Furthermore the design of the ERBD is simple, extremely cost effective and easy to replicate. The Excel® workbook is user-friendly, familiar to supervisors and students and compatible with any computer using Microsoft Windows as an operating system. It is also uncomplicated and will not compromise the operating efficiency of computers on a local area network (LAN) network. Further studies are necessary to determine the benefits and educational impact of the ERBD in other disciplines of Dentistry.
CONCLUSION
In summary the ERBD was more beneficial than the TSRB because:
1. it reduced the administrative workload of calculating procedural credits and CCA marks.
2. it is an e-version of the TSRB, is accessible via the internet (e-mail) and allows the clinical progress, CCA marks and attendance of students to be more frequently monitored by supervisors on a personal computer.
3. it allows students to monitor their formative (procedural credits earned) and summative clinical progress (CCA marks) and compare their clinical progress with their colleagues. This allows self-reflection.
4. it allows frequent and regular feedback (via e-mail) between supervisor and student in relation to their clinical progress (procedural credits) and clinical performance (CCA marks).
5. it helps motivate students by introducing the self-reflection learning experience that results in the self-realization of their competency. This encourages students to strive to improve clinical progress and performance in order to achieve success so that they will graduate as competent practitioners.
6. it complies with university assessment guidelines and identified students that were performing below average and allowed supervisors enough time to provide students with effective remedial support and learning opportunities so that they could progress to their next academic experience.
7. The ERBD possesses the qualities of an “ideal record book” as suggested in the health education literature.

Applications in private practice
The ERBD philosophy could be used in the private sector as an inexpensive method to monitor, calculate and update the total number of procedures performed daily, monthly and annually as well as to calculate the income.

Acknowledgements:
Prof. HS Schoeman for statistical analysis of results.

Conflict of interest: None declared

References
Temporomandibular disorders (TMD) have a multifactorial aetiology, one suggestion being that facial trauma caused by motor vehicle accidents (MVA) may result in TMD. However, the relationship is somewhat controversial as there is no conclusive evidence. Trauma to the temporomandibular joint (TMJ) can be classified as micro- or macro-trauma. The degree of severity varies from malocclusion, whiplash during MVA and facial fractures including mandibular and condylar fractures. Trauma to the TMJ whether direct or indirect may affect the balance of the TMJ, resulting in degeneration of the articular cartilage by altering the mechanical properties of the disc. A number of problems may be experienced including dislocation, effusion, fibrous adhesions, ankylosis, fracture of the condylar head or neck and limited jaw opening.

A long-term effect of MVA to the TMJ is a secondary malocclusion developing long after the primary treatment. The most common reason for this malocclusion is that the anteroposterior or transverse dimensions have been altered. In cases where condylar fractures were undiagnosed an open bite will develop, leading to a retrognathic mandible.

**CASE HISTORY**

A 24 year old female with a history of a previous MVA presented at our Oral Health hospital. The patient had sustained the injuries three years ago and had not received treatment. The main complaint was pain in the TMJ during function as well as a limited range of movement. A panoramic radiograph was taken at the initial examination.

During trauma the fractured segment is often displaced antero-medially due to the pull of the lateral pterygoid muscle. Degenerative changes may occur with time and these changes are more severe if the condyle is displaced.

**ACRONYMS**

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<td>CBCT</td>
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<td>Temporomandibular disorders</td>
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<td>TMJ</td>
<td>Temporomandibular joint</td>
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In cases with trauma to the anterior mandible the possibility of a condylar fracture must always be considered.

**References**

new

1 COMPLETE SENSITIVITY TOOTHPASTE
SPECIALY DESIGNED WITH
7 BENEFITS*

* With twice-daily brushing. † Parkinson C et al., 2013 reported a 33% reduction from baseline in Schiff sensitivity score at Week 8 for a stannous fluoride toothpaste. Sensodyne® Complete Protection combines active ingredient 0.454% stannous fluoride with 5% sodium tripolyphosphate to help prevent extrinsic tooth stain historically associated with stannous fluoride-containing toothpastes. Sensodyne® Complete Protection provides all-round care for your patients with dentin hypersensitivity.

Stannous fluoride forms a robust layer over the exposed dentin and within the exposed dentin tubules. This layer starts to build from first use and continues to build with twice-daily brushing. Clinically proven relief from dentin hypersensitivity pain. Reduction in dentin hypersensitivity from baseline after 8 weeks. 20% reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste. Helps control dental plaque. 29% improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste. Supports good gingival health.

For any product safety issues, contact GSK on +27 745 6001 or 0800 118 274.
NEW SENSODYNE® COMPLETE PROTECTION PROVIDES ALL-ROUND CARE FOR YOUR PATIENTS WITH DENTIN HYPERSENSITIVITY*1-5

Stannous fluoride forms a robust layer over the exposed dentin and within the exposed dentin tubules.1 This layer starts to build from first use6 and continues to build with twice-daily brushing1,6

Clinically proven relief from dentin hypersensitivity pain2,3

Up to 66%

Reduction in dentin hypersensitivity from baseline after 8 weeks†5

Helps control dental plaque4,5

20%

Reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste6,7

Supports good gingival health4,5

29%

Improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste5

"With twice-daily brushing. 1 Parkinson C et al., 2013 reported a 33% reduction from baseline in Schiff sensitivity score at Week 8 for a stannous fluoride toothpaste. 2 Sensodyne® Complete Protection combines active ingredient 0.454% stannous fluoride with 5% sodium tripolyphosphate to help prevent extrinsic tooth stain historically associated with stannous fluoride-containing toothpastes. 3 Sensodyne® Complete Protection is clinically proven to reduce dentin hypersensitivity pain by up to 66% compared to regular fluoride toothpaste. 4 Sensodyne® Complete Protection is clinically proven to reduce plaque by up to 20% compared to regular fluoride toothpaste. 5 Sensodyne® Complete Protection is clinically proven to reduce gingival inflammation by up to 29% compared to regular fluoride toothpaste. 6 Sensodyne® Complete Protection contains 0.454% stannous fluoride, which builds on first use and continues to build with twice-daily brushing.


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Case Report
Clinical Presentation
A 36 year old female suffering from multiple oral ulcers was referred to the Department of Periodontics and Oral Medicine clinic at the University of Pretoria in February 2016. The ulcers had been present for a month, were first seen as “small sores” that had subsequently increased in size. On examination, multiple, relatively painful, large (>1cm) ulcers were seen on the palate, labial mucosa, tongue and gingiva (Figure 1). She also had gingivitis and a plunging ranula of the submandibular gland and reported recent weight loss. The patient had been diagnosed with retroviral disease in 2010; her latest CD4 count was 49 with a viral load of 111 797 copies. Her haemoglobin (Hb) was 11.7g/dL and the estimated glomerular filtration rate (eGFR) >60mL/min. She had defaulted antiretroviral treatment (ART) for a year and was reinstated on treatment, on ART regimen 2 comprising of Lamzid and Alluvia in January 2016. Empiric Dapsone treatment had been instituted for the ulcers.

Management and diagnosis
An incision biopsy was taken under local anaesthesia from the lower lip ulcer. A mucosa covered fragment measuring 8x4x4mm was received. The biopsy specimen was fixed in 10% neutral buffered formalin, processed and embedded in paraffin wax. The histological examination showed an ulcer with a necrotic floor. At the edge of the ulcer was an inflamed non-keratinizing squamous epithelium. The underlying lamina propria contained an acute-on-chronic inflammatory cell infiltrate consisting of histiocytes, plasma cells, lymphocytes, neutrophils, mast cell and occasional eosinophils. Scattered within the inflammation were large immunoblast-like cells with large nuclei, prominent nucleoli and ample cytoplasm. Viral cytopathic effects were not seen. Following routine histology examination, special stains were ordered to exclude an infectious etiology (Table 1). Immunohistochemical stains and in-situ hybridization for EBV-encoded RNAs (EBER) were done to exclude viral and neoplastic infiltrates. The antibodies used, the source, clone and dilution together with results are summarised in Table 2. The final diagnosis was that of HIV-associated oral major aphthous ulceration. The patient was subsequently given chlorhexidine gluconate mouthwash and metronidazole. The patient was seen a month post-biopsy for follow-up with some resolution of some but not all lesions (Figure 2). At two months follow-up all lesions were healed.

Discussion
Oral ulceration may be due to a number of factors including trauma, infection, immune mediated disorders, systemic disease and neoplasia. In patients with HIV the most likely

| Table 1: Special stains used to exclude an infective etiology. |
|-----------------|-----------------|-----------------|
| Stains          | Indication      | Results         |
| PAS             | Fungal microorganisms | negative |
| ZN              | Acid fast bacilli (M. Tuberculosis) | negative |
| Modified ZN     | Acid fast bacilli (M. Leptosy) | negative |
| WS              | Spirochaetes (syphilis) | negative |
| Giemsa          | Bacteria and protozoa | negative |
| PAS (periodic acid Schiff), ZN (Ziehl-Neelsen), WS (Warthin-Starry) | negative |

| Table 2: Summary of antibodies used for immunohistochemical staining. |
|-----------------|-----------------|-----------------|
| Antibody        | Source          | Clone          | Dilution | Results |
| CMV             | Chemicon        | 8B1.2          | 1:4000   | negative |
| CD30            | DAKO            | M0751          | 1:50     | negative |
| HHV8            | Advanced Biotechnologies Chamber | AT4C11 | 1:50 | negative |
| CMV (cytomegalovirus), HHV-8 (human herpes virus type 8) | negative |
Figure 1: Patient presented with large, painful ulcers on the palate (A), lateral border of the tongue (B), upper labial mucosa (C) and lower labial mucosa (D).

Figure 2: Improvement of most of the lesions after one month.
causes are infections and neoplasia, both linked to a decrease in immune surveillance. Infections are prevalent in HIV patients therefore need to be considered in the possible pathogenesis of ulcers. Major oral aphthous ulcers in HIV are associated with a low CD4 count and increased inversion of the CD4+/CD8+ ratio.1,2 The current patient had a low CD4 count (CD4 = 49).

Oral ulceration in HIV have been traditionally divided as ulcerations, not otherwise specified (NOS) (group 2) and recurrent aphthous stomatitis (group 3).3 The clinical significance of this delineation is arbitrary. Aphthous ulcers in HIV are similar to those occurring in seronegative patients, presenting as minor (less than 5mm diameter), major (>10mm) and herpetiform (multiple ulcers of 1-3mm). The diagnostic criteria of major aphthous ulcers in HIV as set out by Phelan et al includes the following: large painful ulcers >1cm present for over >10 days, a negative viral culture and no infectious aetiology; with improvement on topical tetracycline application and resolution with topical or systemic steroids. The current case fits these criteria.

The clinical differential diagnosis of oral ulcers in HIV in a South African setting included histoplasmosis and tuberculosis ulcers. Histoplasmosis is a deep fungal infection caused by inhalation of soil and dust particles contaminated with spores of the fungus Histoplasma capsulatum. In an immune deficient host, the histoplasma infection disseminates into the blood stream leading to, amongst other manifestations, oral involvement.4,5 Oral histoplasmosis presents mostly as ulcerations that range from shallow to deep lesions with concomitant systemic symptoms such as weight loss, fever and malaise. South Africa has the highest worldwide HIV infection rate with the TB/HIV co-infection rate of over 50% making TB a likely causative agent in our setting.7 Mycobacterium tuberculosis primarily affects the respiratory system, however in disseminated cases oral involvement is possible. A few reports of primary oral tuberculosis have also been documented in the literature.6,9 Primary oral tuberculosis is postulated to result from direct mucosa inoculation by Mycobacterium tuberculosis and, rarely, by M. bovis. These infections present with long standing ulcers.

Other differential diagnoses in this case included cytomegalovirus (CMV) ulcer, syphilitic ulcers, Epstein-Barr virus (EBV) associated ulcer and neoplasia. CMV oral ulcers, although infrequent, are an indication of immune suppression. The virus-infected cells can be detected in tissue on routine histopathology examination, seen as large cells with large inclusion-like nuclei surrounded by a clear halo. Confirmation of virus infected cells is via a positive CMV immunohistochemistry stain. EBV associated oral ulceration has been described in immune-compromised individuals.8,10 The reported ulcers ranged from 1 to >2cm and can involve both the keratinizing and non-keratinizing squamous mucosa. Histological examination reveals a polymorphous infiltrate of inflammatory cells within which there are scattered immunoblastic and Reed-Sternberg-like cells. These cells are EBV positive, detected using in situ hybridization for EBV-encoded RNA.

It is important for the clinician to recognize and properly manage HIV patients with oral ulcers. The key features in the diagnosis of oral ulcers are the clinical history, size, duration of the lesions and whether they are single or multiple. Both local (trauma, chemical burn, etc.) and systemic causes of ulcers should be excluded. A single persistent firm non-healing ulcer with indurated margins may be an indication for malignancy and require further lymph node palpation. On the other hand multiple non-persistent ulcers that heal spontaneously are commonly caused by viral infections or aphthous ulcers. It is not uncommon to have persistent ulcers in patient with HIV, which may take months to resolve. Systemic and autoimmune diseases such as lichen planus, lupus and pemphigoid are likely to present with multiple persistent ulcers. It should be remembered that TB is a great mimicker of malignancy and hence may present as a persistent non-healing ulcer. The management of HIV oral aphthous ulcers include pain management, chlorhexidine mouthwash and the maintenance of a good oral hygiene. A biopsy of all ulcers is mandatory to exclude infections and malignancy. The biopsy of the ulcer should include adjacent normal tissue.

CONCLUSION

Major oral aphthous ulcers result in significant patient morbidity due to pain, difficulty in eating and swallowing. The recognition of the entity is vital for proper patient management.

Declaration: No conflict of interest declared.

References
Maxillo-facial radiology case 139

Below are images of the most common tumour of the paranasal sinuses. Discuss the radiographic features discernible and what is your diagnosis?

INTERPRETATION

Upper left (Fig. A) Occipital mental view (caudally angled by 15 degrees) and upper right lateral skull view (Fig. B) shows a large, dense mass occupying the right ethmoid region and expanding into the right orbit. The lower right axial CT (Fig. C) and lower left coronal CT (Fig. D) shows a mass of uniform density in the right ethmoid sinus region. A histological diagnosis of a compact osteoma of the right ethmoid sinus was made.

The osteoma is a slow growing benign bone tumour. It varies in size from a pea to a hen's egg and may fill the entire sinus and extend into neighbouring structures. It has an incidence of approximately 0.25% in all routine examinations of the paranasal sinuses. The frontal sinus is the most common site of occurrence and the tumour is found less frequently in the ethmoid cells. Osteomas rarely occur in the maxillary or sphenoid sinuses. Pathologically, osteomas may be divided into compact or hard and cancellous or soft varieties depending upon the constituents of the lesion. The cancellous osteoma probably represents a form of fibrous dysplasia and should not be considered a true bone neoplasm. The lesion is more common in males than in females. It most often occurs during puberty and in the second and third decades of life. Most of the patients are asymptomatic and the tumour is a coincidental discovery during radiographic examination. Osteoma of the frontal sinus may produce deformity of the forehead, involvement of the orbit, and extension of the anterior cranial fossa. The radiological features of the compact osteoma are sharply defined, homogeneous rounded or lobulated, ivory-hard bony mass, either sessile or pedunculated. This type of osteoma is common. The cancellous osteoma appears as an irregularly defined, rounded or lobulated mass of less density, and may be mistaken for a soft tissue mass. This type of osteoma is rare. Gardner syndrome and familial adenomatous polyposis may be associated with multiple osteomas.

Reference
1. Dodd GD, Jing B: Radiology of the Nose, Paranasal Sinuses and Nasopharynx, Williams & Williams, Section 2 1977 p 180-181
A 75-year old male patient presented to the Department of Maxillofacial and Oral Surgery complaining of a four-month history of a painless, ulcerative lesion which involved the posterior mandibular alveolar ridge in the region of tooth 38 with extension into the base of tongue. The patient reported that the lesion initially presented as a “pimple”. A dome-shaped area of mucosal swelling was clinically noted which subsequently ulcerated and had since failed to heal. The patient had sought treatment at three different hospitals before being referred to our institution.

Intra-oral examination confirmed the presence of an ulcer in the third quadrant. Tooth 37 and tooth 38 were missing while teeth 33, 34 and 35 were mobile. Radiological examination revealed two areas of bone destruction within the left mandible. The posterior area of bone destruction was located distal to tooth 38 extending posteriorly up to the anterior margin of the ramus while the anterior osteolytic defect extended from the distal aspect of tooth 32 to the mesial root of tooth 36. Numerous teeth showed associated periapical radiolucencies (Figure 1). In addition, the patient had suboptimal oral hygiene and appeared to be in a poor general medical state although he did not complain of any other signs or symptoms and was not on any chronic medication at the time of presentation. An incisional biopsy from the ulcerated intra-oral lesion was submitted for histology.

Histological examination of the tissue sections confirmed the presence of a high-grade malignant adenocarcinoma, the morphology of which was highly suggestive of a metastatic neoplasm. The malignant infiltrate comprised a well-formed glandular component with several glands cut in cross section to reveal interspersed lumina containing eosinophilic secretions. The tumour cells were markedly pleomorphic with conspicuous nuclear hyperchromasia, increased nuclear to cytoplasmic ratios and brisk mitotic activity (Figure 2). Central areas of comedo-type necrosis were observed. A panel of immunohistochemical stains was performed on sections of tissue in the presence of adequate positive and negative controls. Strong, diffuse immunoreactivity was noted for cytokeratin 20 (CK20) whilst cytokeratin 7 (CK7) immunostaining was negative. Furthermore, immunopositivity for carcino-embryonic antigen (CEA) was diffuse in its distribution (Figure 3). The histomorphological features and immunoprofile in this case

**CASE REPORT**

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**ACRONYMS**

- CBCT: cone beam computerised tomographic scan
- CEA: carcino-embryonic antigen
- CK7: cytokeratin 7
- CK20: cytokeratin 20
- NCS: numb chin syndrome
- PET: positron emission topographic

**Figure 1:** Reconstructed panoramic radiograph of the cone beam computerised tomographic scan (CBCT) showing two large destructive radiolucent lesions in the left mandible (A). A three dimensional reconstruction of the CBCT highlighting the extent of the bone destruction within the left mandible (B).
were most suggestive of an adenocarcinoma of colorectal origin. Further clinicopathological correlation, systemic investigation and work up were therefore advised.

A full body examination together with positron emission topographic (PET) scanning was performed. Glucose uptake highlighted “hotspots” of activity within the transverse colon and left mandible which served to confirm the histological assertion of a primary colorectal adenocarcinoma (Figure 4). The patient was referred for palliative therapy.

**DISCUSSION**

One of the hallmarks of malignancy is the ability to invade and metastasise to both loco-regional and distant sites. Metastatic tumour spread to the orofacial region is rare and accounts for only 1 to 4% of all oral malignancies and is typically diagnosed in the 5th to 7th decades of life. Secondary malignancy at this site may solely involve bone or soft tissue or in some instances both. Metastatic orofacial malignancies are predominantly located within bone in up to 90% of all cases. The mandible is the preferred site of distant metastatic tumour spread within the orofacial region, being involved in almost 85% of cases and far more frequently than the maxilla or soft tissue. Isolated soft tissue involvement is less usual with cases being largely limited to the gingiva and tongue.

The relative scarcity of mandibular metastases in general, is attributed to the increased bone density at this site which is accompanied by poor vascularity and an age-related loss of active haematopoietic tissue. Jaw bone involvement is almost always a late stage event characterised by multiple co-existent metastatic deposits, representing widespread disseminated disease. Furthermore, in approximately 67% of cases, jaw bone deposits of secondary tumour are concurrently identified at the time of primary tumour diagnosis. The clinical and histological diagnosis of distant metastatic disease in the absence of any known primary tumour remains challenging but should always be borne in mind for unusual soft tissue lesions and destructive bone disease at this site.

The most common primary tumour sites in male patients with secondary orofacial tumour involvement include the lungs, adrenal glands, kidneys and bone whilst in female patients, primary tumours are usually located in the breast, adrenal glands, female genito-urinary tract and colorectum.

Further confounding the accurate diagnosis of jaw metastases from distant sites is the highly varied clinical presentation of secondary disease. Metastatic tumour deposits mimic a wide range of benign, reactive and malignant disease processes. Isolated soft tissue deposits commonly involve the attached gingiva in the anterior maxilla and mandible but may also be identified within the tongue, floor of mouth, palate and buccal mucosa. They tend to present as submucosal masses which ulcerate over time. The clinical differential diagnosis for a soft tissue swelling of this nature would include a pyogenic granuloma, vascular malformation, peripheral giant cell granuloma and fibrous epulis. Metastatic lesions are difficult to separate from reactive benign soft tissue proliferations on the basis of clinical presentation alone. Features supporting the diagnosis of a malignant soft
tissue neoplasm include rapid growth, excessive bleeding, extensive surface ulceration and tissue necrosis. Soft tissue lesions may infiltrate adjacent bone to result in osteolytic destruction.2,7

Tooth mobility, rapid growth, painful swelling, bleeding and paraesthesia should be clinically worrying for symptoms of malignant bone involvement.2 Bone metastases cause osteolytic defects associated with marked tenderness which may be further complicated by trismus, dysphagia and even pathological fracture.7,8 Radiological examination of metastatic tumours within bone shows irregular, ill-defined destructive radiolucent lesions which may be mistaken for infected odontogenic cysts, advanced periodontal bone loss, osteomyelitis or a primary bone or odontogenic malignancy.3 Very occasionally, tumour cells stimulate osteoblastic bone deposition resulting in a mixed radio-opaque/radiolucent radiological appearance.3

Bone involvement may be accompanied by the rapid onset of paraesthesia along the distribution of the mental branch of the inferior alveolar nerve associated with tingling, numbness and a burning sensation on the skin of the chin and lower lip.1,3 This rather peculiar neurological manifestation is termed “numb chin syndrome” (NCS) and is a fairly consistent indicator of primary or metastatic mandibular malignancy.1,2 NCS occurs due to direct tumour infiltration of nerve or as a result of perineural tumour spread. Mental nerve neuropathy consequently strongly suggests the presence of malignancy.3,4 The presence of NCS in a patient with no clinical evidence of pathology is often the only sign of a metastatic neoplasm.4

Colorectal carcinoma represents a disease of lifestyle associated with a diet high in fat and protein. Although previously considered a neoplasm of “Western Society”, its incidence has increased dramatically in other geographic regions. Metastatic colorectal carcinoma is most often reported in the liver, lungs, adrenal glands and kidneys followed lastly by bone deposits. The jaw is an unlikely site reported in the liver, lungs, adrenal glands and kidneys regions. Metastatic colorectal carcinoma is most often incidence has increased dramatically in other geographic groups with no clinical evidence of pathology. As a result of perineural tumour spread. Mental nerve neuropathy consequently strongly suggests the presence of malignancy.3,4 The presence of NCS in a patient with no clinical evidence of pathology is often the only sign of a metastatic neoplasm.4

The CK7 and CK20 immuno-profiling of tumour masses allows for initial categorisation based on site of origin. Colorectal carcinoma consistently displays negativity for CK7 whilst showing strong positive immunoreactivity for CK20. These two simple immune-histochemical stains are exceptionally useful for excluding and including multiple sites of primary tumour origin.2 Additional site specific tissue markers and novel molecular markers are useful confirmatory adjuncts for the determination of the tissue of origin.4

Owing to the advanced nature of disease when jaw bone metastases are clinically evident, palliative therapy is the usual therapeutic option. This typically includes chemotherapy and very occasionally surgery with no curative intent, at both primary and metastatic tumour sites. Palliative therapy is primarily aimed at reducing symptoms of pain and discomfort while facilitating normal function and improving the overall quality of the patient’s life.3,6

CONCLUSION

Metastatic malignancy to the jaws signifies advanced, disseminated, incurable terminal disease. Awareness of the clinical heterogeneity as well as the fact that metastatic tumour deposits may be the first sign of occult primary malignancy emphasises the significance of early recognition and diagnosis. Jaw metastases frequently present as loosening of teeth prompting patients to seek dental treatment first and foremost. Clinicians therefore need to be cognizant of metastatic jaw bone lesions despite their scarcity. Rapidly growing destructive necrotic bone and soft tissue lesions in a geriatric age group with no known underlying cause of disease, as well as in patients who have previously been diagnosed with malignancy, demands expeditious diagnostic and therapeutic intervention. In patients with a previously diagnosed malignancy or in those who are undergoing oncological therapy, such a clinical presentation may be the first indication of tumour recurrence or progression. The earlier metastatic malignancy is recognised, the sooner palliation may be initiated, thus improving the quality of life for the patient.

This case is intended to highlight a rare orofacial manifestation of an underlying distant primary visceral neoplasm in order to increase the clinical index of suspicion for possible occult primary malignancy. It also demonstrates the absolute necessity of acquiring a thorough medical history from each and every patient whilst having adequate knowledge of systemic malignancies.

Declarations: No conflict of interest declared.

References
Vicarious liability – it’s a risky business

S Naidoo

General dental practitioners often envisage that the risks they have are related to them personally as an individual and to their own practice and rarely consider that their employees also affect their risk profile. Most dental practices consist of a dental team that comprises at a minimum of a receptionist, a dental assistant and the dentist. Usually, the receptionist and the dental assistant are employees of the dentist. In addition, a practice may employ a dental therapist or an oral hygienist and he or she may function to their own account or as an employee of the dentist. The dentist, as an employer, can be held responsible for any negligent acts or omissions that the employee commits while performing duties within the scope of his or her employment. This responsibility extends not only to any treatment procedures provided, but also includes any explanations or verbal instructions given to patients by employees. This responsibility is termed “vicarious liability” and it includes all acts or omissions of both lay and professional staff whether or not the staff member was acting according to the instructions given. A dentist must ensure that any employee, locum, or independent contractor working for the practice, who themselves may have a high level of clinical autonomy, has indemnity in their own right. In addition, partners can individually or jointly be liable in legal actions brought against the partnership, and similarly it is essential that each partner and every assistant is appropriately indemnified or insured.

From a legal perspective, establishing responsibility for negligence is important. Where does the responsibility of the employer end with respect to acts of negligence and omission on the part of the employee? Since vicarious liability refers to liability for the wrongful act of another during the course of employment, it will apply when an employee does not act with the required amount of skill and care, and harm may be caused to others. In order to decide if an employer is vicariously liable for the actions of his employee there must be an employer-employee relationship.

In a typical employer-employee relationship, the locus of control lies with the employer and the employee acts within the parameters that have been set by that employer. It is assumed that since employees have been recruited, trained and retained by the employer, the employer may be deemed liable should there be a claim lodged. Claims can include those that have arisen on account of a failure by non-clinical staff to communicate patient complaints to their employer, communicate updated patient information (like medical history) to their employer, and loss of patient records.

The situation may become complicated where the locus of control lies outside the employer, for example in the case of the employment of a locum tenens. In general, a locum tenens operates independently and provides services for a limited period of time. They are usually not supervised and the quality of care provided is not determined by the employer and the locum tenens exercises his/her own professional judgment when treating a patient. It could therefore be assumed that there should be a claim the employer is not liable because they have not defined the manner in which the locum works. On the contrary, the reverse is true insofar as the employer could be deemed liable in the first instance, until the independent contractor status of the locum is clarified. Dental professionals working in the public sector, as an employee of a public hospital or clinic, can also be held individually liable for negligent conduct and this can be found in the terms of the Public Finance Management Act 12(2)3, that states that a public hospital does not have to accept liability for the negligent actions of an employee if the employee:

- Intentionally exceeded his/her powers
- Made use of alcohol or drugs
- Did not act in the course and scope of employment
- Acted recklessly or intentionally
- Without prior consultation with the State Attorney, made an admission that was detrimental to the State or failed to comply with or ignored longstanding instructions which led to damage or reason for the claim.

CONCLUDING REMARKS

It is imperative for all practitioners to consider issues of risk regardless of the contractual agreement that exists between them and the entire dental team of employees. Policies should be in place that clearly define how each should function in providing care to patients, be they independent contractors or not. Vicarious liability claims are more likely to be brought against dentists who do not have established practice policies. There must always be clear lines of communication between all members of the dental team to avoid medico-legal complications. All employees should be adequately supervised and keep their skills up-to-date. This is especially important when delegating work, which should be done only when it is appropriate and if the employee is able to perform the task. All staff in a dental practice must receive adequate training regarding the ambit of their prescribed duties and safety of patients. This is especially important where children are concerned. Clear policies defining the working relationship and specific services that will be provided by them are essential when employing locum tenens. In addition, patients need to be informed if a locum is employed in the practice.

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What’s new for the clinician?
Summaries of and excerpts from recently published papers

1. Clinical efficacy of oxalate-based desensitizing agents in restorations of non-carious cervical lesions – a randomized clinical trial

As more people retain their teeth for longer periods of time and more people undertake daily brushing as part of their daily routine, non-carious cervical lesions (NCCLs) are becoming more common in the mouth. The presence of these lesions is related to many factors including erosion, abrasion, gingival recession, periodontal surgery, and abfraction. They are significantly more prevalent in older people, with premolars being the most affected teeth. Whilst some of these lesions are asymptomatic, a significant number are usually associated with dentin hypersensitivity due to the exposure of dentin in the oral environment.

In an attempt to reduce this discomfort, several desensitizing agents such as calcium hydroxide, stannous fluoride, arginine, glutaraldehyde, and oxalates have been used. Oxalate-based desensitizing agents, derived from oxalic acid, were introduced as an optional treatment for dentin hypersensitivity in the 1980s. These agents are being increasingly used because they act not only by obliterating the dentin tubules, with the precipitation of calcium oxalate crystals on the surface and inside the dentin tubules, but also by depolarizing the nerve endings preventing the conduction of current which leads to pain. Due to this, there have been laboratory based studies that have sought to include oxalate-based desensitizing agents in the adhesive bonding process when placing resin composite restorations. The rationale of this is that these agents will enhance the adhesive bond and also reduce the sensitivity of the dentine. Albuquerque and her colleagues in Brazil (2016) reported on a RCT that sought to evaluate the longevity and clinical success of restorations in non-carious cervical lesions with or without the application of oxalic acid. The null hypothesis tested was that both techniques have similar effectiveness after four years of clinical service.

MATERIALS AND METHODS
Twenty volunteer patients of both sexes (16 female, 4 male), ranging in age from 24 to 55 years old, underwent clinical evaluations, using a mouth mirror, an explorer, and a periodontal probe. Anamnesis, photographs, and radiographic examinations were also performed.

The following were the criteria for inclusion of a patient in this study: appropriate oral hygiene; absence of caries, periodontal disease; bruxism and traumatic occlusion; no wear facets; the presence of at least two non-carious cervical lesions with a depth equal to or greater than 1mm, independent of their location in the dental arcade, and which were to be restored.

The degree of hypersensitivity was determined according to the Verbal Rating Scale (VRS) from 0 to 3, in which:
0 = no discomfort;
1 = minimum discomfort;
2 = mild discomfort; and
3 = intense discomfort.

Each tooth received air blast stimuli with an air syringe for one second at a distance of one cm from the tooth surface, and the presence of sensitivity was used as evidence to enrol the patient in the study.

A total of 90 restorations in 20 patients were performed by one calibrated operator using a standardized protocol, and 45 of these had a prior treatment with oxalic acid.
(Bisblock-BISCO) after etching. The remaining 45 were used as control. Allocation of treatment per tooth was randomly selected using a table. The restorative procedure included cleaning of all lesions with pumice and water in a rubber cup, rinsing and drying, preparation of lesion, acid etch and rinse, application of bond adhesive (XP Bond) with or without oxalic acid, light cure, application of resin composite (Durafill), light cure and then finish.

The restorations were evaluated at baseline and at four years by two experienced and calibrated examiners other than the operator. The clinical evaluation was performed using a mirror and a double-ended probe after tooth prophylaxis with water and pumice in a low-speed hand piece. Modified United States Public Health Service criteria were used to evaluate retention, marginal integrity, marginal discoloration, postoperative sensitivity, anatomic form, and caries at the baseline and four-year periods. Alfa (A) and Bravo (B) scores were classified as clinically acceptable and Charlie (C) as clinically unacceptable. The baseline rating was carried out one week after restoration, immediately after the finishing and polishing procedures.

RESULTS

At the recall, five restorations from the control group and nine from the experimental group were found to have been lost. Therefore, retention rate in the control group was 85.3 % (%A + B) and 70.9 % (%A + B) for the experimental group (p = 0.2288). For all other evaluated clinical criteria (marginal integrity, marginal discoloration, postoperative sensitivity, anatomic form, and caries at the baselines and four year periods), the rate (%A + B) was 100 % in both groups (p = 1.000).

Regarding retention rate, the intragroup (within group) comparisons demonstrated no statistically significant difference between the baseline and four year recall in the control group (p = 0.06), while there was a statistically significant difference in the experimental group (oxalic acid group) (p = 0.003). For all other evaluated criteria in both groups, no statistically significant differences were found (p> 1.000).

CONCLUSION

The researchers concluded that after four years of service, the use of oxalic acid did not influence the clinical performance of retained restorations when it was used under composite resin restorations.

IMPLICATIONS FOR PRACTICE

This trial demonstrated that dentin pretreatment with oxalic acid was an additional step in the etch-and-rinse adhesive technique and although being effective in reducing dentinal hypersensitivity it significantly affected the retention of adhesive restorations over time (the within group retention rate from baseline to four years was statistically significant in the oxalic acid group).

ACRONYMS

C1: 95% confidence intervals
MD: mean Difference
RR: risk ratio

2. Short dental implants versus standard dental implants placed in the posterior jaws: a systematic review and meta-analysis


Implants are often used as a treatment option for partially or totally edentulous patients. Tooth loss in the posterior jaws favours the resorption process of bone tissue, causing greater proximity to the inferior alveolar nerve and maxillary sinus, limiting the use of longer implants.1 To overcome these problems, bone grafts or maxillary sinus lifting have been used to re-establish the height of restored bone tissue and allow for placement of standard implants.1 However, these techniques are associated with increased postoperative morbidity, higher costs, and higher risks of complications during patient rehabilitation.1 Thus, short implants are used, which are considered to be simpler and more effective for subsequent rehabilitation of atrophic ridges. Lemos and colleagues (2016) undertook a systematic review with meta-analysis to evaluate the survival rate of short implants (equal to or less than 8 mm) compared with standard implants (larger than 8 mm) in the posterior jaws. The null hypotheses were: (1) there are no differences between short implants and standard implants with regard to survival rates of implants and (2) there are no differences in marginal bone loss, complications, and prosthesis failures when short implants and standard implants are used.

MATERIALS AND METHODS

Electronic searches were conducted at the selected databases PubMed/Medline, Embase, and Cochrane Library for articles which met the eligibility criteria and had been published before 10 September 2015. The keywords used in this study were: ‘short implant AND dental implant OR short dental implants OR short dental implants posterior OR short dental implants maxilla OR short dental implants mandible. Hand searching was also
carried out in selected journals and the grey literature was also checked for unpublished studies.

Eligible studies in the English language that were considered for inclusion were:
1. randomized controlled trials,
2. prospective studies,
3. trials with at least ten patients,
4. studies published within last 10 years,
5. trials that compared short implants and standard implants in the same study,
6. patients or data repeated in other included articles, and
7. studies that showed only short implants without a comparison group.
8. studies that considered short implants larger than 8mm.

The PICO approach (population, intervention, comparison, outcomes) was used to address the question: do short implants have similar survival rates compared with standard implants? In this process, the population comprised patients rehabilitated with dental implants in the posterior jaws (maxilla and mandible). Intervention was short implants in the posterior jaw, and the comparison was made with patients who received standard implants in posterior jaws. The primary outcome evaluated was the survival rate of implants in the posterior jaws. The marginal bone loss, complications, and prosthesis failures were the secondary outcomes.

One of the authors collected relevant information from the articles, and a second author checked all of the collected information and a third author settled all of the disagreements between the investigators through discussion until a consensus was obtained. Two authors assessed the methodological quality of studies according to the Jadad scale, which ranges from 0 to 5, with scores of three considered high quality. The Cochrane collaboration criteria for judging risk of bias was used to assess the quality of the studies included for review.

The meta-analysis was based on the Mantel–Haenszel (MH) and Inverse Variance (IV) methods. Survival rates of implants, complications and prostheses failures were the outcome measures evaluated by risk ratio (RR) and marginal bone loss, the continuous outcomes were evaluated by mean difference (MD) and the corresponding 95% confidence intervals (CI). The RR and MD values were considered significant when P < 0.05. The software reviewer Manager 5 (Cochrane Group) was used for meta-analysis.

RESULTS

The search identified 1460 references, and, after inclusion criteria were applied, 13 studies were assessed as eligible. A total of 1269 patients, who had received a total of 2631 dental implants were assessed in the included trials. The studies showed that 83 out of 2631 implants placed had failed (3.15%), which included 45 standard implants (2.72%) and 38 short implants (3.87%). A random-effect model found no statistically significant difference between standard implants and short implants placed in the posterior regions (P = 0.24; RR: 1.35; 95% CI: 0.82–2.22). Significant differences for the longer implants were not observed when compared with short implants in the maxilla (P = 0.28; RR: 1.50; 95% CI: 0.72–3.09), and similarly, no differences were observed in the mandible (P = 0.34; RR: 1.52; 95% CI: 0.64–3.63). There was no significant difference for 8 mm implants (P = 0.34; RR: 0.50; 95% CI: 0.12–2.07), but the short implants with length less than 8 mm showed lower survival rates than standard implants (P = 0.02; RR: 2.05; 95% CI: 1.12–3.74).

Nine studies evaluated the differences in length concerning marginal bone loss around the implants through means (mm), which were evaluated by the same studies in different follow-up periods. For the meta-analysis, only the final follow-ups of the studies were used. The overall analysis of studies that evaluated marginal bone loss showed no significant difference between short implants and standard implants (P = 0.06; MD: 0.20; 95% CI: 0.41 to 0.00) and no differences were observed between the maxillary and the mandibular arches.[28,31–33] (P = 0.09; MD: 0.19; 95% CI: 0.41 to 0.03), (P = 0.39; MD: 0.23; 95% CI: 0.76 to 0.30).

Complication rates were reported by seven studies, which considered any biological or mechanical complication. Although there were higher rates of complications for the standard implants, these were not statistically significant (P = 0.08; RR: 0.54; 95% CI: 0.27–1.09). The mandibular arch had the highest prevalence of biological complications. It is noteworthy that most of the studies in this review that reported complication rates performed bone grafting procedures for the installation of standard implants.

Prosthesis failure rates were evaluated by seven studies. The analysis considered prostheses failures that could not be repaired or that failed together with the implant. No significant differences were observed (P = 0.92; RR: 0.96; 95% CI: 0.44–2.09) in relation to prosthesis failure rates.

CONCLUSION

Short implants showed marginal bone loss, prosthesis failures and complication rates similar to standard implants, being considered therefore a predictable treatment for posterior jaws, especially in cases that require complementary surgical procedures. However, short implants with length less than 8mm (4–7mm) should be used with caution because they present greater risks for implant failures when compared with standard implants (P = 0.02; RR: 2.05; 95% CI: 1.12–3.74).

IMPLICATIONS FOR PRACTICE

This high quality systematic review with meta-analysis has provided compelling evidence that short implants show equivalent performance when compared with standard implants for the outcomes assessed in the posterior jaws.

Reference

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GENERAL

An in vitro comparison of micro-leakage between three calcium silicate cements and amalgam. (p 100)
1. Calcium silicate cements set by a hydration reaction, which makes them conducive for use in a moist environment.
   a. True
   b. False

2. Amalgam was found to have a more superior sealing ability than calcium silicate cements when used as a root-end filling.
   a. True
   b. False

3. Calcium silicate cements are bioactive materials that stimulate the formation of hydroxyapatite crystals when in contact with a physiologic solution.
   a. True
   b. False

The whitening effect of four different commercial denture cleansers on stained acrylic resin. (p 106)
4. Immersion type denture cleansers contain aggressive abrasive particles.
   a. True
   b. False

5. Identify the INCORRECT statement below:
   Denture base polymers may be susceptible to colour-shifting if:
   a. the cleaning solutions are not used correctly.
   b. the water used in the solution is at high temperatures
   c. there is erratic use of chemical denture cleansers.
   d. irregularities and porosities present on denture surfaces retain stain and microbial plaque.

Salivary Creatine Kinase MB in myocardial infarction. (p 112)
6. Creatine Kinase MB (CK-MB) has been proposed as the best alternative where troponin assays are not available.
   a. True
   b. False

7. Identify the INCORRECT statement below:
   There is an increasing interest in salivary-based analyses because:
   a. saliva offers increased flexibility
   b. it is cost effective
   c. it is convenient, and minimally invasive
   d. More biomarkers can be detected in salivary samples than in blood and urine samples.

8. This study has not shown that alteration of salivary CK-MB levels could be a possible indicator in the diagnosis of myocardial infarction.
   a. True
   b. False

Adolescent caries management: an interdisciplinary approach. (p 116)
9. This paper reports that globally the prevalence of dental caries in permanent teeth is approximately 50% in 12- to 15-year-olds and 78% in 17-year-olds.
   a. True
   b. False

10. Whenever crown lengthening is planned, the biological width must be considered, for if it is encroached upon, periodontal destruction may follow, leading to gingival recession.
    a. True
    b. False

Comparison of a Custom made electronic record book database with a traditional student record book in Restorative Dentistry (p119)
11. Identify the type of study design reported in this paper.
    a. sectional descriptive study.
    b. quasi-experimental study.
    c. longitudinal study.

12. Does Self- realization promote deeper learning?
    a. Yes
    b. No
    c. Maybe

Maxillo-Facial Radiology Case 139 (p 131)
13. Osteomas occur commonly in the maxillary sinus.
    a. True
    b. False

14. The cancellous osteoma may be mistaken for a soft tissue mass.
    a. True
    b. False

15. South Africa has the highest worldwide HIV infection rate with a TB/ HIV co-infection rate of over 50% making TB a likely causative agent in the country.
    a. True
    b. False
Previously undiagnosed MVA trauma to TMJ (p 125)

16. A long-term effect of a motor vehicle accident which caused trauma to the TMJ is a secondary malocclusion developing long after the primary treatment.
   a. True
   b. False

Oral pathology case: Metastatic colorectal carcinoma to the mandible (p 132)

17. Tooth mobility, rapid growth, painful swelling, bleeding and paraesthesia should be clinically worrying for symptoms of malignant bone involvement.
   a. True
   b. False

Clinical windows (p 136)

18. In the Albuquerque et al. trial, the intragroup (within group) comparisons demonstrated a statistically significant difference in the experimental group (oxalic acid group) at Year Four.
   a. True
   b. False

19. In the Lemos et al. review, there was no statistically significant difference between standard implants and short implants placed in the posterior regions for both the primary and secondary outcomes.
   a. True
   b. False

20. In the Lemos et al. review, no differences were noted for the complication rates between short and standard length implants.
   a. True
   b. False

ETHICAL

Vicarious liability – it’s a risky business (p 135)

21. The dentist, as an employer, can be held responsible for any negligent acts or omissions that the employee commits while performing his/her duties within the scope of his or her employment.
   a. True
   b. False

22. “Vicarious liability” includes all acts or omissions of both lay and professional staff whether or not the staff member was acting according to the instructions given.
   a. True
   b. False

23. In terms of the Public Finance Management Act 12 (2), a public hospital does not have to accept liability for the negligent actions of an employee if the employee:
   a. Intentionally exceeded his/her powers.
   b. Made use of alcohol or drugs.
   c. Did not act in the course and scope of employment.
   d. Acted recklessly or intentionally.
   e. All of the above.

24. It is not important for staff in a dental practice to have training regarding their prescribed duties and safety of patients.
   a. True
   b. False

25. From a legal perspective, it is important to establish responsibility for negligent acts.
   a. True
   b. False

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

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

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Contact details:
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South African Dental Association
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Fax to email: 086 688 0392
e-mail: ABayman@sada.co.za
or via fax to 086 688 0392

SADA Contact Numbers:

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