The Sardine *Sardinops sagar*, a type of pilchard, spawns in the cool waters of the Agulhas Bank and gathers in huge shoals off the eastern coast of South Africa in June/July. The shoal can be 7 kms long, 1.5 kms wide and 30 metres deep. Teeth: prominent basibranchial dentition, ie teeth on the basibranchial bone behind the tongue and between the gills.
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The Dental Student: Paradox or Paragon?

The vitality of the profession rests in each succeeding crop of graduates, an injection of youthful vigour and enthusiasm which the Schools are proud to contribute to the country each year. Emerging from the rigours of the demanding dental curriculum, our new colleagues are eager to embrace the profession and to put their hard won expertise to work. That many may find it difficult to enjoy the full spectrum of treatment possibilities in Community Service is a passing problem, for the future beckons with wider options.

Too fanciful, too idealistic? Casting our students as paragons of virtue? Perhaps, but the truth is that there are classes at our Schools approaching the final hurdle and now looking beyond student days ready to assume greater responsibilities, BUT could this year be one facing possible impediments to graduation? There has been talk and plans at high levels in South African academic circles regarding the deferment of examinations and of graduation. It may be possible that dental graduands are affected. An additional burden of stress on already laden shoulders?

Much has been written about the stress of studying Dentistry. The course is recognised as one of the most challenging amongst all University curricula. In 2015 the JOURNAL published an in depth study of stress levels amongst students at The University of the Western Cape. Based on the analysis of a 78% response to a questionnaire the study found that levels of stress increased over the years of the course, peaking in Fourth Year. Major stressors were identified, and consistently appearing as a significant influence was the fear of failing. Whilst such apprehension is seen and felt by students as a personal emotion, it is well to recognise that the Institution also views failures with dismay, the intention always being to successfully produce well trained, confident new practitioners. Both students and staff have been exposed to additional stress these past weeks as Universities were engulfed by student activism.

And that has been a most potent force through past and present times. Student activism has a long history. France lead the way in the 13th century when students challenged social and academic issues, but Korea was not long in following suit when in 1519, students demonstrated against the King. In general, student strikes and marches have been markedly successful in achieving defined objectives. Those objectives have been varied in the extreme, political clashes and factional feuds have beset Universities in Bangladesh, Communism has been supported and opposed by students. Nuclear Disarmament, benefits for disadvantaged populations, attacks on the existence of disparate levels of society, health care delivery for all, have featured as causes for activism on Western campuses. There have been many instances when student demonstrations have indeed influenced Government policies. Opposition to the Vietnam War, issues of racism, freedom of the press have all attracted the attention of student leaders. Pertinent to the current South African status is the realisation that in the UK, a 2010 eruption of student protests was raised against, you guessed it, tuition fees!

In all these actions, students have shown commitment, resourcefulness and resolution. Dental and Medical student participation, however, sincere though intentions may have been, appears to have been muted, as a result of clinical commitments and overall work load. To that extent, the epithet paragons may be applicable. Students have shown commendable professional responsibility, BUT therein is also the element of paradox, student empirathies and sympathies constrained by the very values being challenged by others.

The JOURNAL carries this month a pertinent paper. An in depth study reports an assessment of just how effective is the management of emergency pulpotomies at one of the South African schools. The outcome is not encouraging and one conclusion is that there should be an expansion of dental services in the urban areas. The role of the School must then be to continue to produce graduates, even in the event of student activism bringing classes to a halt. Students are facing year end and perhaps Final Assessments within a few weeks. The sincere wish of the Association is that the students shall have the opportunity to be paragons, to devote themselves to the required tasks and to relish the elation of success. These will be the professionals who will carry forward some of the ideas recorded in this JOURNAL. It is they who may realise the glittering promises of stem cells, will strive for enhancement of endodontics, will experience the stimulation of research. But first they must graduate.

Is it a paradox that tacit support may be given to the lofty ideals of student activism whilst at the same time trusting that sound ethical principles will reign and that a new echelon of dental graduates will confidently be released to help manage the challenges of dental and oral disease?
September, National Oral Health Month, was marked by SADA encouraging members to meet the challenge of educating their patients and members of the public about proper dental routine and conveying the message of good oral health. It is surprising – and not a little disheartening – to learn that after all these years those routines are not as thorough nor as commonplace as should be for basic and necessary oral hygiene.

According to a statement released by the South African Government late last year, cavities and gum disease are two of the world’s most common health problems. Oral diseases remain a major public health problem in South Africa because of their high prevalence, severity, and impact on quality of life.

Thus a very important, but often underrated part of everyday life – oral health – comes under the spotlight during September each year. The aim of Oral Health Month is to create awareness in communities of the importance of maintaining a clean and healthy mouth and to promote good oral health practices, in order to minimise the risk of future dental problems.

SADA issued guidelines to members who were offering free screenings and provided information on promotional opportunities during the month. A number of practitioners took up the challenge to offer free screening services to their patients and members of the public, at malls, schools, other public places and at their practices. There were reports from the public about seeing dentists and their clinical staff at malls and many enquiries were received about practitioners in the area.

SADA participated in educational messages through the electronic and printed media, with our Head of Education, Dr Nosipho Mzobe, appearing on an SABC3 feature about oral health, attracting some 60 000 viewers The programme was facilitated through Clicks Group, to whom our appreciation is recorded. A frenzy of comments on Twitter and other social medial platforms attested to the impact of the presentation.

SADA has been invited to join the National Department of Health in holding Oral Health Month celebrations in North West from 12 to 13 October 2016 when the team will visit the Mmabatho Nursing College, amongst other institutions.

September was also a month of intense activity at Head Office, with the Board, assisted by the HR and Remunerations Committee, continuing in its efforts to search for a new Executive. The Board successfully concluded this process and SADA is delighted to announce that a new CEO, Mr Khomi Climus (“KC”) Makhubela, has just been appointed. He will take office on 1 November 2016. We take this first opportunity to welcome him to the SADA offices and, during the coming weeks, the Board and the Journal will continue to introduce the new CEO to members and the structures of the Association.

SADA

Annual General Meeting (AGM)

Notice is hereby given that the Annual General Meeting (AGM) of the South African Dental Association will be held

at Sunnyside Park Hotel, Parktown, Johannesburg

on Thursday 16 March 2017 at 18:00 followed by snacks and refreshments.

The Agenda for the meeting will be posted on the SADA website.

SADA is your Association and your voice counts.

Punkaj Govan - Acting Chief Executive Officer
Dental Protection Limited explains…..
Public or private: Know your indemnity cover

There appears to be still some confusion about the difference between the professional indemnity cover and subscription rates provided by Dental Protection Limited (DPL) for state employed dentists and private practitioners in South Africa.

There is also some uncertainty about exactly what members are getting for their money and what cover is provided. Private practitioners are also under a common misconception that they are somehow ‘subsidising’ state-employed members for most of the rates paid by state employed dentists are significantly lower than those paid by dentists working in the private sector.

Practitioners employed by dental schools which are attached to public health facilities or conduct clinics and public sector facilities (such as clinics, hospitals and other public facilities) are sometimes given incorrect, misleading or perhaps no information about the nature of indemnity cover provided by their employing institution or the State. These practitioners are encouraged or sometimes led to believe that by taking out indemnity cover with DPL, they would be fully covered on the same basis as private practitioners.

As will be more fully explained below, it is important for practitioners to understand the extent of indemnity cover offered by the State and DPL and who is responsible for obtaining indemnity cover.

Private practitioners need to indemnify themselves against any claim for compensation made by a patient they treated who believes they had been harmed by negligent treatment. With the correct level of cover, DPL can manage the claim from first notification to conclusion, and can take care of all the legal costs and compensation payments.

The State institution (usually provincial health) must accept responsibility for all claims and losses arising from treatment provided in a negligent fashion by a practitioner employed by a state institution and indemnity obtained from Dental Protection by practitioners working in the state or the tertiary institution will provide indemnity cover.

State cover will also be forfeited by the public practitioner if they used a state vehicle without permission, drove without licence, deviated from the route or allowed others to use the vehicle or the use of the vehicle was not in the State interests.

Practitioners employed by dental schools which are attached to public health facilities or conduct clinics and public sector facilities (such as clinics, hospitals and other public facilities) are sometimes given incorrect, misleading or perhaps no information about the nature of indemnity cover provided by their employing institution or the State. These practitioners are encouraged or sometimes led to believe that by taking out indemnity cover with DPL, they would be fully covered on the same basis as private practitioners.

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The State institution (usually provincial health) must accept responsibility for all claims and losses arising from treatment provided in a negligent fashion by a practitioner employed by a state institution and indemnity obtained from Dental Protection by practitioners working in the state or the public sector does not include cover for any claims arising from treatment carried out by the practitioner in that sector. This duty remains the responsibility of the State in terms of the National Treasury’s regulations which provides that the State will bear the risks of its own damages and accidents. This explains the significant difference between the cost of indemnity for those working in the public sector and those in private practice even though they may work similar hours and provide similar care.

Normally any compensation paid by the State to the patient will not be recovered from the employee (practitioner).

However, the regulations do allow the State to recover any losses from an employee practitioner in circumstances where the damage or harm caused to a patient flows from one of the following exceptions where the practitioner:

- intentionally exceeded his or her powers.
- made use of drugs or alcohol.
- did not act in the course and scope of employment.
- acted recklessly or intentionally.
- without prior consultation with the State Attorney made certain admissions detrimental to the state.
- failed to comply with or ignored a standing instruction which he or she was made aware of, leading to the loss or damage.

Inquests

As the state provides indemnity for its employees, cover with DPL does not extend to settling claims against the state by a patient. Any member of Dental Protection working within the public/state sector can look to Dental Protection for assistance when it might be necessary to remind the state of its obligations.

The cover provided by DPL to dentists working in the public sector also includes assistance with the following:

- **Internal disciplinary matters** – assistance with these matters.
- **HPCSA referrals** – it is quite possible that the staff or employer (state) can refer one of their practitioners to the HPCSA. Clearly the state would not pay for the defence of one of their dentists at the HPCSA – particularly if they referred the dentist in the first place.
- **Complaints** – dentists can be asked by hospital managers to respond to complaints about clinical care and, essentially, this response is on behalf of the state. DPL can assist members long before a claim or complaint arises with advice on how to best protect them and can also assist in preparing and checking reports for the State Attorney or to ensure that the blame is not shifted on to the dentist.
- **Inquests** – While the state would probably assist a dentist in the case of an inquest, it is usually only
on the ‘coat tails’ of its own defence. If a dentist is vulnerable to individual criticism, or there is a conflict of interest between the state and a dentist during an inquest, because of this, it may not be in a member’s best interests to rely solely on the representation of a state attorney. Conversely it may not be in the member’s best interests to be separated out from the rest of the staff involved; DPL can advise on the best approach in any given situation.

• Claims – as already discussed, DPL does not handle clinical negligence claims on behalf of state dentists – but they can assist in some areas, such as writing reports.

It is also important for those public sector dentists who are given permission to carry on private practice after their full time employment with the State for the day is over, to obtain indemnity cover to protect themselves against claims or complaints by patients treated after hours in their private practice.

Dental practitioners also often think that risks are related to them individually and to their practice. They do not consider that their employees also affect their risk profile.

The dentist as employer in the practice 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 is called ‘vicarious liability’ and includes acts or omissions not only by employees who provide clinical services but also by non-clinical staff in the practice. It also does not matter whether or not the employee was acting according to instructions.

It is also not limited to only clinical advice provided by the dentist but also includes any instructions or advice provided by employees. The question as where the responsibility of the employer starts and ends is not absolute but will depend on issues like control.

Private practitioners should therefore consider that it is in their own interests to ensure that any employee, locum, or independent contractor working for them and who are directly involved in delivering treatment to patients obtain indemnity in their own right, as DPL will not normally extend the benefits of membership to the assistance with any matter arising from the vicarious liability of such staff. As partners are jointly and severally liable in legal actions brought against the partnership, it is also essential that each partner and every assistant is a member of indemnity organisation like DPL.

The situation is less clear cut when one considers the position of a locum. Locum tenens literally means “hold the practice” – this is best done by the reception staff. The locum should also make sure that the patient is aware to be made aware of the presence of the locum in the practice – this is best done by the reception staff.

Undoubtedly, this can be an onerous and tiresome process for both the employer and the locum and the aim is to avoid reaching that stage. It is therefore imperative that the independent contractor status of the locum and the requirement that they have their own indemnity arrangements is emphasised and that there is documentary evidence of their professional indemnity arrangements. Furthermore, patients need to be made aware of the presence of the locum in the practice – this is best done by the reception staff.

The locum should also make sure that the patient is aware of his/her role within the practice and that this is clearly documented in the medical records.

It is important for all practitioners to consider issues of risk regardless of the contractual agreement that exists between them. Policies should be in place that clearly outline how each member of the clinical team should function in providing care, whether they are independent providers or not.

It is therefore imperative that all practitioners consider the issue or risk regardless of their contractual relationship.

In conclusion, dentists working in the public sector on average pay lower fees than those working in the private sector as any claim for compensation would be against the state and be the responsibility of the state. A dentist who is a practice owner and who employs or engages self-employed contractors in his/her practice should insist that each clinician whether it is a dentist or a dental therapist/hygienist has their own indemnity or policy of insurance in place. Membership of Dental Protection is priced for one clinician’s risk and does not provide cover for any employees who may be engaged by the members practice or business.

A time for Greetings and Good Wishes

This is a special time for many colleagues and the Journal extends on behalf of the Association very warm wishes to:

Jewish members for Rosh Hashanah

Hindu members for the period of worship for Navrathi

Muslim members: Muharram Mubarak
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 pain*2,3
- Reduction in dentin hypersensitivity from baseline after 8 weeks*†
- 20% reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste*5
- Helps control dental plaque*4,5
- 29% improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste*5
- Supports good gingival health*4,5

For any product safety issues, contact GSK on +27 745 6001 or 0800 118 274.
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- Clinically proven relief from dentin hypersensitivity pain2,3
- Helps control dental plaque4,5
- Supports good gingival health4,5

**Up to 66%**

Reduction in dentin hypersensitivity from baseline after 8 weeks†

**20%**

Reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste§

**29%**

Improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste§

*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.†§


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The use of textural analysis to test the hardness and penetrability of three types of gutta percha cones when exposed to two endodontic solvents

ABSTRACT

Aim: Gutta-percha (GP) is removed from root canals by mechanical instrumentation used in conjunction with solvents such as Xylene and Eucalyptus oil. This study used textural analysis to test changes in the penetrability and hardness of Conventional GP, Thermafil® and Guttacore™ when exposed to these solvents: rigidity was used for hardness and deformation energy and resilience for penetrability.

Methods: GP cones (n=81) were tested prior to, and following, solvent exposure. For each outcome variable, results were tabulated by group. Between-group differences were assessed employing a General Linear Model, with the outcome as the dependent variable and the solvent, GP type and solvent-GP type interaction as the independent variables.

Results: Significant differences in rigidity and deformation energy were observed. Resilience decreased in Thermafil and Guttacore, but increased in Conventional GP. A greater reduction in the hardness of Thermafil was observed with Eucalyptus oil. Conventional GP was susceptible to both solvents but penetrability decreased with Xylene. Guttacore was significantly altered by both solvents.

Conclusions: Considering the toxicity profile of Xylene, and the biocompatibility and antimicrobial effects of Eucalyptus, Eucalyptus oil is recommended for use during endodontic retreatment.

Keywords: Gutta percha; hardness; penetrability; solvents

INTRODUCTION

An important stage in endodontic therapy is the three-dimensional filling of the root canal system to provide as perfect a seal as possible to aid periapical repair. Since its introduction as a root filling material by Bowman in 1867, gutta-percha (GP) has remained the material of choice, and has thus been synonymous with endodontic obturation. Endodontic therapy is dependent on multiple factors, and, even when meticulously performed, can fail, resulting in the need for retreatment.

Advances in endodontic retreatment have also lead to changes in the solvents used. Chloroform and Halothane were the solvents of choice for many years as they were the most effective in dissolving endodontic sealants. However, due to the related toxicity and carcinogenicity of these solvents, clinicians have sought suitable alternatives. To date, several studies have quantified the dissolving capacity of a solvent by measuring the weight of GP before and after exposure to it, but none sought to test changes in the physical properties. Such alterations in the material following solvent exposure are important as they can make removal by mechanical instrumentation easier, or, indeed, more difficult. Properties such as hardness and penetrability are particularly important as mechanical files are required to engage the GP in the root canal to allow its removal.

The hardness of a material refers to its ability to resist indentation, which affects the mechanical file’s ability to engage the GP in the root canal. Penetrability is difficult if not impossible to measure directly, but deformation en-
energy and resilience can serve as its proxies. Deformation energy is the energy required to deform a material during penetration, whilst resilience refers to the ability of a material to deform while absorbing the energy of the applied load, with subsequent recovery. Thus, a decrease in deformation energy and resilience would ease file penetrability into the GP.

The aim of this study was to use textural analysis to test the changes in the hardness and penetrability of three types of commercial GP when exposed to two types of solvents, and to deduce whether these changes would be of benefit to the operator during endodontic retreatment. Whilst textural analysis features very scarcely, if at all, in the dental literature, it is frequently employed in pharmaceutical research laboratories and the food industry. It plays an invaluable role in determining the properties of materials including, inter alia, rigidity, resilience, cohesiveness, and adhesiveness. Rigidity, deformation energy and resilience were the parameters applicable to this study, as they can be used to represent hardness and penetrability.

METHODS

Sample size calculation
The sample size estimation, performed in G*Power,21 was based on the combined influence of GP type (three types) and solvent type (two types) on each of the outcome variables (hardness and penetration), as determined by a two-factor ANOVA with interaction. Sample size estimations were based on a significance level of 5%, a power of 80% and the effect sizes calculated from pilot data. From these calculations, and considering that each individual test would yield measurements on all three outcome variables, ultimately each group required nine sets of data, requiring a total of 81 experiments.

Materials
The solvents were Xylene BP and Eucalyptus oil BP (Merck South Africa) with distilled water as control. The three different types of GP were: conventional Protaper® size F3 GP cones, thermoplastic GP Thermafil® (Dentsply, York, USA) ISO 030 carrier and cross-linked GuttaCoreTM (Dentsply, York, USA) 0.04 size 030. Conventional GP has pure β-phase gutta percha and zinc oxide as its bulk constituents.22 Thermafil® (Dentsply, York, USA) comprises warm α phase GP wrapped around a central polysulfone core.23 GuttaCoreTM (Dentsply, York, USA) also has warm α phase GP but wrapped around an internal cross-linked GP core.24

Each GP cone from the respective GP type used was from the same manufacturing batch to eliminate variations in physical properties.

Method
The GP cones were placed in Eppendorf vials, labelled according to their experimental group and numbered from 01 – 81. These numbers were then tabulated on an Excel® spreadsheet and randomly arranged into three experimental batches consisting of 27 vials each. The GP from each group was texturally analyzed using the TA.XT Plus® texture analyzer (Stable Micro Systems, Godalming, UK), which was calibrated for weight, force and distance before each test. A flat-ended cylindrical probe at a force of 10N with a speed of 5 mm/s-1 was used; each cone was placed against a fixed horizontal platform with graded markings for reproducible positioning of the cones (see Figure 1). The handles of the Thermafil and GuttaCore cones prevented the cones sitting flush on the platform and so were removed. After testing prior to solvent exposure, the cones were seated in an Endo stand and box® (Dentsply Maillefer, Switzerland) and immersed into 160 ml of one or other of the solvents at 24±1°C for 10 minutes, followed by immersion in 160 ml of distilled water for 20 minutes to neutralize the solvent action. The cones were allowed to dry for 24 hours at a room temperature of 24±1°C. The ambient room temperature and the temperature of the solvent and distilled water were recorded. The cones were then texturally re-analysed. The software, Exponent®, linked to the equipment, captured data at 200 pps and processed the data into Force-Distance and Force-Time graphs. Rigidity is the gradient of the curve on a Force-Distance graph and deformation energy is the area under the curve on that graph (Figure 2). A Force-Time graph (Figure 3) was used to measure resilience: it is the area from the peak of the curve to the end point divided by the area from the beginning of the curve to its peak, multiplied by 100.

Data analysis
The outcome variable for analysis, for each of the three measurements (rigidity, deformation energy and resilience), was the difference (DIFF) between the post-sol-
vent (AFTER) and pre-solvent (BEFORE) exposure measurements. The use of the DIFF variables was validated by employing randomization to ensure that there were no significant differences in the BEFORE measurements between the three groups within each GP type, assigned to each of the two solvents and the control, water. A General Linear Model (GLM) with main effect for GP type, solvent (nested in GP type), and experiment day as a blocking variable, was used to model each of the BEFORE dependent variables in turn. Post-hoc tests were conducted using the Tukey-Kramer test with the effect sizes calculated using Cohen’s d interpreted as follows: >0.80: large effect; 0.50 to 0.79: moderate effect; 0.20 to 0.39: small effect; and <0.20: near zero effect. Between-group differences were assessed by means of a GLM with the outcome variable as the dependent variable; independent variables were the solvent, GP type and solvent-GP type interaction; covariates were room and solvent temperatures.

Comparison of the DIFF results for Xylene and Eucalyptus oil was effected using a one-sample t-test of the DIFF value with respect to 0 to establish whether a significant reduction for a specified parameter was achieved following exposure. A two-sample t-test was performed to determine whether there was a significant difference between the DIFFs of Xylene and Eucalyptus oil. Where the assumptions of these tests were not met, non-parametric alternatives were used, namely the Wilcoxon Signed Rank test and the Wilcoxon Rank sum test. The 5% significance level was employed throughout the study. Data analysis was carried out using SAS software (SAS Institute Inc. USA).

RESULTS

Comparison of GP type before solvent exposure indicated that for Conventional GP, the mean rigidity and deformation energy was significantly lower than in the other two materials (p<0.001), whereas the mean resilience was only significantly lower than that of Guttacore (p=0.021). Comparison of DIFF revealed that the rigidity and deformation energy had either decreased or remained the same following solvent exposure across all groups. Resilience remained unchanged or decreased in all groups except for one, the Conventional GP/Xylene group, where an increase in resilience was observed following solvent exposure.

The comparison of the DIFF results for Xylene and Eucalyptus oil are shown in Table 1.

DISCUSSION

Whilst mechanical instrumentation serves as the primary method for removing GP, chemical solvents assist by softening and partially dissolving the GP in the canal. This study employed textural analysis to assess the changes in the physical properties of three types of GP following exposure to two endodontic solvents. Rigidity, deformation energy and resilience were the parameters applicable to this study, representing hardness and penetrability.

Hardness

The results obtained prior to solvent exposure revealed that Thermafil and Guttacore had higher rigidities than Conventional GP. This can be attributed to the strengthened central cores of the former two types of GP. Distilled water, employed as a control, was incapable of causing any significant reduction in rigidity across all groups.

The rigidities of all the GP types were significantly but variably reduced following exposure to Eucalyptus oil (p<0.05) and Xylene (p<0.05). For Guttacore there was no significant difference between the two solvents. The decrease in rigidity for Conventional GP was significantly greater following exposure to Xylene than to Eucalyptus Oil (p=0.0007; Cohen’s d=2.09). In contrast, Eucalyptus oil elicited a significantly greater reduction in rigidity in Thermafil as opposed to Xylene (p=0.019; Cohen’s d=1.30).

Conventional GP was less susceptible to a reduction in rigidity, which could be attributed to the comparatively thicker quantity of β-phase gutta percha in this GP. Xylene has been shown to weaken the polysulfone core of Thermafil, contributing in this way to a reduction in its rigidity. The internal cross-linked core of Guttacore has been shown to resist softening when exposed to solvents. These results further support the findings of Mushtaq et al (2012)
Table 1: Comparison of the DIFF results (the difference between the post-solvent (AFTER) and pre-solvent (BEFORE) exposure measurements for Xylene and Eucalyptus oil, indicating the significant differences in bold type

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conventional GP</th>
<th>Guttacore</th>
<th>Thermafil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-24.45</td>
<td>-32.81</td>
<td>-31.48</td>
</tr>
<tr>
<td>95% Conf. Limits for Mean</td>
<td>-95.29 -45.39</td>
<td>-101.82 -48.28</td>
<td>-93.38 -59.90</td>
</tr>
<tr>
<td>Interquartile Range</td>
<td>3.35 -17.37</td>
<td>5.62 -20.89</td>
<td>2.70 -10.50</td>
</tr>
</tbody>
</table>

Penetrability

Deformation energy and resilience serve as representative parameters for penetrability. Any increase in deformation energy following solvent exposure infers that a greater force is required by the retreatment file when penetrating the GP. The deformation energies of all the GP types were significantly reduced with Eucalyptus oil (p<0.05) and Xylene (p<0.05). The decrease in deformation energy for Conventional GP was significantly greater for Xylene than for Eucalyptus Oil (p=0.0006; Cohen’s d=2.13). There was no significant difference between the two solvents for Thermafil and Guttacore, but a significantly greater reduction with Thermafil and Guttacore than with Conventional GP (p<0.05). This is in accordance with Tanomaru-Filho et al (2010) who demonstrated that Xylene and Eucalyptus oil presented a greater solvent effect on Thermoplastic GP than on Conventional GP.28

An increase in resilience denotes that the material will absorb a greater energy of the applied force before yielding to penetration or fracture. A decrease in file penetration reduces the surface area of the file that engages the GP. This reduction in contact leads to a decline in the amount of GP being removed with each successive file withdrawal thereby increasing clinical procedure time.

Eucalyptus oil produced no significant reduction in the resilience of Thermafil and Guttacore, with an insignificant increase observed with Conventional GP (p=0.37). Following exposure to Xylene, there was a significant increase in the resilience of Conventional GP (p=0.0175), but a significant decrease with Guttacore (p=0.0015), and an insignificant decrease with Thermafil (p=0.61). Hence, while the solvents may aid the penetration of retreatment files into Thermafil and Guttacore, they may actually confound the retreatment procedure when Conventional GP is present in the canal. Nonetheless, with resilience being closely related to the ability of the polymer chain to rotate freely, additional factors such as the rate and extent of deformation, the applied force, as well as temperature will also affect the resilience value of the material.29 However, increasing the force applied to the retreatment file will amplify the resultant mechanical stresses, which in turn can lead to instrument separation.29

The two crystalline phases (α-phase and β-phase) of GP are molecularly both trans isomers, differing only in single bond configuration and Rubino et al (2012) who reported Xylene as an effective solvent of gutta percha.20,26 Magalhães et al (2007) reported that Eucalyptus oil was an acceptable solvent, which differed from previous studies that observed significantly less dissolution efficiency with Eucalyptus oil.9
and molecular repeat distance. The molecular repeat distance for β-phase GP is shorter than that of α-phase GP. This results in the α-phase being more flexible and contributes to its vulnerability to solvents, as illustrated by Tanomaru-Filho et al in 2010.18 Both Thermafil and Guttacore rely on heating to make their circumferential GP flowable during canal insertion. Heating the material to a temperature range of 46-48°C causes the α-phase GP to transform into β-phase and lose flexibility. Should the heating temperature exceed 58°C, the GP then transforms into an irreversible amorphous phase which then exhibits entirely different mechanical properties.30-32 Thermal treatment was not used in the present study and since thermal exposure causes molecular phase transformations, and changes the bond structure and orientation of the GP, further study is required to assess the changes in the physical properties that may occur. Therefore, the current data may not necessarily reflect the properties of the material at the chairside. However, they do provide a base reference for physical changes that occur in GP following solvent exposure.

CONCLUSIONS

Within the limitations of this study, and considering the toxicity profile of Xylene, and the biocompatibility and antimicrobial effects of Eucalyptol, Eucalyptus oil is recommended for use during endodontic retreatment.

Conflict of Interest: None declared.

Acknowledgements

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References

A survey of the opinions of Dentists regarding stem cells in Dentistry

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ABSTRACT
Regenerative and stem cell therapy is a new field in dentistry. The opinions of dentists and their acceptance of the concepts are important in successful clinical implementation of these procedures.

Objectives: To determine the levels of awareness, attitudes and knowledge concerning the therapeutic potential of stem cells in regenerative dentistry among dentists and to determine whether a need exists for additional training in the field.

Materials and Methods: A questionnaire on regenerative dentistry was distributed to 140 dentists in the private sector in South Africa, consisting of three broad sections: Professional status; Opinions and Beliefs; and Clinical Practice. 130 copies were returned anonymously. A descriptive analysis of the frequencies was performed.

Results: The majority of the dentists (90%) had not received any training on stem cell therapies but many (73%) were interested in attending further training. Almost all participants (95%) would recommend regenerative therapies to their patients. The majority (80%) were willing to save teeth in cell banks for future therapeutic purposes.

Conclusions: Dentists are supportive of using stem cell and regenerative dental procedures and most are willing to undergo more training in regenerative dentistry. A majority felt that the topic should be included in the undergraduate course.

INTRODUCTION
Research on adult stem cells is leading to new dental treatment protocols for caries, endodontics, periodontal and oral-maxillofacial procedures.1 A characteristic of dental pulp stem cells, i.e. their plasticity, make them an important source of mesenchymal stem cells for regenerative therapies in dentistry and for tissue bioengineering in medicine.2

Regenerative dentistry potentially offers substantial benefits for dental patients.3 Induced pluripotent stem cells (iPS cells) from dental pulp stem cells (DPSCs) may play an important role in tooth reconstruction.4 The possibility of regeneration of dentine through the use of bone morphogenetic proteins (BMPs) has positive implications for the future of clinical dentistry, for example, in the development of improved pulp capping agents and alternatives to root canal therapy.3

A 2010 American Association of Endodontics (AAE) survey showed that nearly 75% of program directors were teaching regenerative endodontics in didactic and clinical settings.5 According to the AAE position statement, Advanced Specialty Education Programmes were required, as from 2014, to provide in-depth instruction and clinical training in revascularization/regenerative endodontics.2

The value of pulpal regeneration is considered in two reviews6,7 one of which, by Tatullo et al discusses the importance of stem cell research for neuronal regeneration.6 Maeda and Akamine8 examined the importance of stem cell research for tooth root and periodontal tissue regeneration for the avoidance of tooth loss in a world population with an increased longevity rate. Lin et al.9 further discuss new approaches for periodontal reconstruction using regenerative procedures to help prevent tooth loss.

The use of adult stem cells for the regeneration of craniofacial structures holds potential in tissue engineering.10 New non-invasive methods for obtaining autologous bone from stem cells derived from different tissues from the same patient are being researched.11

Besides the capacity of mesenchymal stem cells (MSCs) to differentiate, (which is important for tissue engineering), their immune-regulatory capacity and trophic activity are essential in the establishment of a regenerative micro-environment at sites of tissue injury. The bioactive factors secreted by MSCs inhibit scarring and apoptosis, while stimulating angiogenesis and mitosis of tissue-intrinsic progenitor or stem cells.12

Although scientifically promising, the development of stem cell research in dentistry may have been hampered by fears regarding potential abuse of the stem cell technology. While this research is a relatively new field in dentistry, it seems...
to hold a great potential for treatment. However, very little information about its introduction to, and incorporation into, dentistry is available in the literature.

The advancements in stem cell research and regenerative dentistry warrant serious consideration of the need to include this field of study in the education of dental students and in post graduate courses for qualified dentists. An obligatory subject “Regenerative Medicine” for 5th year medical students was introduced at the Copernicus University, Bydgoszcz, Poland, after a brief survey completed by 1st year medical students, conducted by Bajek and Drewa. Undergraduate students at Lahore Medical and Dental College, affiliated with the University of Health Sciences, Lahore, Pakistan, receive no clinical training in regenerative medicine but they do receive information in the form of lectures during the last two years of their training. They also observe regenerative procedures done by the faculty members, whilst postgraduate students do themselves perform guided tissue regenerative procedures. Undergraduate students at the Faculty of Dentistry, Griffiths University, Australia and the College of Dentistry, University of Dammam, Saudi Arabia, also receive no clinical training in regenerative dentistry. Whilst there is not much literature on the status, it appears that current undergraduate and postgraduate dental programmes do not equip the student with the in-depth knowledge and understanding required for the performance of stem cell-based procedures in dental treatments.

There is no evidence in the scientific literature on opinions, beliefs and attitudes of dentists regarding the potential of regenerative procedures in dentistry. Recently a few surveys have examined perceptions of dentists regarding regenerative dental treatment options. The status in medicine has been considered. In China, Deng et al. conducted a survey on health care workers while a survey by Gucciaro et al. focused on researchers and medical practitioners in Perinatology.

Currently, there is a lack of guidelines in the field of regenerative dentistry. The establishment of ethical guidelines will require a survey of practicing dentists to seek data about their attitudes towards regenerative dental procedures. Considerable debate regarding the use of stem cell research exists in the scientific, ethical, and political fraternity. The important questions deal with the impact upon national regulation and social behaviours as well as considering the advice of experts.

The aims of this survey were to gain a current view of the opinions on the ethical aspects, to investigate the perceptions and awareness of dentists on stem cell procedures and to assess the potential for the acceptance of regenerative treatment as a routine amongst dentists in private practice.

MATERIALS AND METHODS

Questionnaire

Existing questionnaires on perceptions of the use of stem cells in dentistry and medicine were examined and modified in compiling the questionnaire used in this study. The content validity was evaluated from an in-depth literature search on surveys conducted on regenerative dentistry. The questionnaire was further subjected to scrutiny after it was initially distributed to a smaller group of dentists as a pilot study to eliminate any discrepancies or duplication of questions. This descriptive, cross sectional study was conducted among consenting dentists from private practice in both major and smaller cities in South Africa.

Study sample

The survey was given as an anonymous questionnaire to practicing dentists. A total of 140 copies of questionnaires were sent out. Ten were discarded as incomplete or no response.

The questionnaire consisted of three sections:

Section A: Professional status

Section B: Ethical opinions, beliefs and judgment

Section C: Clinical practice

Statistical analysis

The data was recorded in Excel (n = 130) and the frequencies were analysed.

The data was examined in the three key areas, namely professional status, opinion and awareness and clinical practice. A descriptive analysis of the frequencies was performed.

RESULTS

The overall response rate to the questionnaire was 93%. The questionnaire results are shown in Table 1.

Professional status

Most of the participants were male (61.5%), the majority (70.8%) were less than 50 years old and about half the participants were below 40 years of age. A higher number of female dentists were found in the younger age groups with more males in the older, more clinically experienced group (43.8%). Most of the dentists (69.3%) practised in urban areas and 45% of the participants had been in private practice for 10 years or less. About half of the participants (45.4%) read scientific journals monthly or weekly with 10.8% doing so on a weekly basis. A minority of 10% of the participants had attended lectures on stem cells but a considerable majority (73%) were interested in attending more advanced training courses and lectures on the dental application of stem cells.

Opinions and awareness

About half the participants (48.5%) were aware of the potential therapeutic applications of stem cells in dentistry, but 20% reported being unsure of these options. While two thirds (63.1%) of participants thought that dental stem cell banking will be useful for the regeneration of dental tissue, the majority (80%) were willing to save teeth for future regenerative dental procedures. About 28% of participants believed that within 10 years, some regenerative procedures will be used in clinical practice and 38% felt that it will take less than 20 years before dentists are able to implant teeth grown in the laboratory. About two thirds of participants (64.6%) felt that the regenerative dental treatment will be a better option than implant replacement while 29% of the participants were unsure. Most of the participants (83%) felt cost was the biggest obstacle to a patient accepting regenerative treatment and 48% of participants also felt that fear may be a limiting factor. A minority of the participants (37.7%) felt that there was a health hazard when regenerative dental procedures are used. Only 16.9% of the participants held ethical concerns regarding the use of stem cells in dentistry and indeed the majority (58.5%) had no ethical concerns whatever. While 60.8% of participants were not sure of the availability of stem cell banks for dental use, 58.5% would recommend a patient to store dental stem cells for future prospects. More than half the participants (78.4%) agreed that dental professional associations should regulate the use of stem cell and regenerative dentistry, while 33.6% advised that academic institutions should develop dental stem cell research.
Table 1: Survey results

<table>
<thead>
<tr>
<th>Question</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Professional status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. In which field/s of dentistry do you mostly practise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. General Practitioner                                                  95.4</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>b. Endodontics                                                          1.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>c. Orthodontics                                                         1.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>d. Periodontics                                                         0.8</td>
<td>1</td>
<td></td>
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<tr>
<td>e. Prosthodontics                                                       0.8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2. How many years have you been in practice?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 0 - 10 years                                                         45.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. 11 - 20 years                                                        23.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. &gt; 20 years                                                           30.8</td>
<td></td>
<td></td>
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<tr>
<td>3. Where is your primary place of practice located? (name of city/town)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Cape Town                                                            23.1</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>b. Johannesburg                                                        20</td>
<td>26</td>
<td></td>
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<tr>
<td>c. Durban                                                               20</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>d. Nelspruit                                                            10.7</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>e. Tzaneen                                                             10.0</td>
<td>13</td>
<td></td>
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<tr>
<td>f. Rustenburg                                                           10.0</td>
<td>13</td>
<td></td>
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<tr>
<td>g. Port Elizabeth                                                       4.6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>h. Harare                                                               0.8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>i. Windhoek                                                             0.8</td>
<td>1</td>
<td></td>
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<tr>
<td>4. What is your gender?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Male                                                                 61.5</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>b. Female                                                               38.5</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>5. What is your age?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 20-30 years                                                          22.3</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>b. 31 - 40 years                                                        28.5</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>c. 41 - 50 years                                                        20.0</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>d. 51 - 60 years                                                        20.0</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>e. 60+ years                                                            9.2</td>
<td>12</td>
<td></td>
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<tr>
<td>6. How frequently do you read scientific dental journals?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Weekly                                                               10.8</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>b. Monthly                                                              34.6</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>c. Once in a while                                                      53.1</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>d. Never                                                                1.5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7. Have you attended a training course/program/lecture on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dental application of stem cells?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  10</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>b. No                                                                  90</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>8. Would you be interested in attending more advanced training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>courses regarding dental application of stem cells?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Very interested                                                      73.1</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>b. Neutral                                                              10</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>c. Not interested                                                       16.9</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>B. Opinions and awareness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Are you aware of the potential therapeutic applications of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>stem cells in dentistry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  48.5</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             20</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>c. No                                                                   31.5</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>10. Do you think that dental stem cell banking will be useful for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>regeneration of dental tissues?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Agree                                                                63.1</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>b. Neutral                                                              32.3</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>c. Disagree                                                             4.6</td>
<td>6</td>
<td></td>
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<tr>
<td>11. Should regenerative therapy be incorporated into the dentistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>undergraduate course?</td>
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<td></td>
</tr>
<tr>
<td>a. Agree                                                                73.9</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>b. Neutral                                                              20</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>c. Disagree                                                             6.2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12. How many years do you think it will take for some regenerative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>stem cell therapies to be used in dentistry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 0 - 10 years                                                         28.5</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>b. 11 - 20 years                                                        27.7</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>c. &gt; 20 years                                                           11.5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>d. Unsure                                                               32.3</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>13. How many years do you think it will take before dentists are</td>
<td></td>
<td></td>
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<tr>
<td>able to implant new teeth grown in a laboratory?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 0 - 10 years                                                         15.4</td>
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<td></td>
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<tr>
<td>b. 11 - 20 years                                                        23.1</td>
<td>30</td>
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<tr>
<td>c. &gt; 20 years                                                           22.3</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>d. Unsure                                                               38.5</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>e. Never                                                                0.8</td>
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<tr>
<td>14. In your opinion what do you think would be the biggest obstacle to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a patient accepting regenerative dental treatment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Cost                                                                 83.8</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Not sure                                                                10.1</td>
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<td></td>
</tr>
<tr>
<td>No                                                                      5.3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>b. Fear                                                                 48.9</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Not sure                                                                22.5</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>No                                                                      28.6</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>c. Other                                                                0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>15. Would you be willing to save teeth and dental tissue for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>future regenerative dental treatment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  80</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             13.8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>c. No                                                                   6.2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>16. Do you think that regenerative dental treatment will be a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>better treatment option than tooth implant placement?</td>
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<td></td>
</tr>
<tr>
<td>a. Yes                                                                  64.6</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             29.2</td>
<td>38</td>
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</tr>
<tr>
<td>c. No                                                                   6.2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>17. Are you concerned about any potential health hazards regarding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the use of stem cells as part of regenerative dentistry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  37.7</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             29.2</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>c. No                                                                   33.1</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>18. Do you believe that stem cell clinics will deliver future dental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatments?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  58.5</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             33.8</td>
<td>44</td>
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</tr>
<tr>
<td>c. No                                                                   7.7</td>
<td>10</td>
<td></td>
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<tr>
<td>19. Do you believe that dental professional associations should</td>
<td></td>
<td></td>
</tr>
<tr>
<td>regulate the use of stem cell and regenerative dentistry?</td>
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<td></td>
</tr>
<tr>
<td>a. Yes                                                                  78.4</td>
<td>102</td>
<td></td>
</tr>
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<td>b. Not sure                                                             16.2</td>
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<td></td>
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<tr>
<td>c. No                                                                   5.4</td>
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</tr>
<tr>
<td>20. Do you have any ethical concerns regarding use of stem cells in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dentistry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  16.9</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             24.6</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>c. No                                                                   58.5</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>21. Are there any dental stem cell banks in South Africa?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes                                                                  14.6</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>b. Not sure                                                             60.8</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>c. No                                                                   24.6</td>
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</tbody>
</table>
Clinical practice and knowledge

Most of the respondents (64.6%) knew the origin of dental stem cells. Continued root formation with stem cells and the regeneration of pulp/dentine complex was regarded as the most beneficial application of dental stem cells by the participants (56.2%). Most of the participants (78.5%) delivered treatment involving necrotic immature teeth every month while the remaining participants (21.5%) reported that in their clinic such treatment was not routine. More than half the participants considered tribiotic paste and pulpal regeneration to be the optimal treatment for necrotic pulp in immature teeth; 17.7% felt that MTA apical plug and back fill with obturation material is the optimal treatment, while 25.8% used calcium hydroxide either alone or with MTA. A minority of the participants (37.6%) were already using some form of regenerative therapy in their practice such as membranes, scaffolds or bioactive materials. The remaining participants (62.8%) did not use any form of regenerative therapy in their practices. In a theoretical case where participants could not provide regenerative treatment, almost all participants (84.6%) were willing to refer the patient to a practitioner who did provide that option. Almost all the participants (96.9%) would most likely recommend stem cell and regenerative treatment to their patients if it is the most effective treatment option. Almost all the participants (96.2%) felt that for practising dentists, short courses to improve knowledge about stem cells in practice and more hands-on training would be advantageous. The introduction to the undergraduate programme of topics related to stem cells would benefit the incipient qualified dental professionals.

DISCUSSION

The discovery of stem cells in the pulps of permanent and deciduous teeth and the possibility of using dental pulp stem cells for tissue engineering has prompted much research in this field. Stem cell research is a fast growing field in medicine with about 20,000 publications for tissue engineering and regenerative medicine in 2015 and 1,300 publications in dentistry in 2015 (Pubmed search). There is therefore, enthusiasm for the incorporation of regenerative procedures into dental practices, and a growing demand for more lectures, together with incorporation into undergraduate teaching programmes.

### Question

<table>
<thead>
<tr>
<th>Question</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. In a clinical practice, will you recommend a patient to store</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dental stem cells and explain its future prospects?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>58.5</td>
<td>76</td>
</tr>
<tr>
<td>b. Not sure</td>
<td>28.5</td>
<td>37</td>
</tr>
<tr>
<td>c. No</td>
<td>13.1</td>
<td>17</td>
</tr>
<tr>
<td><strong>C. Clinical practice:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Which of the following are sources of dental stem cells?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Dental pulp, Apical papilla, Gingiva</td>
<td>64.6</td>
<td>84</td>
</tr>
<tr>
<td>b. Enamel</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>c. Do not know</td>
<td>35.4</td>
<td>46</td>
</tr>
<tr>
<td>24. Can stem cell tissue regenerative technology be applicable to</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dentistry?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>68.4</td>
<td>89</td>
</tr>
<tr>
<td>b. Not sure</td>
<td>30.0</td>
<td>39</td>
</tr>
<tr>
<td>c. No</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>25. Can dental stem cells be used to develop non-dental tissues/organs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>28.4</td>
<td>37</td>
</tr>
<tr>
<td>b. Not sure</td>
<td>65.4</td>
<td>85</td>
</tr>
<tr>
<td>c. No</td>
<td>6.2</td>
<td>8</td>
</tr>
<tr>
<td>26. Which of the following procedures can benefit by the application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of dental stem cells?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Continued root formation</td>
<td>56.2</td>
<td>73</td>
</tr>
<tr>
<td>b. Regeneration of enamel</td>
<td>56.2</td>
<td>73</td>
</tr>
<tr>
<td>c. Pulp/dentin tissue engineering and regeneration</td>
<td>56.2</td>
<td>73</td>
</tr>
<tr>
<td>d. Do not know</td>
<td>43.8</td>
<td>57</td>
</tr>
<tr>
<td>27. Which of the following would most help newly qualified dental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>professionals to be better able to gain knowledge about stem cells?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. More hands-on training and short courses to improve knowledge about</td>
<td>96.2</td>
<td>125</td>
</tr>
<tr>
<td>stem cells in practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Topics related to stem cells to be included in the undergraduate</td>
<td>96.2</td>
<td>125</td>
</tr>
<tr>
<td>curriculum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Do not know</td>
<td>3.8</td>
<td>5</td>
</tr>
<tr>
<td>28. In your opinion how should dental stem cell research be developed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in future?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Under Public Sector initiatives</td>
<td>8.5</td>
<td>11</td>
</tr>
<tr>
<td>b. Under Private Sector initiatives</td>
<td>16.2</td>
<td>21</td>
</tr>
<tr>
<td>c. Under Public-Private Partnership</td>
<td>40.8</td>
<td>53</td>
</tr>
<tr>
<td>d. Academic institutions</td>
<td>33.1</td>
<td>43</td>
</tr>
<tr>
<td>e. Other Specify:</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>29. Do you use any type of regenerative procedures in your practice,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>such as membranes, scaffolds or bioactive materials?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Regularly</td>
<td>9.2</td>
<td>12</td>
</tr>
<tr>
<td>b. Once in a while</td>
<td>28.4</td>
<td>37</td>
</tr>
<tr>
<td>c. Do not use</td>
<td>62.4</td>
<td>81</td>
</tr>
<tr>
<td>30. Which of the following regenerative treatments are the most</td>
<td></td>
<td></td>
</tr>
<tr>
<td>valuable?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Healing of peri-radicular bone, continued root development in</td>
<td>62.0</td>
<td>81</td>
</tr>
<tr>
<td>immature teeth and pulp tissue revitalization within a root canal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Tooth re-implantation</td>
<td>28.0</td>
<td>36</td>
</tr>
<tr>
<td>c. None of the above</td>
<td>10.0</td>
<td>13</td>
</tr>
<tr>
<td>31. What percentage of cases in your practice involve necrotic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>immature teeth monthly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. 0</td>
<td>21.5</td>
<td>28</td>
</tr>
<tr>
<td>b. 1%</td>
<td>43.8</td>
<td>57</td>
</tr>
<tr>
<td>c. 2%</td>
<td>15.4</td>
<td>20</td>
</tr>
<tr>
<td>d. 2% or more</td>
<td>19.3</td>
<td>25</td>
</tr>
</tbody>
</table>

### Question

<table>
<thead>
<tr>
<th>Question</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>32. What do you consider to be the optimal treatment for necrotic pulp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in immature teeth?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Calcium hydroxide apexification</td>
<td>11.3</td>
<td>14</td>
</tr>
<tr>
<td>b. Calcium hydroxide application followed by MTA apical plug and back</td>
<td>14.5</td>
<td>18</td>
</tr>
<tr>
<td>fill with obturation material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. MTA apical plug and back-fill with obturation material</td>
<td>17.7</td>
<td>22</td>
</tr>
<tr>
<td>d. Tribiotic paste and pulpal regeneration</td>
<td>56.5</td>
<td>76</td>
</tr>
<tr>
<td>33. In a case where you can’t provide regenerative treatment, would</td>
<td></td>
<td></td>
</tr>
<tr>
<td>you be willing to refer your patient to a practitioner who does provide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>regenerative treatment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Yes</td>
<td>84.6</td>
<td>110</td>
</tr>
<tr>
<td>b. Not sure</td>
<td>10.8</td>
<td>14</td>
</tr>
<tr>
<td>c. No</td>
<td>3.8</td>
<td>6</td>
</tr>
<tr>
<td>34. What would you most likely recommend stem cell and regenerative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatments to your patients?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. If it is the most effective treatment option</td>
<td>95.3</td>
<td>122</td>
</tr>
<tr>
<td>b. If it is safe and reliable</td>
<td>3.1</td>
<td>4</td>
</tr>
<tr>
<td>c. If it is the most cost-effective option</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>d. I would not recommend it</td>
<td>1.5</td>
<td>2</td>
</tr>
</tbody>
</table>
In this study the dentists demonstrated a willingness to attend further training on stem cells which may be indicative of the acceptance of the newer treatment modality of regenerative dentistry. This was further emphasised by the fact that most of the dentists were willing to save teeth for future use with stem cell banking, recognizing the potential of these regenerative procedures. Participants who believed that stem cell banking would be useful for regeneration of dental tissue were also willing to refer patients to a practitioner who could provide the treatment in cases where they were unable to do so themselves. Although most of the dentists believed that stem cell tissue regeneration will be applicable to dental therapies, most were unsure whether these dental stem cells could be used to develop non-dental tissue or organs.

Most of the dentists who participated in this survey read scientific dental journals on a weekly or monthly basis indicating that they are keeping abreast with latest dental advancements and research. This may be the source of the majority having current knowledge on the origin of stem cells. A minority of the dentists in our study (10 % of participants) had received some measure of continued education on regenerative dentistry in the form of lectures, symposiums or seminars, compared with data reported from other studies which ranged attendance from 16% to 50%.

In a similar study amongst endodontists, Epelman et al., (2009) found that 56% (n=53) of the respondents had received continued education on stem cells/regenerative dental treatments. It should be noted however, that the above studies were conducted on registrars specializing and endodontists compared with the current study in which general dentists were surveyed. There was a positive interest (73%) shown amongst the present sample to attend additional training course and lecture programmes on stem cells as well as supporting the concept of the incorporation of regenerative therapy into the undergraduate programme (73,9%). Utheja et al. showed that 86.6% of participants in their study advised the incorporation of regenerative therapy into the undergraduate dentistry programme. A similar study, conducted amongst medical doctors, found that the majority of the physicians interviewed did not have specific knowledge on stem cells (59%), most (65%) of those involved did not attend additional training courses regarding stem cells, but most were interested in stem cells (70%), suggesting that they believe in the potential benefits of developing stem cells therapies.

Most dentists felt that regenerative dentistry is a better option than implant dentistry and that it will take less than 20 years before teeth can be replaced using regenerative procedures. Most participants felt that stem cell therapy did not pose a health hazard and only 5% had ethical concerns with the use of stem cells in dentistry.

Most respondents would recommend stem cell regenerative procedures if it is the most effective treatment. This reflects on the attitude of the dentists to provide the best and most effective care to their patients. Cost did not seem to be the main priority in offering this treatment modality. Subjects who believed that stem cell banking would be useful for regeneration of dental tissue were also willing to refer patients to a practitioner who could provide regenerative treatment in cases where they were unable to do so themselves. Currently, 23% of respondents use some type of regenerative procedures in their practice, such as membranes, scaffolds and bioactive materials.

Most dentists felt that a joint Public-Private partnership would be most appropriate to develop the future of dental stem cell treatment and considered that the Dental Association should be involved in this process.

**CONCLUSION**

The data from this survey revealed that dentists showed high levels of awareness regarding the use of stem cells in dentistry. Respondents were willing to save teeth in stem cell banks for future use. Dentists showed interest in incorporating regenerative procedures into their practices, were willing to undergo further training and were eager to attend more lectures on stem cells and regenerative procedures. Dentists also felt that dental regenerative procedures should be introduced in the undergraduate dental curriculum.

**References**

The capacity of the Oral Health Centre, University of Pretoria, to complete root canal treatments.

SUMMARY

Introduction: The University of Pretoria Oral Health Centre (UPOHC) is inundated by patients presenting with toothache, many requiring emergency pulpectomies (EPs). To date, the outcome of these procedures performed at this academic/public health facility, remains unknown.

Aims and objectives: To determine the completion rate of treatment of teeth that had received EPs at the UPOHC.

Study design: A retrospective survey of data obtained from electronic and paper records of 498 randomly selected teeth from the 1050 that had undergone EPs between 1 July 2012 and 30 June 2013 at the UPOHC, followed to 30 June 2014.

Methods: The outcome of treatment was recorded as "no treatment after initial pulpectomy", "pulpectomy repeated", "tooth was removed" or "root canal treatment (RCT) was completed by student or dentist".

Results: Of the 498 teeth included, 224 (44.98%) were obturated, 35 (7.03%) were retreated, forty two (8.43%) teeth were referred for extraction and 197 (39.56%) remained untreated. After 16.56 (SD 6.19) months, treatment remained incomplete in 46.58% (n=232) of cases.

Conclusions: The UPOHC lacked capacity to complete all RCTs that were started. A primary health care approach focussed on prevention combined with an integrated resource plan for oral health in the region is recommended.

INTRODUCTION

The University of Pretoria Oral Health Centre (UPOHC) is a joint initiative between the School of Dentistry of the University of Pretoria and the Gauteng Department of Health. The institution trains dental and oral hygiene students and provides subsidised dental care to the public.

The bulk of South Africans who pursue treatment at government facilities, such as the UPOHC, are unable to pay private health fees. Internal statistics from the UPOHC indicated that approximately 17 500 patients visited the facility to be screened for oral health problems during 2014. It is challenging for the staff of UPOHC to balance such a high service load with academic obligations.

In under-resourced countries, extraction is often the only option for compromised teeth because of costs or lack of qualified personnel to perform specialised treatment. The UPOHC offers an emergency pulpectomy (EP) (extraction of the inflamed or necrotic pulp) as the preferred treatment to alleviate pain in patients who wish to retain the compromised tooth. Emergency procedures such as EPs are often squeezed in between treating other waiting patients. High patient numbers for root canal treatment (RCT) often means that a decision to retain or extract the tooth must be made quickly. Several studies have demonstrated that between 4% and 45% of patients requiring emergency dental treatment receive EPs. The purpose of an EP is to decrease or eradicate infected tissue and bacterial count in root canal systems, in order to prevent apical spread. Proper debridement and obturation of all canals is necessary for the RCT to be completed. An incomplete RCT can result in recurring pain, which could appear about six months after the first phase of treatment. An EP is not a long-term solution, although it is effective in the relief of pain. Despite this knowledge, however, no data exist on the time frame within which the obturation should be completed after the initial pulpectomy.

Staff of the UPOHC render services in addition to their academic and research responsibilities and EPs are generally performed by dentists, rather than students. Patients are
#OralHealthMonth

September is Oral Health Month

It all starts here.

Healthy mouth. Healthy body.

Instill good eating habits as well as oral health habits in children for healthy mouths and healthy bodies.
subsequently placed on a waiting list for the preparation and obturation of the affected root canals. The majority of RCTs are completed at the UPOHC by fourth and fifth-year dental students under the supervision of academic staff. Each student has to complete a minimum of five RCTs per annum. Fourth year students work on incisors, canines and premolars, while the fifth year students work on molars. There are approximately 50 students in each cohort. This means roughly 500 teeth can be obturated during the academic year by the students.

There is no information on the outcome of EPs in South Africa. The only published study establishing the attendance for RCT completion following an emergency pulpectomy was from the UK. That study, conducted by Lynch et al at the University Dental School in Cork, Ireland, revealed that 39% of 574 patients returned for the obturation of the root canal. An extraction was performed in 11% of cases and 50% did not return for the final phase of the RCT. The authors concluded that it is necessary to correctly select patients for completion of the required RCT. They recommended that patients be advised and instructed beforehand on the importance of completing the RCT to ensure that the manpower and resources are utilized in the best possible way.

Hence, it is important to measure the outcome of emergency procedures such as EPs provided in academic institutions such as the UPOHC. The aim of this study was therefore to measure the completion rate of EPs at the UPOHC and to suggest solutions for related inefficiencies in the service-rendering processes of the UPOHC.

**METHODS**

The University of Pretoria granted ethical approval. The manager of the UPOHC gave permission for a retrospective analysis of electronic and paper records to be conducted. The target population included patients who had undergone an EP during the period of 1 July 2012 until 30 June 2013.

The paper-based and electronic files, including radiographs on the Kodak® digital radiograph system, were accessed at the UPOHC in July 2014. Teeth that received EP during the study period were identified by procedure code: “8132” on the GoodX Dental Studio software®. These accounted for 1050 teeth of which 500 teeth were selected using computer generated randomization (Biostatistics Unit, Medical Research Council). Two of the records of the selected teeth were discarded. One record on the electronic system was a mock entry and the other was a duplicate record. The final number of teeth included for the analysis was 498.

The outcome of the pulpectomy through to 30 June 2014 was determined by studying the files and was recorded by selecting one of the categories (indicated in Table 1):

- The tooth had no further treatment after the initial pulpectomy.
- The pulpectomy was repeated but no further treatment was performed.
- The tooth was removed.
- The case was referred for extraction.
- The RCT was completed by a student.
- The RCT was completed by a dentist.

The initial pulpectomy and final treatment dates were also indicated. Thus the period for final outcome was between 12 and 24 months (1 July 2012-30 June 2014).

**RESULTS**

Table 2 displays the outcomes of the 498 pulpectomies which had been recorded in the sample of 498 case records examined.

In this sample, less than half (44.98%) of the teeth that were treated with EPs were completely obturated at the UPOHC (Table 2). It may be noted that of the 224 completed cases, 104 were completed by dentists, including part-time dentists appointed at the UPOHC.

Kaplan-Meier analysis revealed that 46.58% (n=232) of cases were still incomplete 16.56 months (SD 6.19) after the initial treatment.

**DISCUSSION**

This is the first study to report the outcome of EPs in the South African oral health care system. The resulting information provides valuable insight into capacity of the UPOHC to provide RCT to people who are dependent on Government services in the Tshwane District. These statistics are particularly relevant since the UPOHC is the sole government funded dental facility that provides RCT in the Tshwane District.

**Demand versus capacity to treat - UPOHC**

RCT is a very costly and time-consuming procedure in dentistry. The results of this study clearly show that the demand for EPs at the UPOHC exceeds the capacity of the institution to complete the ensuing RCTs. The clinical outcomes of EPs presented in Table 2 attest to the protocol whereby the UPOHC provides EPs to non-scheduled, emergency, patients presenting with pain, without taking into account the time required for completion of the endodontic component.

The outcomes measured in this study are similar to those reported in Ireland by Lynch et al. The current study showed

<table>
<thead>
<tr>
<th>Table 1: Outcome of initial pulpectomy</th>
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<tbody>
<tr>
<td><strong>Categories</strong></td>
</tr>
<tr>
<td>No further treatment was done on that tooth after the initial pulpectomy.</td>
</tr>
<tr>
<td>The pulpectomy (initial step) was repeated and no further treatment performed.</td>
</tr>
<tr>
<td>The tooth was removed.</td>
</tr>
<tr>
<td>The case was referred for tooth extraction.</td>
</tr>
<tr>
<td>The RCT was completed by a student.</td>
</tr>
<tr>
<td>The RCT was completed by a dentist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Frequency table for distribution of treatment procedures, performed (n=498)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment Procedure</strong></td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Only the initial pulpectomy performed</td>
</tr>
<tr>
<td>Initial pulpectomy procedure repeated</td>
</tr>
<tr>
<td>The specific tooth was removed/extracted</td>
</tr>
<tr>
<td>The specific tooth was referred for extraction</td>
</tr>
<tr>
<td>The root canal treatment was completed</td>
</tr>
</tbody>
</table>
that the RCT was completed in 45% (Table 2) of teeth that had received an emergency pulpectomy at the UPOHC. In the Irish study the completion rate was 39%. Our results show that after an average of 16.56 months, 46.5% of RCTs that were started remained incomplete. This is close to the 50% of cases that were incomplete in Lynch’s study (2010).\textsuperscript{13} The prime reason for the uncompleted cases at the UPOHC was that patients were most probably not recalled due to the long endodontic waiting lists.

It should be noted that the UPOHC appointed a number of part-time dentists to alleviate the backlog in August 2012. These dentists completed 104 out of the total of 224 cases during the study period shown in Table 2. These results may however not be a true reflection of the UPOHC’s capacity to complete RCTs. The service of some of the dentists could not be sustained due to insufficient funds. Therefore, the actual percentage of completed RCT’s could have been as low as 25% had these dentists not been employed.

The extended time interval between EP and obturation at the UPOHC, as illustrated in the current study, also suggests the EP might not have been the best treatment option\textsuperscript{13} in the context of what the local health care system can provide. At the time of the study it was standard procedure at the UPOHC to give the patient the choice of removal or EP and placement on the waiting list. The current study shows that 7.03% of cases returned as emergencies, probably because the patient had re-occurring pain, the tooth fractured or loss of the temporary restoration (Table 2). Moreover, 8.23% of teeth that underwent EPs were eventually extracted or were referred for an extraction. It is universally accepted in dentistry that a tooth with a vital pulp should be preserved without question.\textsuperscript{20} Preserving teeth through RCT in contrast to tooth loss due to extraction is an indicator that the quality of life has been improved. Every institution should aspire to offer such quality health care.\textsuperscript{30} The reasons why 8.23% of teeth were removed after the EP at the UPOHC is unknown. It could be speculated that patients became disheartened with the constant pain or repetitive dental visits for the same tooth. Also, the decay within the tooth could have been very extensive causing a weakened tooth structure even prior to the pulpectomy.

Lynch \textit{et al} suggested that one of the reasons for non-completion was that patients did not receive adequate pre-treatment counselling. The authors also suggested that teeth were poorly selected for RCT because in 10% of cases an extraction was eventually performed.\textsuperscript{13} Since institutional resources such as materials and salaries had been utilized to deliver those pulpectomies, a failed procedure could be considered as wasted money.\textsuperscript{13} Based on these findings they recommended that the quality of pre-counselling be improved to reduce such wastage.\textsuperscript{13} These recommendations may also be useful to improve service rendering at the UPOHC. A solution to the problem may be to correctly select patients for RCT completion and to explain to these patients how important it is to follow through with their decision to save the tooth. All feasible options should be offered to patients in an impartial way so that a well-informed decision can be made.\textsuperscript{21}

\textbf{Demand versus capacity to treat - Public Health Care System}

The above-mentioned findings and the discovery that 46.58% (\textit{n}=232) of cases were still incomplete 16.56 months (SD 6.19) after the initial treatment can probably be linked to the very high demand for subsidised dental care in South Africa. The deficit in human resources in South Africa clearly does not allow the dental needs of the South African population to be adequately met.\textsuperscript{14,15} New dispensations in Health in 1994 granted free dental services to many at government facilities (clinics), resulting in increased demand and placing a burden on the limited existing personnel.\textsuperscript{16} Since 1994 the population of South Africa has grown considerably,\textsuperscript{17} yet, the capacity of the government dental services has remained unchanged.

The lack of capacity is further exacerbated by the escalating demands of a population beset by high unemployment rates and socio-economic inequalities. The unemployment rate in South Africa is high with nearly 13.5% of South Africans occupying informal settlements.\textsuperscript{7,18} The demand by patients of lower socioeconomic class for treatment at public facilities, certainly contributes to the problem of adequate delivery of oral health care in South Africa. This is particularly true of the more costly procedures such as RCT.\textsuperscript{4,19} In South Africa, as in other parts of the world, dentistry receives a small portion of the overall health budget and has a comparatively low ratio of 0.085 dentists per 1 000 population.\textsuperscript{20,21}

A proposal by the South African government to reduce the number of dentists employed and to increase the numbers of dental therapists (which to date has not been implemented), was aimed at reducing the cost of basic dental care.\textsuperscript{21} The rationale for these changes was that dental therapists, whose salary scales were lower, could perform basic restorative procedures, extractions and preventive care, allowing the dentists to deliver the more complex procedures like RCT and crown and bridge work.\textsuperscript{21}

The South African Department of Health implemented a compulsory community service (CCS) year for dentists in 2001.\textsuperscript{23} A report by Holtshousen on CCS dentists working in Gauteng, South Africa in 2003 found that over 80% performed mainly extractions, especially those placed in rural areas.\textsuperscript{8,24} Holtshousen suggested that if the dental therapists were also compelled to complete a community service year, this would release the newly qualified dentists to focus on specialized dental procedures such as RCT and crown and bridge work, thereby also improving their skills.\textsuperscript{24} In the light of the long waiting list for endodontic treatment shown by the present study, another way of increasing service delivery output might be to allow these community service dentists to complete more RCTs at the UPOHC, during the periods when the rural clinics are less busy. There is most definitely a need to place a full time community service dentist at the UPOHC and possibly at other oral health teaching institutions. This placement as well as implementation of CCS for dental therapists will require capital funding by the Government into facilities, equipment and more support staff. No unfilled positions for dentists currently exist at the UPOHC and treatment chairs are restricted due to the fact that the UPOHC is primarily a training hospital.

Thus far the discussion has considered only factors related to the health care system. It is however also conceivable that factors related to the patient may also have played a role in the current predicament. Patients receiving an emergency pulpectomy often present with neglected tooth decay that extends into the pulp.\textsuperscript{25} Within the South African context of joblessness and poverty, lack of resources may contribute to the delay, as transport and even phone calls to make appointments, cost money desperately needed for food. The cost of transport to the Faculty could influence
the amount of patients returning for RCT completion. Delay in seeking treatment may also be associated with anxiety linked to the perception patients have that the dental procedure is painful. This anxiety related to fear of pain is visible in the high number of patients that have poor oral health, who often only seek help when the decay has already reached the pulp or when the pain is unbearable.\textsuperscript{26-28} The identification of these factors suggest a need for an integrated primary health care approach that would be able to identify and prevent tooth decay at an early stage, reducing the need for expensive RCT.

Limitations of the study
As with many retrospective studies, the quality of the data depends on the nature of the documented records.\textsuperscript{32} The recording by dentists or students on the hospital files may have omitted some treatment procedures or the tooth number or the handwriting could be illegible. Nevertheless the record keeping was of such standard that it could be determined, with relative ease, whether a RCT was completed or not. In this regard, the digital radiographs employed in the UPOHC proved most valuable. The study period was limited to a relatively short period of two years, which may have influenced the results. Additionally, the appointment of part-time personnel on a short-term basis may have skewed the results.

The quality of completed RCTs was not considered and should also be assessed during a follow-up study to obtain a broader sense of the success of RCT provided at the UPOHC.

CONCLUSION
The evidence in this study confirms that the UPOHC lacks the capacity to complete the RCT’s. An integrated primary health care strategy with a strong preventative focus should be incorporated into the National Health Insurance plan to obviate the need for expensive treatments such as RCT. It is suggested that the Government consider the expansion of oral health services in urban areas such as Tshwane as the demand for service, population growth and socio-economic disparities clearly does not correlate with the capacity to provide service.

Finally, the UPOHC should consider improving their pre-counselling protocol before providing EPS to ensure that the prognosis of a tooth is properly determined before relocation to a waiting list for further complex treatment.

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#OralHealthMonth

September is Oral Health Month

It all starts here.

Healthy mouth. Healthy body.

Instill good eating habits as well as oral health habits in children for healthy mouths and healthy bodies
COMMUNICATION

Beyond Statistics: Part 3:
Getting started with Research

INTRODUCTION
If you have read this far – then you are ready to Research! So where, and how do you start? This paper is intended to guide and to stimulate novice researchers to take the plunge and delve into the exciting world of research and publication. A brief look at the “Instructions to Authors” of any reputable journal will give an indication of the many different types of papers that can be written, ranging from: Research and Education; Clinical Research; Case Reports; Dental Techniques; Material Sciences; Systematic Reviews; down to interesting or helpful Tips From Readers. The first step is to identify a problem, a clinical dilemma, a need, a new material or product to test, a novel idea, or an interesting clinical patient scenario to report on. You are now on your way to become the SMARTEST researcher – this acronym will be used as a guide on how to proceed.

S - SPECIFIC
Before beginning, you need to have a clear idea of the topic that you wish to investigate. Be specific, and narrow the focus to a particular field or issue of interest. At the same time consider whether it is a subject that you will be able to manage with your level of experience, technical ability and expertise. Note that an idea alone does not lead to research. Within that topic, there must be a well-crafted question which identifies what the research hopes to discover. It should be possible to write this out in the Aim as a (problem) statement in one concise sentence. This is almost a declaration of your belief, and the research will then consist of an investigation aimed at supporting and defending, or refuting this notion. At this stage, avoid making assumptions or postulations in anticipating the results. These expectations could result in investigator bias and the researcher may subconsciously influence all the subsequent stages of the investigation. The Objectives are then written in the format of a “To do” list with an explanation, given in a step-by-step manner, of the procedure that will be followed in order to pursue the Aim. This is an introduction for the Materials and Methods section that follows, and should link in with the more detailed description.

M – MEASUREABLE
This aspect is related to the Materials and Method that will later be used. Consider what is going to be done, to whom, how it will be done, and how will the results be measured and interpreted? At this stage a thorough literature review is needed. This will reveal if, and what, studies have already been carried out in this field. There may be merit in duplicating previous designs in order to verify or refute the findings, add more information, or test a different product / method against the currently accepted “gold standard”. It makes sense to keep and use what is acceptable and alter only those aspects where you have identified an inadequacy. i.e. don’t re-invent the wheel. If you are duplicating someone else’s work or ideas, they must be given full credit, and their publication needs to be clearly cited and referenced.

Some tips to help during the literature search: Use keywords taken from your Aim to help narrow down the search. Before even reading a paper, examine the reference sources critically. Consider the authors. Are they well known and respected in their field? Is the particular work in their area of research? Is there any evidence that they may have a bias which could skew their argument? This is particularly relevant in studies that have been sponsored. Look too at the publication information: who was the publisher and was it published in a book, newspaper, on a website or blog, or was it in a peer-reviewed journal, and if so, what kind of journal, and what is its impact factor? Try to restrict references to the latter, a more scientifically acceptable practice. Also take note of when the article was written to be sure that it is still up to date. Be careful when quoting .com (commercial) sites as many of these are sponsored by manufacturers and are basically advertisement sites carrying information which has been drafted by the manufacturers themselves.

The plan should be detailed enough to allow others to replicate the procedures. The chosen method and data collection will vary according to the type of research being conducted. However there still needs to be explicit details regarding what data will be collected, how it will be measured, what instruments will be used for measuring, how issues of standardisation and calibration will be addressed.

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and the statistical methods that will be used for analysis of the results (even if it is a descriptive study, the statistical tests need to be stated). If data collection sheets are used, they must be standardised, specific and applicable to that form of study. Establish who will be collecting the information and filling in the forms. Calibration of all involved may be a requirement to ensure reliability and repeatability. When using questionnaires, one can make use of internationally accepted and recognised collection sheets. However, if none are available it is wise to carry out a pilot study amongst people who are representative of the study’s target population. This will establish whether the questions are clear, relevant, and understandable, and will also indicate whether the responses do answer the research question.

A – ACHIEVABLE

This involves considering whether YOU will be able to carry out the research. Consider realistically whether the scope and scale of the project are within your ability to tackle.3 The research should be specific and within the broader area of your expertise, or something that you are interested to learn more about. Try to confine the number of aspects under investigation, and develop a research question to explore each one.1 Consider what type of research will need to be used to answer the questions e.g. literature review, a laboratory experiment, patient related assessment, clinical trial, questionnaire. Then map out a research plan, including issues such as time frames, budget, facilities and technical expertise needed, required patient pool or records, and what authorisation or permission may be needed, if applicable. It is imperative that whenever participants, patients, clinical records or human tissue are used, there is a signed consent form from the person(s) involved. In the case of minors the legal guardian must sign for consent, and the child must give assent.5 Compare this with the resources you have at your disposal. Do you have access to people, statistics, or documents from which to collect the data you need? Will you be able to relate the concepts of your research question to these observations, phenomena, indicators or variables? Will the findings produce Results that are in accordance with the Aim, and can these data be accessed within the limited time and resources you have available?3 This will help one decide if the objectives are achievable and if the study can be managed. Team work and collaboration with other more experienced researchers or experts is beneficial to all. However, in any joint venture it is imperative that the role of each person is clearly defined, understood, agreed upon and documented before beginning the study. This also applies to the rights to retention of study material and authorship.

R – RELEVANT

The research question must be of academic, intellectual or clinical interest to people in the field you have chosen to study, usually arising from issues raised in the literature or experiences in practice.3 Re-look at your literature review to ensure the research is needed and whether the results will make any meaningful contribution to that field. From this point onwards – keep a record of all references i.e. a full bibliography including author, title, and place of publication, date, publisher details, and page numbers. For internet sources quote URLS, creation dates, and your date of access. Be vigilant in correctly citing and accrediting any quotes or sources – plagiarism is one of the worst publication offenses. Remember that a paper without an accurate bibliography is useless since it will have no citations of the reference source material and the information cannot be verified.2

T – TIME DEPENDENT (TENTATIVE DRAFT)

Create a draft outline of the study. This will help ensure that each step follows in a logical sequence. Try to estimate the time, resources and budget that will be needed for each stage. This will vary tremendously depending on the type of study. A literature review may be labour intensive, but only requires dedicated time and access to the internet. An experimental study could require materials, facilities and help from other skilled people including a statistician. Patient-centred research / clinical trials are the most difficult and time consuming to conduct. There are often limitations and difficulties that may not be anticipated up front. They usually require approval from a Human Ethics Committee, patient consent, a control group, an intervention, patient co-operation, a variable length of time to monitor effects, and patient recall to collect the results. Drop out is high and this must be anticipated when initially estimating sample size. It is disheartening to complete a study and then discover the results are null and void because the sample was not representative or not large enough, or that there was not a comparative control group. This further emphasises the need to consult a statistician during the planning stage. However, long-term clinical research is high up on the evidence ladder, and is well respected.4

E – ETHICAL

The ethics of research goes beyond the four principles of medical ethics set out by Beauchamps & Childress in 2001.6 While autonomy, beneficence, non-maleficence and justice are key issues, the ethics of conducting research aim to safeguard the scientist, protect the participants and maintain objectivity. This topic will be the focus of Paper Four. However, a few points on “What makes research unethical can be mentioned beforehand. Consider them as the four DEADly don’t’s, and the seven DEAR do’s: (Note the 4:7 ratio: Thus it is easier to be ethical than NOT!)

Don’t:
1. Don’t Ever Alter Data
2. Don’t Extract or Add Details (if not found in your research)
3. Don’t Exclude Adverse events to Deceive
4. Don’t Erase Alternative Discoveries

Do:
1. Detail Exact Actions for Replication (allow others to copy the study)
2. Document Everything Accurately in Results
3. Declare Errors And p3. Roblems
4. Discuss Each Aspect of the Results
5. Deliver Evidence-based Appropriate Recommendations
6. Declare Each Author’s Role
7. Declare External Aid or Rands (donor’s contributions and conflicts of interest)

S – STIMULATING

The chosen topic must excite and intrigue you as the researcher, and the question must be able to maintain your interest throughout the project.5,7 If it does not, there’s little chance that it will appeal to anyone else either, less...
chance that it will be done well, and even less that it will ever see completion. Think about what aspects you find the most interesting, if there is scope for investigation into that area, try to formulate the question in different ways, and finally, once you are happy with the question, try to tie it in with the Aim, Objectives and Problem statement. Finally, formulate a concise, applicable title that will attract and entice the reader.

T- TRENDING

Science and technology are advancing at such a rate that is almost impossible to keep up to date with all the new developments in any field. This is one of the main reasons for beginning with a literature search. One of the most deflating experiences is to carry out an intricate study, collect data and then discover that the results have already been published by others. Or worse still, to find that new and better techniques, materials, drugs etc. are available. However, avoid “fad” issues which will not maintain yours or anyone else’s interest.

CONCLUSIONS

Research is not just for academics. Many people unwittingly carry out investigations on a daily basis – for example, consider how much time is spent deciding on a simple task such as purchasing a new cellular telephone. So then why not expend the same amount of energy conducting research in your chosen profession? The basic principles are the same! For both you may ask yourself: Is this something I/others care about? Are there pros and cons that must be considered? Is it arguable? Is it a new spin on an old idea? Does it solve a problem? Is it too broad or too narrow? Is it within reasonable time frames, budget, resources, capabilities and location? Is the information accessible or researchable? If you can answer all of these in the affirmative – Well done! Go for it, YOU can do research.

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INSIGHTS into the clinical effectiveness of whitening products - Part 1: Dentist-supervised-at-home bleaching product

SADJ September 2016, Vol 71 no 8 p365
S R Grobler, Y Osman

ABSTRACT
This section of the report is about the success of a dentist-supervised-at-home tooth whitener, giving the results of a clinical study. Opalescence PF 10% was applied for 14 days and the colour change followed over a 14 month period. It could be concluded that: a) Opalescence is a good tooth whitener, b) the time of re-bleaching should actually depend on the colour choice expressed by the patient. Overall re-bleaching should only be done after six months and not on a monthly basis, otherwise enamel damage may become a problem. Remember that peroxide, which is responsible for the bleaching process, is a strong oxidizing agent. Furthermore, A2 and darker teeth showed more aesthetically observable colour changes.

INTRODUCTION
Today it is known that tooth discolouration varies in appearance, etiology, localization, severity and adsorption to tooth structure which can be intrinsic, extrinsic or a combination of the two. Intrinsic discolouration is mainly caused by the incorporation of chromatogenic material in enamel and dentine, exposure to high fluoride levels from different sources, tetracycline intake and others. Extrinsic stain (as the word implies) comes mainly from the consumption of all kinds of foodstuff with different colouring pigments like carrots, wine (mainly red wine), coffee, tea, etc.

Tooth whitening in cosmetic dentistry has experienced a revolution in the last decade. Film stars in particular took the leading role in whitening their teeth on a regular basis, which influenced many in the general public. The different ways in which teeth can be whitened include dentist-supervised-home-bleaching (nightguard vital bleaching), in-office or power bleaching, a combination of in-office and take-home bleaching as well as over-the-counter whitening products, for use at home. Tooth whitening products were assessed, we also experienced that tooth sensitivity can be rated as a minor problem. Some 20% of the subjects experienced tooth sensitivity right at the start of the treatment phase. When other tooth whitening products were assessed, we also experienced that tooth sensitivity can be rated as a minor problem.

METHODS AND MATERIALS
This part of the report is about the success of a well-known at-home tooth whitener, i.e. Opalescence PF 10%, containing carbamide peroxide, potassium nitrate and sodium fluoride (Ultradent Products, Inc., Utah, USA). The relative effect on darker vs lighter teeth will be discussed. Students with two sound central maxillary incisors (teeth 11 and 21), and otherwise in good dental and medical health and not on any medical treatment were selected. Customized bleaching trays were made for each patient. The bleach was administered nightly for a 14 day treatment period as described by the manufacturers and the colour change was monitored with a spectrophotometer over a 14 month period.

RESULTS AND DISCUSSION
With the spectrophotometer one can quantify colours by measuring them numerically in a three dimensional colour space (L*a*b*). The total colour included three components which are defined as a*, b* and L*.

The a* value varies (see figure) from a negative side (more greenish) to the positive side (more reddish), while the b* value varies from the more blue side (negative side) to the more yellow side (positive side). The L* value varies from a more black side (negative side) to a more white side. For Opalescence the L* values (black/white) decreased with time, losing 10.6% after six months, however, after 14 months the decrease in the L* value was 52.4% of the value recorded 14 days after treatment. The a* values (green/red) were better (more greenish) after the 14 day treatment. The improvement remained after six months but after 14 months, the value had declined to a level worse than at the beginning (more reddish). The b* value showed the least loss, decreasing about 9% after six months and about 8% after 14 months (more yellowish). Some 20% of the subjects experienced tooth sensitivity right at the start of the treatment phase. When other tooth whitening products were assessed, we also experienced that tooth sensitivity can be rated as a minor problem.

CONCLUSION
Thus it can be concluded: a) Opalescence is a good tooth whitener, b) the time of re-bleaching should actually depend on the choice of that colour which is more important to the person. Overall re-bleaching should only be done after at least months and not on a monthly basis, otherwise enamel damage may become a problem. Remember that peroxide, which is responsible for the bleaching process, is a strong oxidizing agent. Furthermore, A2 and darker teeth showed more aesthetically observable colour changes.

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Continuous education in sedation: Anaphylaxis management during procedural sedation

INTRODUCTION
Anaphylaxis is a medical emergency that requires immediate recognition and intervention. Equipment and medication should be readily available. Early administration of adrenalin is the key to survival. In this paper we discuss the critical aspects of anaphylaxis: the definition, presentation, the pathophysiology, the best emergency management and measures to prevent recurrence.

Keywords: anaphylaxis, adrenaline, laryngeal oedema, emergency management, procedural sedation

DISCUSSION
Anaphylaxis is a severe, life-threatening, systemic hypersensitivity reaction that is immunologically mediated.1 This unpredictable syndrome involves multiple organs as a result of the sudden systematic release of mast cells and basophil mediators.2 Nothing should delay the early administration of intra-muscular adrenaline as this is the key to a successful outcome.1

Many definitions, criteria and terminology exist for anaphylaxis. Sampson et al proposed a consensus that is widely agreed upon.3 Anaphylaxis is likely when any one of the three following criteria is met:

1. Acute onset of an illness with involvement of skin and/or mucosal tissue (flushing, urticaria, angioedema) with at least one of the following:
   a. Respiratory compromise (e.g. dyspnea, bronchospasm, stridor)
   b. Hypotension or associated symptoms of end-organ dysfunction (e.g. hypotonia, syncope)

2. Two or more of the following rapidly occurring symptoms following exposure to a likely allergen:
   a. Involvement of the skin-mucosal tissue (generalized hives, swollen tongue)
   b. Respiratory compromise (e.g. dyspnea, bronchospasm, stridor)

3. Hypotension and exposure to a known allergen for the patient
   a. Infants and children: low systolic blood pressure (age specific) or > 30% decrease in systolic blood pressure
   b. Adults: systolic blood pressure of < 90 mmHg

The syndrome can develop in minutes to hours, therefore the sedation practitioner must be vigilant and able to recognize the development of symptoms suggestive of anaphylaxis. Monitors cannot change the outcome, therefore practitioners need to monitor what they cannot control. We accept that different levels of sedation require different standards of monitoring, yet, any patient who receives sedation of any kind needs some monitoring according to SASA Guidelines. Moderate sedation levels require continuous monitoring that includes pulse oximetry, heart rate, respiratory rate and pattern of breathing, and the recording of blood pressure.4

The manifestations of anaphylaxis are seen in the cardiovascular system, upper and lower respiratory tract, gastrointestinal tract and skin. Some or all of the following features can be present: nasal congestion, rhinorrhea, lacrimation; generalized erythema, pruritus, urticarial, angio-oedema, bronchospasm, laryngeal oedema, nausea, vomiting, hypotension, myocardial ischaemia and cardiac arrhythmias.5 A feeling of impending doom (angor animi) is often the first symptom to occur.

Food most commonly triggers anaphylaxis in children, and drugs in adults. Certain drugs like muscle relaxants, antibiotics and aspirin are more often the culprits.6

Local anaesthetics: Anaphylactic reactions to amide and ester type local anaesthetics are extremely rare.7

Propofol has a 1:60 000 incidence of anaphylaxis. Initially there was a higher incidence due to the cremophor used as a preservative.8 There is not an increased incidence in patients allergic to eggs.7

Antibiotics: Penicillin is the most common cause of anaphylaxis in the community and may be responsible for up to 75% of deaths due to anaphylaxis.1 Only a minority of patients who report an allergic reaction to penicillin have a documented allergy on skin testing.7
Certain factors contribute to the severity and the fatality risk of anaphylactic reactions: poorly controlled asthma (particularly in adolescents and young adults), underlying cardiovascular disease and extremities of ages (young children and adults above 55).9

Important chemical mediators of anaphylaxis include cytokines, preformed granule-associated substances (histamine, tryptase, chymase) and lipid derived mediators (prostaglandins, leukotriens). These are released due to the degranulation of mast cells and basophiles.2 Histamine release is the pivotal event that activates H1 and H2 receptors. Activation of H1 receptors causes pruritus, rhinorrhea, bronchospasm, flushing and tachycardia. H2 receptors mediate increased vascular permeability and hypotension.

These chemical mediators could affect the myocardium directly. H1 receptors mediate coronary artery vasospasm and increased vascular permeability. H2 receptors mediate increased atrial and ventricular contractility, increased atrial rate and coronary artery vasodilatation. Anaphylaxis has been associated clinically with myocardial ischemia, conduction defects, atrial and ventricular arrhythmias and T wave abnormalities.

The treatment of anaphylaxis should begin with a rapid assessment, maintenance of airway, breathing and circulation and recognition of the presenting alarm symptoms.3 Help should be called immediately and the practitioner should initiate emergency treatment.3 Of great importance is the discontinuation of the exposure to the allergen (if known). When the criteria for the diagnosis are fulfilled, adrenaline should be given without delay.3 The sedation practitioner needs to be able to identify these clinical features in correlation with the diagnostic criteria to prevent the delay of life-saving treatment.

A prominent risk factor for fatal anaphylaxis is the delay in the administration of adrenaline. Early administration of adrenaline is defined as the correct dose given within 30 minutes of exposure to the allergen: 0,01mg/kg (0.5mg maximum dose) administered intramuscularly (anterolateral thigh), repeated every 5-15 minutes.2,3 Intravenous dose is dependent on severity: 10μg-1mg boluses, with subsequent infusions as needed.

Further management includes patient positioning by elevating the legs in the supine position, and rapid intravenous fluids via large bore cannula, concurrently giving high flow of oxygen.1 H1 antagonists: e.g. Diphenhydramine/Promethazine 25-50mg given intramuscularly or slow intravenous administration of H2 antagonists: Ranitidine 1mg/kg or cimetidine 4mg/kg. Treat bronchospasm as per usual protocol.

Should cardiac arrest occur, good quality CPR should be initiated immediately as per current resuscitation protocols, including intravenous adrenaline.12

Patients taking β-adrenergic antagonists may be more likely to experience severe reactions characterized by a slow pulse, severe hypotension and bronchospasm. Glucagon can be given to these patients.11

The major causes of death due to anaphylaxis is listed as asphyxia, shock, disseminated intravascular coagulation and adrenaline overdose.

Recurrent or biphasic anaphylaxis may occur in up to 20% of patients, usually within 8-12 hours. Corticosteroids should be given to prevent the incidence of recurrence, Hydrocortisone up to 2g or Methylprednisolone as an alternative, can be given intravenously.

The patient should be referred to an Emergency unit for further management.

After an anaphylactic event, the patient should be referred to an allergist for testing. Skin-prick, intradermal or serological testing are the usual modalities used. Skin prick testing has a high predictive value in the setting of a history of anaphylaxis. Intradermal testing is used for local anaesthetics, propofol and muscle relaxants. Skin testing should be performed 4-6 weeks after an anaphylactic reaction. Risk of triggering anaphylaxis is small (<0.1%), but resuscitative equipment must be available.

Measures to reduce the incidence of anaphylaxis and anaphylactic deaths include appropriate training and counseling on the use of auto-injectors for the patient and their families. Patients should also wear bracelets or warning identification. Patients and families need to be taught to use the adrenaline auto-injector and cautioned to keep the adrenaline kit with them. Patients need to be able to identify the allergen to which they are allergic and know how to avoid it.7 All anaphylactic drug reactions should be reported.

Sedation practitioners always need to obtain a thorough history for drug allergy.

CONCLUSION

Anaphylaxis is a severe, life-threatening, systemic reaction that can occur within minutes after exposure to an allergen. Sedation practitioners need to know the clinical presentation as well as subtle signs and symptoms suggestive of the diagnosis. Early adrenaline administration is the key to the survival of patients with anaphylaxis.

References

A dentist places temporary crowns and a follow up appointment is made to place the permanent crowns, which are manufactured and ready for that appointment. Before the date of the appointment, the patient advises the dentist that he/she has consulted with another practitioner who has now placed the permanent crowns. This is done without the patient terminating the contract with the dentist or settling outstanding fees due.

The first dentist is understandably upset and wants to report the second practitioner for unethical and unprofessional conduct (supersession). The issue becomes more acute if the patient owes the original practitioner substantial fees or if the first practitioner cannot submit a final account as treatment is not yet completed and the contract for services by the patient is not terminated.

A specialist carries out complicated treatment on a patient, the patient then seeks the final stages of treatment from another practitioner whose scope permits it but who charges lower fees. The specialist is upset that the intellectual skill of the specialist is now taken over by the second practitioner and the specialist considers this supersession.

On a daily basis practitioners experience their colleagues taking over ongoing treatment. The colleague then completes the treatment without further notification or consultation with the original practitioner. The second practitioner when confronted often claims that treatment was provided at the patient’s request.

Another instance is where dental advisors employed by medical schemes are considered to be transgressing the rules on supersession by denying benefits, declining authorisations, imposing limitations or providing other treatment modalities. From a reading of the Rules (below), the dental advisor is not taking over treatment of the patient (scheme member) but simply imposing scheme rules, benefits and limitations as to whether or not they will fund the member’s dentist in terms of the contract the member has with the medical scheme.

There is very little about the conduct of practitioners, apart from advertising, that evoke such strong responses and sense of anger from practitioners as ‘supersession’ where practitioners believe their colleagues have violated their collegiate relationships and professional relationships by stealing away their patients.

The supersession rule was evolved not to ensure that the first at the dinner table does not lose his/her dinner. It was designed to enhance the conjoint welfare of the patient and the dentist. In most cases, the patient’s treatment is compromised as the full benefit of the first practitioner’s initial findings, investigations and dental expertise is not carried forward. It may be that the advice of the first practitioner may be superior, but being not carried forward, it is lost to the patient.

Supersession is a verb which means to take the place of or supplant, to replace or discard or set aside or cause to be set aside as obsolete or inferior.

Supersession is a practice of taking over the patient of another practitioner without informing the other practitioner where the patient has not terminated or paid for the first dentist’s services.

The Ethical Rules of Conduct for Practitioners registered in Rule 10 under the heading Supersession provides that “A practitioner shall not supersede or take over a patient from another practitioner if he or she is aware that such patient is in active treatment of another practitioner, unless he or she-

(a) Takes reasonable steps to inform the other practitioner that he or she has taken over the patient at such patient’s request; and

(b) Establishes from the other practitioner what treatment such patient previously received, especially what medication, if any, was prescribed to such patient and in such case the other practitioner shall be obliged to provide such required information.

The rule above shows supersession is permissible provided the positive actions mentioned in paragraphs (a) and (b) above are met by the second practitioner who is taking over treatment of the patient. Therefore any complaint that the practitioner has ‘stolen’ or ‘taken away’ the patient may be based on an accusation of unethical conduct and breach of ethical rule 10 above only if the conditions are not complied with.

The issue of supersession must also be read in conjunction with right of trust and patient’s autonomy, their right to decide whether or not to undergo any intervention, even if refusal may result in harm. It should be remembered that a patient has the right to terminate treatment at any
time and to seek treatment from another practitioner. In this case, the practitioner who is taking over the patient should inform the first practitioner about the patient’s decision and seek details of treatment carried out thus far. Although the rules are silent, reading the rights of confidentiality and the injunction not to impede patients, it would seem that the patient’s consent would first need to be obtained.

The question may also arise if the first patient has to hand over files or depending on the nature and extent of information that should be given. It appears the first practitioner may be required to give information but not the files. Where the patient has not paid for the service provided by the original practitioner for example, specialist or special skills assessment done, the document remains the property of the original practitioner.

One must also read this in conjunction with provisions of Ethical Rule 11 “Impeding Patients” which impose a duty on a practitioner not to impede his/her patients from obtaining an opinion from another practitioner or from being treated by another practitioner.

Rule 12 also provides that a practitioner should not cast reflections on the probity, professional reputation or skills of another registered person.

Thus despite the belief to the contrary, supersession is not prohibited, it is permissible subject to compliance with the positive duties imposed on practitioners. If the practitioner taking over treatment of patients of another practitioner does not comply with the conditions above, he/she may be reported for unethical conduct.

References
2. HPCSA Ethical Booklets 1-14
A sixteen year old male patient presents at your office with the main complaint of a painless, slowly enlarging bony swelling in his lower left jaw Fig.1. The radiographs presented are from other patients with the same condition. Discuss the radiological features and what is your diagnosis?

**INTERPRETATION**

After histological evaluation of the bony swelling of the presenting patient a diagnosis of an osteoma was made. This benign lesion of bone is characterized by a bony protuberance of mature lamellar or woven bone that usually arises in membranous bones. These lesions are usually considered to represent hamartomas or reactive lesions secondary to low grade inflammation. When they occur centrally in bone they are endosteal in origin. The central tumours are characterized by a dense mass and are also known as the compact or ivory osteoma (Fig.2). When the tumour is located in the vicinity of teeth, root resorption may occur. When they occur on the peripheral surface of bone, they are subperiosteal in origin. The peripheral tumour is characterized by a dense sclerotic mass projecting from the surface of the affected jaw (Fig.3). The most common locations are the mandibular condyle and near the angle of the mandible. Other notable sites are the coronoid notch and the lateral aspect of the ramus. A compact osteoma is attached at the mandibular notch (Fig.4), whilst an incidental finding of a compact osteoma in a 45 year male patient seeking orthodontic care is discernible in Fig.5. The trabecular osteoma (Fig.6) is another type of osteoma which is most frequently encountered in the maxilla, where it may be located in the palate on the vestibular side of the alveolar process. The trabecular osteoma can occur subperiosteally, elevating the mucosa, as well as centrally within the jaw, most often in the premolar region. The growth of the tumour is very slow. There is a female predominance, with a ratio of 3:1. The reported age range for osteoma of the head and neck is 16 to 74 years, with patients in their sixth decade being most commonly affected. Surgical removal is advisable for the peripheral located osteomas, while centrally located tumours usually require no treatment.

**Reference**

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

1. Mineral trioxide aggregate (MTA) versus Biodentine for pulpotomies in primary molars: a randomized clinical trial


Pulpotomy is a common procedure where the coronal pulp is amputated and the remaining vital radicular pulp tissue surface is treated with a pulp-dressing agent such as Formocresol which has long been considered the gold standard. However, its continued use has been controversial due to its potential mutagenic and toxic effects. With the development of materials that are both biocompatible and bioinductive, the emphasis has shifted from preservation to regeneration of residual pulp tissue. MTA has gained popularity among pediatric dentists for use in pulpotomy because of its excellent sealing ability, biocompatibility, and ability to stimulate hard tissue formation. More recently though, Biodentine, a calcium silicate-based cement, packaged as powder and liquid, has been introduced to combine the high biocompatibility and bioactivity of calcium silicates with enhanced properties such as rapid setting time (conferred by the calcium chloride) and high strength (conferred by the low water-to-cement ratio). These properties make Biodentine a viable choice for use as a pulp-dressing agent for pulpotomies in primary molars.

Cuadros-Fernández et al (2016) reported on a trial that sought to clinically and radiographically evaluate and compare the performance of MTA and Biodentine as pulp-dressing materials following pulpotomy in human primary molars in a 12-month follow-up study.

MATERIALS AND METHODS

This is a randomized open label clinical trial reported in the CONSORT (Consolidated Standards of Reporting Trials) format. An open-label trial or open trial is a type of clinical trial in which both the researchers and participants know which treatment is being administered.

Patients eligible to participate were healthy individuals aged 4–9 years requiring pulpotomy in one or two primary molars. The criteria for the selection of teeth to be included in the study comprised the following:

- Carious pulp exposure in symptom-free vital primary molars found during the removal of caries
- No clinical or radiographic evidence of pulp degeneration (excessive bleeding from the root canal, internal root resorption, or inter-radicular and/or furcal bone destruction)
- The potential for proper restoration of the tooth with a minimum of three walls present
- Physiologic resorption of less than one third of the root

The exclusion criteria included the presence of systemic pathology and any history of allergic reaction to local anesthetics or to the constituents of the test pulp-dressing agents.

A single postgraduate student in paediatric dentistry performed the procedures, and one investigator checked to ensure that the pulp was exposed during preparation and that the teeth were suitable for pulpotomy. The molars were randomly assigned to either the Control (MTA) or Experimental (Biodentine) Groups using a random number table.

A standardised treatment protocol was used in both groups prior to the application of the control and experimental materials. Rubber dam isolation was used in all cases. After gaining access to the pulp orifice, the coronal pulp tissue was removed using a sterile slow-speed round bur. The remaining radicular pulp tissue was treated with either MTA paste (obtained by mixing MTA powder with sterile saline in a ratio of 3:1) or Biodentine (obtained by mixing Biodentine powder with a single dose of liquid) according to group allocation.

The pulp chambers of the molars in both groups were filled with a polymer-reinforced zinc-oxide–eugenol restorative material and all molars were restored with stainless steel crowns cemented with glass ionomer cement (Ketac-Cem).
At the 6-month and 1-year recall visits, clinical and radiographic examinations were performed. Teeth were evaluated clinically by a single investigator and scored as a clinical success if the patient had no symptoms of pain, and there was no swelling or gingival inflammation, fistulation, or pathologic mobility. Teeth were scored as a radiographic success if they showed no evidence of internal or external resorption or periapical radiolucency.

RESULTS
The final study population comprised 68 children (35 boys, 33 girls) with a mean age (± standard deviation) at the time of treatment of 6.6 (± 1.3) years.

A total of 90 primary molars were initially included in the study, but six were excluded because of uncontrollable bleeding during treatment. In total, 84 pulpotomies were performed on teeth randomly assigned to either the MTA or Biodentine Groups. Twenty-five patients had one pulpotomy with Biodentine, 27 patients had one pulpotomy with MTA, and 16 patients had two pulpotomies (one with MTA and one with Biodentine). This made a total of 41 pulpotomies with Biodentine and 43 pulpotomies with MTA. The types of teeth were as follows: 24 mandibular first primary molars, 18 mandibular second primary molars, 24 maxillary first primary molars, and 18 maxillary second primary molars. After 6 months of follow-up, all molars were clinically and radiographically evaluated without any drop-out; whereas, at the 12-month follow-up evaluation, which had a recall rate of 93 % (78/84), six molars could not be checked as a result of four drop-outs from the MTA Group and two drop-outs from the Biodentine Group.

After 6 months of follow-up, three clinical failures had occurred. All involved gingival inflammation (two molars from the MTA Group and one from the Biodentine Group). One molar from the MTA Group showed gingival inflammation at the 12-month follow-up visit. These molars were re-evaluated after educating the patient on oral hygiene, and the gingival inflammation was resolved. No clinical failures were observed in the Biodentine Group at the 12-month follow-up evaluation. Therefore, the clinical success rate in the MTA Group after 12 months was 92% (36/39), whereas the clinical success rate in the Biodentine Group after 12 months was 97 % (38/39) (p=0.346). No patients showed signs of pain, tooth mobility, fistula, or swelling.

No evidence of internal or external resorption or periapical radiolucency was observed in any molar in either group at the 6-month recall. All radiographic failures were observed at the 12-month follow-up evaluation. One molar from the MTA Group showed internal resorption; therefore, use of MTA yielded a radiographic success of 97 % (38/39). Use of Biodentine yielded a radiographic success of 95% (37/39). One molar showed internal resorption and a second exhibited periapical radiolucency (p = 0.635).

CONCLUSIONS
The researchers concluded that Biodentine showed similar clinical results as MTA with comparable success rates when used for pulpotomies of primary molars over a 12 month follow-up.

IMPLICATIONS FOR PRACTICE
Compared with MTA, Biodentine offers many advantages (shorter setting time, enhanced compressive strength, micro-hardness, and lower cost) and should be considered as a viable alternative.

Reference

2. Dentoalveolar effects of slow versus rapid maxillary expansion in complete bilateral cleft lip and palate patients: a randomized clinical trial


Cleft lip and palate (CLP) are considered the most common craniofacial anomalies and usually involve the upper lip, alveolar ridge or/and the palate which often results in aesthetic, functional, and/or psychosocial impairments.¹ Complete bilateral cleft lip and palate (BCLP) is the most severe type of cleft and these patients usually show severe deficiencies of maxillary growth, demonstrating maxillary dental arch constriction and posterior crossbites.¹

Orthodontic treatment of patients with BCLP commonly requires maxillary expansion either with slow maxillary expansion (SME) using the quad-helix appliance and its variations or rapid maxillary expansion (RME) with Haas-type or Hyrax expanders.¹
de Medeiros Alves and colleagues (2016)¹ reported on a randomized clinical trial that sought to compare the dentoalveolar effects of slow and rapid maxillary expansions in patients with bilateral complete cleft lip and palate using three-dimensional analyses on digital dental models. The null hypothesis was that SME and RME are not different regarding the maxillary dental arch changes in patients with BCLP.

MATERIALS AND METHODS
This study was a randomized clinical trial involving two parallel groups randomized with a 1:1 allocation ratio.

Eligibility criteria for the participants were patients with complete bilateral cleft lip and palate, ages ranging from 7 to 11 years, lip and palate repair performed from 3 to
24 months of age, and presence of maxillary dental arch constriction and need of maxillary expansion prior to secondary alveolar bone grafting. Exclusion criteria were the presence of associated syndromes, carious lesions, and history of previous orthodontic treatment.

At the initial orthodontic exam, the participants and their legal guardians were informed about the need of a maxillary dental arch expansion prior to secondary alveolar bone grafting and they received invitation to participate in the study. Once informed consents were signed by parents, the patients were randomly allocated into two study groups: slow maxillary expansion group (SME group) or rapid maxillary expansion group (RME group). After at least a month after the initial orthodontic exam, the patients returned for appliance installation.

The SME group was treated with the quad-helix appliance. The expander was constructed using 0.036-in. stainless steel round wires. Molar bands were adapted preferentially on maxillary first permanent molars. When these teeth were partially erupted, second deciduous molars were banded. The quad-helix appliance was activated 6mm (3mm per side), and subsequent reactivations were performed sequentially at a 2-month interval. The expansion active phase ranged from 4 to 21 months. Expansions were considered adequate when the palatal cusp tip of the maxillary posterior teeth contacted the buccal cusp tip of the mandibular posterior teeth. After the active expansion phase, the appliance was maintained in the oral cavity as a retainer for six months. Dental models were obtained immediately pre-expansion (T1) and six months after the end of the active expansion when the appliance was removed (T2).

The RME group was treated with the Hyrax expander. Considering that the participants were in the mixed dentition, appliance anchorage was provided by bands adapted on either the maxillary first permanent molars or the second deciduous molars, and circumferential clamps were bonded to the deciduous canines. When the second deciduous molars were banded, a lingual extension wire was placed in the partially erupted maxillary first permanent molars. The 11-mm screw (Dentaurum) was activated two-quarter turns in the morning and two-quarter turns in the evening. The expansion active phase ranged from 7 to 14 days. Expansions were considered adequate when the palatal cusp tip of the maxillary posterior teeth contacted the buccal cusp tip of the mandibular posterior teeth. After this phase, the appliance was kept as a retainer for six months. Similarly to the SME group, dental models were obtained immediately pre-expansion (T1) and six months after expansion at the occasion of expander removal (T2).

Standardized dental models were scanned using the 3Shape R700 3D© scanner. Measurements were performed on the pre- and post-expansion maxillary digital dental models using OrthoAnalyzer 3D©.

The primary outcomes were the changes in the maxillary dental arch widths (3-3, 4-4, 5-5, 6-6), arch perimeter, arch length, palatal depth, and buccolingual inclination of posterior teeth (I3, I5, I6). The secondary outcome was the differential amount of expansion accomplished at the canine and molar regions. There were no outcome changes after trial commencement.

Computer-generated randomization based in random permuted blocks of 20 patients was accomplished with Stata© software to ensure equal distribution of participants in the groups. Allocation concealment was achieved with sequentially, numbered, sealed, opaque envelopes containing the expansion modality allocation cards, which were prepared before the trial. One operator was responsible for opening the next envelope in sequence and implementing the randomization process.

Blinding of patients and operator regarding the modality of expansion was not possible; however, the outcome assessment was blinded because digital dental models were unidentified during analysis.

One operator performed all the measurements on the digital dental models and repeated the measures in 30% of the sample at least one month later.

Inter-phase changes analysis for both groups was performed using paired t tests. Intergroup comparisons of primary outcomes and intragroup and intergroup comparisons of secondary outcome were performed using t tests. Differential expansion assessment was performed comparing the difference between 3-3 change and 6-6 change between SME and RME groups using t tests.

A statistical significance level of 5% was accepted for all tests, and associated 95% confidence intervals (CI) were calculated. All analyses were conducted with Statistica®, version 11.

RESULTS
Eighty-three participants were considered for this trial but 21 patients (25.30%) were excluded because they did not meet the eligibility criteria. Sixty-two patients were then randomized in a 1:1 ratio to study groups (SME group, 31; RME group, 31). The trial ended when the sample size allowed a dropout rate of 20%.

Baseline characteristics showed that the patients’ initial mean ages were similar in both groups. Treatment time was significantly greater for the SME group compared to RME group. Most of the patients of both groups were male, and no intergroup differences were found for sex distribution.

Five out of 31 (16.12%) and six out of 31 (19.35%) patients from the SME and RME groups, respectively, were lost during enrolment because canines or maxillary deciduous molars had exfoliated and there was not enough dental anchorage to install the appliances. Expanders were installed in 26 patients of the SME group and 25 participants of the RME group. One patient from the SME group was excluded from the sample because the quad-helix appliance was misadjusted. Twenty-five patients for each group were properly analyzed in their original assigned groups. The primary analysis was carried out on an intention-to-treat basis involving all patients randomized after consideration of missing data.
No significant differences were found between the maxillary dental arch dimensions of both groups at T1.

SME and RME caused significant increases of arch widths and arch perimeters. Arch length and palatal depth decreased nonsignificantly with SME but significantly with RME. Buccal tooth tipping was significant only for the maxillary deciduous canines in both groups. No significant differences were observed between SME and RME changes.

The quad-helix appliance produced a differential expansion with a statistically significant greater increase of the intercanine width compared with the intermolar width. No significant differences were found between the differential expansions of SME and RME.

No serious harm was observed other than variable pressure sensations around the teeth, under the eyes, and at the nasal area reported during treatment by participants of the RME group. However, these symptoms rapidly disappeared with no major discomfort.

**CONCLUSIONS**

The researchers concluded that Slow and Rapid maxillary expansions caused similar maxillary dental arch changes in patients with complete bilateral cleft lip and palate. However, slow maxillary expansion required greater treatment time compared with rapid maxillary expansion.

**IMPLICATIONS FOR CLINICAL PRACTICE**

Although both interventions (SME & RME) showed equivalence in treatment effect, the significantly shorter time required for RME must be a serious consideration in determining the choice of treatment in these patients.

**References**

GENERAL

The use of textural analysis to test the hardness and penetrability of three types of gutta percha cones when exposed to two endodontic solvents. (p 346)

1. Halothane and Chloroform have lost favour in endodontic usage because they are:
   a. Toxic and have unpleasant tastes
   b. Ineffective in dissolving gutta percha
   c. Carcinogenic and cause staining of the tooth
   d. Carcinogenic and toxic
   e. Prone to render teeth fragile

2. Textural analysis of a substance yields information on rigidity, resilience, cohesiveness, and adhesiveness.
   a. True
   b. False

3. The rigidity and deformation energy of all test Gutta Percha samples either decreased or remained the same following solvent exposure to Xylene but not to Eucalyptus oil.
   a. True
   b. False

4. Conventional GP has a comparably thicker quantity of β-phase gutta percha which made the sample less susceptible to a reduction in rigidity.
   a. True
   b. False

5. The study concluded that not only was Eucalyptol, Eucalyptus, an effective solvent of Gutta Percha but also had attributes of biocompatibility and antimicrobial effects, making it the solvent of choice.
   a. True
   b. False

A survey of the opinions of Dentists regarding stem cells in Dentistry (p 351)

6. Research into the potential of stem cells in Dentistry shows that they could be harnessed to regenerate the roots of teeth, periodontal tissue and craniofacial structures.
   a. True
   b. False

7. The bioactive factors secreted by MSCs inhibit apoptosis and angiogenesis, while stimulating mitosis of tissue-intrinsic progenitor or stem cells.
   a. True
   b. False

8. The ethics of using stem cells in regenerative procedures was not considered a major impediment to the practice.
   a. True
   b. False

9. Most respondents knew the origin of stem cells and were using regenerative procedures in their practices.
   a. True
   b. False

The capacity of the Oral Health Centre, University of Pretoria, to complete root canal treatments. (p 356)

10. At the Institution, provision is always made for endodontic treatment to be delivered to teeth which have undergone emergency pulpectomy.
    a. True
    b. False

11. Explicit data are available indicating the most favourable time lapse before root treatment is delivered after emergency pulpectomies.
    a. True
    b. False

12. The paper argues that full time community service dentists should be allocated to Oral Health Teaching Institutions.
    a. True
    b. False

Beyond Statistics: Part 3: Getting started with Research (p 362)

13. When undertaking a literature search, the impact factor of a journal in which a relevant paper has appeared is not relevant.
    a. True
    b. False

14. A statistician is best consulted:
    a. At the planning stage
    b. At the literature search stage
    c. At the stage of active research
    d. At the stage when results have been collected

15. When a minor child is to be enrolled as a subject in research it is required that the Informed Consent document be signed by:
    a. The guardian
    b. The child
    c. Both guardian and child
    d. Neither
Continuous education in sedation: Anaphylaxis management during procedural sedation (p 368)

16. Signs and symptoms of anaphylaxis may include any or all of the following: nasal congestion, rhinorrhea, lacrimation; generalized erythema, pruritus, urticaria, angio-oedema, bronchospasm, laryngeal oedema, nausea, vomiting, hypotension, myocardial ischaemia and cardiac arrhythmias.
   a. True
   b. False

17. Crucial in the management of anaphylaxis is the early administration of adrenaline within 30 minutes of exposure to the allergen and at a dose of 0.01mg/kg (0.5mg maximum dose) administered intramuscularly (anterolateral thigh), repeated every 5-15 minutes.
   a. True
   b. False

18. The severity and the fatality risk of anaphylactic reactions are associated with poorly controlled asthma (particularly in adolescents and young adults), underlying cardiovascular disease and extremities of ages (young children and adults above 55).
   a. True
   b. False

Maxillo-Facial Radiology case 144 (p 372)

19. Osteoma may cause root resorption when located in the vicinity of teeth.
   a. True
   b. False

20. Surgical removal of a central osteoma is advisable.
   a. True
   b. False

ETHICAL

Supersession (p 370)

21. Strictly speaking, a Medical Aid advisor is not guilty of supersession when he/she advises an alternative course of treatment.
   a. True
   b. False

22. The Supersession Rule was designed solely to ensure the protection of the practitioner.
   a. True
   b. False

23. The Rules do provide for ethical supersession to take place.
   a. True
   b. False

24. A practitioner may prevent a patient from seeking a second opinion if he/she believes incorrect treatment may be advised.
   a. True
   b. False

25. Claiming that the patient requested to be taken over excuses an act of supersession, even when the original practitioner is not informed.
   a. True
   b. False

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

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