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8 Antifungal susceptibility of Candida albicans isolated from the oral cavities of patients with HIV infection and cancer
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26 The emerging role of epigenetics in the pathogenesis of periodontitis - A review

Two major species of Tigerfish. *Hydrocynus goliath* (illustrated) occurs in Lake Tanganyika and Congo river, up to 110 pounds, has been known to attack humans! more familiar is *Hydrocynus vittatus* Okavango swamp, Zambezi River up to 33 pounds and a fine fighting fish. Both have fearsomely large and protruding teeth supplemented by a series of replacement teeth in case of loss or fracture.

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Why do some birds hop and others walk?

An old enquiry which still evokes considerable speculation. It may well be that birds who habitually perch in trees will habitually hop should they be on the ground. They have to hop whilst moving from branch to branch and that habit persists on the ground, of course! What about the length of their legs? Observation tells us that long legged birds will walk… short legged birds hop. Clear examples are the water birds… long legs to enable wading, and walking is the method of locomotion. Sparrows are the short legged variety… and hop they do!

But I enjoy the thought proposed by a Scottish correspondent… he claims it is to do with the size of their brains! Smaller birds have less grey matter, so walking is beyond them! True, walking demands extraordinary combinations of neuromuscular control. I am reminded of a famous lecture delivered by the late Professor Phillip Tobias. Dealing with human walking, he succinctly summarised our efforts… “The tottering biped”!

Serious opinion relates hopping and/or walking to considerations of energy and efficacy. Hopping may consume more energy but is generally faster than walking… except when the bird is a ground dweller such as a guinea fowl whose strong legs make running efficient… and less energy consuming than flying. Yes, let’s accept that the bird instinctively chooses the mode of locomotion best suited to the circumstances and with the least energy demands.

It is now only a short hop – or flight (!) - to Dentistry, which is also, intellectually and instinctively, seeking greater efficiency and enhanced conservation of energy. That is the essential principle underlying contemporary dentistry. Prevention of debilitating disease, achieving maximum health and efficacy of oral function. All ideally to be achieved with the greatest expedition. Worldwide, the 20th March will be marked the World Oral Health Day. Members may recall that that the FDI decided in 2013 to move the Day from September to March, the essential reason being to reduce the potential clash between World Oral Health Day and the Annual World Dental Congress, conventionally held in September. It is worth repeating the FDI Policy Statement that national dental associations “should develop activities and initiatives aimed at increasing awareness for oral health as well as the impact of oral diseases on general health, well being and economy”.

Our Association continues to celebrate Oral Health Month in September, as recorded in the Health Calendar, 2016, issued by the Health Systems Trust. Intriguingly, the Calendar does not mention World Oral Health Day in March, which is otherwise recorded as Reproductive Awareness Health Month… and perhaps fittingly, there are two special weeks juxtaposed—the first being Pregnancy Awareness Week, 8 - 14 March, and Condom Week, 10 - 16 March. Seems there may be a case for conservation of energy there as well!

The February issue prints a paper in the context of the 2015/2016 Association Theme: Oral Health and Psychological Well Being. The authors, from Sefako Makgatho Health Sciences University, have closely followed that theme in their paper: Oral health and subjective psychological well-being among South African Adults: The paper is compulsive reading and the conclusion is telling: “Good oral health is independently associated with greater subjective well-being. This highlights the need to prioritise oral health promotion as an integral part of promoting general health and improving the quality of life of South Africans.” An eloquent case for conservation of energy… whatever effort may be devoted to the promotion of oral health is energy well spent.

Now look at a linguistic conservation of energy … the word “holophrasis” defined by the OED as “the expression of a combination of ideas by one word”. Absolutely apt for the forthcoming Congress of the Association… the programme represents a holophrasis of our profession. So many concepts, so many skills, so many stimulations… all summarised in that one word. A conservation of energy indeed… and our attendance at the Congress will reap rich rewards across all disciplines 19-21 March.

So we have solved the question, large birds walk, small birds hop, except vultures hop, don’t they? And wagtails walk, don’t they? How fortunate we are that there are always questions to be posed and answers to be sought. Dentistry is no exception.
Communique, Communique

Just how many balls does the Association currently juggle in the air…. some relatively small like the possibility of IADR fee subsidies for sessional academic staff (sadly cannot be done) whilst others are huge: representing the profession on pertinent legal issues at the HPCSA or handling extensive publicity campaigns or managing that all important Coding. All members should be apprised of these ongoing and productive activities and how better than the frequent SADA Communiques?

Several communiques have dealt with the forthcoming Association Congress to be held in March. By the time you read this, the Early Bird option will have come and gone… but never fear, the Association will be delighted to register you now and you will still have the opportunity to revel in three days of comprehensive contemporary dentistry, led by some thirty erudite lecturers. Refer to recent Communiques 27th, 29th January and to the SADA Congress website www.sadacongress.co.za.

We commence with a challenge: David Grier will probe the concept: *When the going gets tuff, the tuff get going*. An inspiring start to the Congress. Over the following three days, Saturday through Monday, prosthetics, orthodontics, endodontics, implantology, periodontology, legal issues, aesthetic dentistry, practice management… what has been omitted…. Oh yes, materials.. all will be considered, and by the leaders in the field. Of course delegates will sit down to a gorgeous Gala Dinner, there will be other social events. Did you know all this.. or did the Communiques slip past?

A recent and most important communique announced the new dispensation on Membership Fees. Whilst Maretha Smit has indeed been visiting various Branches to expound on the concepts, it may be worth including some aspects in this Communique. Essentially members now have a choice apart from Core Membership, they may elect to enrol for one or both of a further two options.

Core Membership ensures members have the full benefit of the essential commitment of the Association to represent Dentistry at every level nationally and internationally. This is no routine exercise but demands a constant vigilance and a full preparedness to invoke every energy to ensure that the Voice of the profession is heard ….. and listened to. In a word, this is Advocacy of the profession in every forum. Without this, it is more than likely that we would indeed feature less and less in every issue affecting Health Care. Then the more mundane tasks of Coding, of Publicity, of handling the DPL administration, are basic to the Association… did I say “mundane”? Perhaps these may be daily activities but how absolutely central to our profession. Core membership is the foundation of commitment to the community of the Dental Health Care Team.

This Core category of membership involves an annual fee of R 2850 (including VAT).

Now comes the enterprising developments for members to identify and to select opportunities for further membership benefits. There are two options, Education and Advisory Services.

Education… the option is a double commitment, for on the one hand the Association accepts the role of provider, whilst on the other hand the member simply commits to being the beneficiary…. all Education benefits are aimed at enhancing expertise and acumen, at facilitating the acquisition of CPD points, and ultimately providing the base for more confident and successful practice. Participation in the option ensures members have full access to Branch events, may take advantage of all CPD events including...
the Journal CPD questionnaire option, will be considered on application for Research Grants through the Dentistry Development Foundation… and most pertinently, offers a full R1000.00 discount for registration to the annual SADA Congress. This option will cost members R1140 (including VAT). Seems an excellent bargain especially when the member attends the Congress!

The second option is Advisory Services. During the complexities of professional life, it is almost inevitable that at some stage we will earnestly seek guidance from our peers… whether a serious matter involving an HPCSA enquiry after patient complaint, or simply some information on how to interpret the Codes. It is now the individual member who may decide whether to subscribe to this option. Quite evidently if a member is in retirement there may be little need for taking the service. Busy practitioners may well be advised to subscribe. The annual cost is R1140 (including VAT).

So there is a new dispensation and members have a flexible membership package. Understand that the Association is committed to providing the best services at all times. Frequently asked questions include the enquiry as to whether a member may adjust the package at any time, to add (or remove) an option? The answer is yes, there will be continued flexibility. Perhaps it is self-evident that the hope is that the majority of members will elect to subscribe to the full package.

Then a recent communique forwarded on behalf of the HPCSA advises members that it remains the responsibility of the patient to secure authorisation from Medical Aid Schemes.

A bitter-sweet communique sent in early December invites applications to two positions at Head Office. We have most sadly lost the presence of Dr Mehroon Khan and Dr Khanyi Makwakwa. Both served the Association with such dedication and commitment and distinction. Both are moving to positions where their experience at the Association will be of high benefit. Both will remain full members of the Association. We wish both every success in their new enterprises. Now we await with keen anticipation the appointment of new staff and look forward to absorbing them in their turn into the fabric of the Association.

Why did Joanne Rowling choose the owl as the bearer of letters to Harry Potter? The owl is wise…and the regular SADA Communiques are invaluable sources of intelligence for members. Regular perusal of the inbox, electronic or owl, will pay great dividends.

The South African Dental Association presents:

**CONFERENCE & EXHIBITION 19 - 21 March 2016**

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Gallagher Convention Centre
Midrand, Johannesburg

**Organiser**
South African Dental Association

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Paul van Zyl, Mark Wertheimer, Nadeem Osman

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John Bronner
Imran Cassim
Nuno Sousa Dias
Howard Farran
Carlo Ferretti
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Livio Yoshinaga

**CPD points:**
**20 Clinical & 2 Ethical**

A fantastic learning opportunity awaits the dental profession
This warm and sincere tribute was written by his children, Eric, Lorna and Janice, to whom are sent the deep sympathies of the Association and members. Harold was a stalwart member of the Federal Council for many years and made significant contributions to Dentistry South Africa.

Dr Harold Levenstein lived in Durban for most of his life, although he had been born in Johannesburg (in 1935) and had attended Hillel School and Jeppe High. Then to Durban High School where he matriculated and ended up living and practicing dentistry for decades in this, his home town. Harold graduated BDS from Wits in 1956, when he was 21 years old. He served as the President of the South African Dental Association (Natal Branch), was respected by his peers and was honoured for his service in the profession. My father was immensely proud of his achievements in dentistry and particularly enjoyed his involvement with SADA, of which he was extremely proud to be a member. Dentistry was his life and he loved practising and being involved in everything to do with dentistry, especially endodontics. What he enjoyed most was imparting to younger dentists his knowledge about dentistry and instilling enthusiasm for his profession to other dentists. He delivered papers, mainly on endodontics, his first love in Dentistry and published three.

We (as his children) grew up with a father who was a true professional and where he set the example of what it means to give back to his profession and to an organisation which set the standard for dentists in South Africa.

He had many interests – watching Sharks rugby with friends, playing chess and bridge. He was chairman of the Durban Jewish Tennis Club for many years, and was a member of the Durban Chess Club for over 25 years.

Harold was happily married to his beloved wife Annette for over 40 years. Annette sadly passed away in 2004, and was sorely missed by him.

Harold lived life in a quiet and dignified manner and his respect and love for his profession and for his family was well known. He was extremely organised and meticulous. Harold loved challenges and persevered in all that he did. He mastered technology in a manner which even made his grandchildren proud.

He loved his three children Eric, Lorna and Janice, his daughter in law and sons in laws Mireille, Allan and Julian and his 5 grandchildren, all boys – Darren, Justin, Michael, Daniel and Lucien.

Harold loved Durban and his community. He would often be seen walking vigorously on the Durban beachfront on a Sunday morning with his friends.

Due to his illness, Harold moved into Beth Shalom late last year. He was very happy there, interacting with the other residents and wonderful staff. He passed away peacefully at the age of 80 on Saturday 23 January 2016.

He will be fondly remembered by his children, family and friends.
The well known Prof Maryna Ferreira passed away on 23 December 2015. Maryna was born on 17 September 1925 on an apple farm in the Langkloof, Eastern Cape. She completed a BSc in Physiology and Zoology at the University of Stellenbosch in 1945, and a Masters degree in Zoology at the same University in 1947.

In 1952 she was one of the first groups of dental graduates (and the only female) at the University of Pretoria. She immediately joined the staff, and became a world authority in Dental Materials. In 1976 she obtained a Masters degree in Dental Sciences at the University of Pretoria. She taught hundreds of students about dental materials and restorative dentistry over the years, and her lively, enthusiastic and humoristic lecture style not only became very popular with students, but also with qualified colleagues at Refresher Courses.

In 1982 she became the first female Full Professor in Dentistry in South Africa, and in 1996 she was awarded an Honorary Doctorate from Medunsa (now Sefako Makgatho Health Sciences University). Maryna published more than 120 scientific articles and abstracts, and presented about 100 scientific lectures in various countries. She received a number of research awards (amongst others the prestigious Middleton-Shaw Award in 1976) and also an Honorary Achievement Award (Deans Award) from the University of Pretoria (1988).

Apart from her own distinguished career, Maryna was known for her selfless helping of undergraduate and post-graduate students with their research projects and dissertations. She was always available to help, guide, and assist, and she spent many hours of her own time (even over weekends) to assist her colleagues.

She was a strict mentor, who did not tolerate any “sloppy” research. She was meticulous when it came to scientific writing and many young academics had their manuscripts or dissertations sent back numerous times for corrections. Perfection! Excellence! Accuracy! Honesty! were some of her buzz words. The role she played in the stimulation and improvement of dental research at UP cannot be overestimated.

Maryna was a dedicated, hard worker, who spent the largest part of her life on her career and her job as a lecturer/researcher. She delivered scientific papers at about 30 IADR Congresses, and at the time of her death she was still a Life Member of the IADR. The Dental Materials Group of the SA Division of IADR honoured her by naming one of their research awards after her. She was a reviewer of manuscripts for the SADA Journal for many years, and rendered a valuable service – often improving the original manuscript to such an extent that the authors rarely recognised their publications. She served on the SABS Committee for the Specification/Registration of Dental Materials for more than 20 years.

Maryna retired in 1998, but for a number of years after that she still rendered valuable inputs at the University of Pretoria and Medunsa. This remarkable woman will always be remembered for all the valuable inputs she had into the dental field.

She had a streak of rebellion in her, and did not hesitate to challenge out-dated research/teaching techniques, and also out-dated gender stereotypes. She was fond of quoting Oscar Wilde who said: “Rules are for the guidance of wise people and for fools to follow”. Some called her eccentric, but most called her brilliant, an icon and a legend.

She leaves behind a son, Jonathan, who resides in Australia, a daughter-in-law, Alet, and three grandchildren.

Maryna - we will always remember you! Small in posture, but a giant in your field.

Prof Francois De Wet
The death of Aubrey Sheiham has been received with great sadness by his friends and colleagues across the world but particularly in South Africa where he was born and obtained the Bachelor of Dental Surgery degree at the University of Witwatersrand. Although he had left the country shortly after graduation in the 1960s, his roots, contact and heart were very much with its peoples. He never forgot to offer his advice and support to the oppressed peoples during the long difficult years of apartheid. Many young graduates from the developing world including South Africa received their postgraduate training and higher degrees in dental public health under the mentorship of Aubrey. He was an outspoken and courageous visionary and an inspiring advocate of promoting dental public health as part of general health for the populations at large and especially for the poorer parts of the world. He had demonstrated convincingly through his research, scholarship, teaching and intellectual grasp of his discipline that we needed to transcend the drill and fill approach to a preventive and promotive philosophy if a difference for the better is to be made for health of populations rather than the privileged few. An impressive list of publications, books and lecturing engagements would bear testimony to his devotion and single-mindedness in trying to achieve this objective. During his career Aubrey published over 500 articles and supervised 52 PhD students from 20 countries. Aubrey’s 1977 publication in the Lancet questioned the wisdom of the six monthly dental check. He demonstrated the danger of dentists intervening too quickly, resulting in over-treatment. Although he was heavily criticised by the profession for this point of view, he was vindicated by the Guidelines of the National Institute of Health and Care Excellence, published in 2004.

Early in his professional career Aubrey highlighted the importance of sugar as not only a prime aetiological factor in dental caries but as a major risk factor for general health. Recent research has again supported this pioneering advocacy. While the major thrust of the dental profession has been on technological advancement, specialisation, the individual practice and the individual patient, Aubrey emphasised population thinking and in particular the social determinants of health. This philosophy if followed may be the only feasible approach in controlling and preventing oral and dental disease especially in the populations of the developing world.

Aubrey’s international reputation is marked by his receiving Honorary Doctorates from the University of Athens and the University of Western Cape, and the Distinguished Scientist Global Oral Health research award from the International Association of Dental Research.

On a personal level I am grateful to Aubrey Sheiham for being a friend, mentor and inspiration during my professional career as a lecturer at the Eastman Dental Hospital, London, as Dean of the Faculty of Dentistry, University of Western Cape and as Vice-Chancellor at the University of Durban–Westville. More recently, Aubrey provided invaluable advice to the Steering Committee which is planning the Faculty of Dentistry at the University of KwaZulu-Natal. Aubrey and Helena’s generosity is marked by their leaving a sizeable endowment to the University of Witwatersrand and for funding researchers from the developing world to complete an evidence-based Cochrane Health Care Review each year.

He will be greatly missed by his friends and colleagues and he will be remembered for his monumental contribution to the health profession and in particular to dental public health.

Our thoughts and our support go out to his wife Helena and other members of his family at this difficult time.

Photograph: acknowledgement to Oliver Curry

Jairam Reddy
Chair of Council
Durban University of Technology
Durban, South Africa
Antifungal susceptibility of *Candida albicans* isolated from the oral cavities of patients with HIV infection and cancer

**ABSTRACT**

This study investigated the antifungal susceptibility of *Candida albicans* isolated from the oral cavities of 205 HIV positive patients, 49 cancer patients and 20 normal healthy individuals. *C. albicans* were isolated and the antifungal susceptibility was determined. The results were analysed using the clinical break points and epidemiological cut off values. Prevalence of *C. albicans* carriage in HIV, in cancer patients, and in healthy individuals was 73%, 45% and 43% respectively. Resistance of the fungus to anidulafungin (0.49%), caspofungin (0.97%), posaconazole (3.4%), voriconazole (0.97%), itraconazole (0.97%), fluconazole (1.94%), amphotericin B (0%) was found to be low. For posaconazole the number of resistant strains and the non-wild type (3.4%) were the same. However for the rest of the antifungal drugs, the number of non-wild type was found to be higher than the resistance determined by clinical break points. Multi-azole resistance was also noted in some patients. In conclusion, there is a low rate of antifungal drug resistance among *C. albicans* isolated from the oral cavities of immunocompromised patients in Johannesburg, South Africa. However, the high number of non-wild type strains suggests that there is a need for an ongoing surveillance.

**INTRODUCTION**

*Candida albicans* is a commensal of the human oral cavity, gut and vagina. This yeast causes infections in immunocompromised individuals including HIV and cancer patients. Oral candidiasis is the most common infection in these patients. It is frequently treated with antifungal agents such as amphotericin B, nystatin and fluconazole. In addition, prophylactic antifungals, particularly fluconazole, are prescribed to many patients undergoing cancer therapy especially in advanced cases and in patients with HIV infection (Epstein, 1996, Greenspan, 1994).1,2

Prior to the introduction of HAART, recurrent oral candidiasis was a problem in HIV positive patients, and still occurs, although to a lesser extent, in the era of HAART therapy. The development of antifungal resistance has been related to the use of antifungal agents to treat recurrent infections in patients with HIV where the appropriate doses, prescribed for the usual duration, become ineffective.2 *Candida* species have exhibited a very high level of variability in the pattern of sensitivity to antifungal agents.4 In Africa, routine antifungal susceptibility testing is not undertaken because oral thrush is treated with empirical antifungal agents. Consequently, the data on the antifungal sensitivity of *Candida* species from South Africa is still very sparse. A large study on the antifungal sensitivity profile of oral isolates was published more than 10 years ago, before fluconazole became widely available.5 More recently, antifungal testing has become standardized globally through the Clinical Laboratory Standards Institute (CLSI) with the objective of detecting sensitivity patterns and discovering the development of resistant strains which is a growing problem.2 It is therefore important to characterize the pattern of antifungal susceptibility of *Candida* species in the era of moderate availability of antifungal agents. This knowledge serves as a guide for antifungal therapy and can also help to predict the outcomes of therapeutic interventions. The present study investigated the antifungal sensitivity profile of *C. albicans* isolated from the oral cavities of HIV positive patients, cancer patients on chemotherapy or radiotherapy and normal healthy individuals.
MATERIALS AND METHODS

Study population and identification of *C. albicans*

Ethics clearance was obtained from the Committee for Research on Human Subjects (Medical), University of the Witwatersrand, Johannesburg, Gauteng. One hundred and nine patients, diagnosed with mainly head and neck cancers, who were scheduled for either radiation or chemotherapy and were attending clinics at the Department of Oncology, together with 529 HIV positive patients who were attending the HIV clinic in Charlotte Maxeke Johannesburg Academic Hospital, were asked to volunteer for the study. Forty nine normal healthy individuals without any signs of oral candidiasis were also included in the study since *Candida* is a commensal in oral cavities and candidiasis does sometimes develop. All these patients were also the subjects of three other studies.

The procedure was explained to participants and written consent was obtained. Data such as the presence of active infection, other risk factors and previous exposure to antifungal agents were not available due to incomplete patient records and a lack of verification by the patients. Heterogeneity of the study population and the incomplete patient data are limitations of this study.

An oral rinse with 10ml of sterile distilled water was used to collect samples in sterile sputum jars. 100 μl of the rinse sample was inoculated onto CHROMagar® Candida plates (CHROMagar Microbiology) and incubated at 37°C for 48 hours. CHROMagar is a chromogenic agar that supports the growth of many *Candida* species and even enables the identification of some species on the basis of the colours the growth of many hours. CHROMagar is a chromogenic agar that supports the growth of many *Candida* species and even enables the identification of some species on the basis of the colours of the colonies. For example, *C. albicans* presents green colonies, *C. tropicalis* produces steel blue colonies and *C. krusei*, purple colonies. All the different colour colonies were selected, subcultured on Sabouraud dextrose agar for 48 hours for purity and identified using API 20 C AUX system® (bioMérieux). This is a standard substrate assimilation test of the inoculum was added to the Sensititre YeastOne® colorimetric microtitre plates. The procedure is based on the Broth Microdilution minimum inhibitory concentration system described by Clinical Laboratory Standards Institute document M27-A2. The microtitre plates contained two-fold dilutions of anidulafungin, micafungin, caspofungin, 5-flucytosine, posaconazole, voriconazole, itraconazole, fluconazole, amphotericin B. Also contained was AlamarBlue®, a proven cell viability indicator that uses the natural reducing power of living cells to convert resazurin to the fluorescent molecule, resorufin, which produces very bright red fluorescence. Fresh yeast cultures (five randomly selected colonies) were suspended in normal saline and adjusted to a turbidity of 0.5 McFarland standards. 20μl of the inoculum was added to the Sensititre YeastOne® broth and gently vortexed. 100 μl of the inoculated broth was added to each well of the Sensititre YeastOne® panel using a multichannel pipette and incubated at 35°C for 24 hours. Wells with growth were red in colour. The results were read and the minimal inhibitory concentration (MIC) was determined as the lowest concentration that prevented a growth (the first blue well). Control strains of *C. parapsilosis* ATCC 22019 and *C. krusei* ATCC 6258 were included as recommended by the CLSI guidelines. The results were interpreted as clinical break point (CBP) and epidemiological cutoff values (ECV). Clinical break point represents clinical isolates that are likely to respond to treatment with a given antimicrobial agent administered using the approved dosing regimen for that agent. They are relevant to clinicians. By contrast, epidemiological cutoff values represent the most sensitive measure of the emergence of strains with decreased susceptibility to a given agent. This means that ECV results will detect development of resistance ahead of clinically relevant resistance, which would present as a treatment failure due to drug resistance. The re-established clinical break points and epidemiological cutoff values of the CLSI and the EUCAST for anidulafungin, micafungin, caspofungin, voriconazole, itraconazole and fluconazole as described by Pfaller and Diekema (2012), and for amphotericin B and posaconazole as described by Arendrup et al. (2011) and Lass-Fìörl et al. (2011) were used to characterize the sensitivity profiles of the *C. albicans* isolates.

### RESULTS

#### Prevalence of *C. albicans*

The carriage rate of *C. albicans* was 73.16%, 44.95% and 42.86% in patients with HIV, with cancer, and in normal healthy individuals, respectively (Table 1). Patients with HIV and cancer carried a variety of *Candida* species other than *C. albicans* in their oral cavities.

#### Antifungal susceptibility of *Candida albicans*

The range of MIC values (MIC obtained by all the strains), MIC50 (MIC obtained by 50% of the strains) and MIC90 (MIC obtained by 90% of the strains) obtained for the test antifungal agents are shown in Table 2. The interpretation of these MIC results were obtained using previously described standards.4,7,8 The characterized sensitivity profile of the *C. albicans* isolates are given in Table 3.

#### DISCUSSION

*Candida albicans* is the most frequently isolated *Candida* species from the oral cavities of HIV patients (73%) and cancer patients (45%) which is similar to elsewhere. Although HAART has reduced the carrier rate of *Candida* species in these patients, the proportions of *C. albicans* and non-albicans *Candida* have not dramatically changed. Therefore the antifungal agents are still used to target C.
Table 2: MIC results of Candida albicans isolated from the oral cavities of HIV and cancer patients, and normal healthy individuals.

<table>
<thead>
<tr>
<th>Antifungals</th>
<th>MIC range</th>
<th>MIC&lt;sub&gt;S&lt;/sub&gt;</th>
<th>MIC&lt;sub&gt;50&lt;/sub&gt;</th>
<th>MIC&lt;sub&gt;90&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anidulafungin</td>
<td>&lt;0.015 - 8</td>
<td>0.03</td>
<td>&lt;0.015 - 0.06</td>
<td></td>
</tr>
<tr>
<td>Micafungin</td>
<td>&lt; 0.008 - 8</td>
<td>&lt; 0.08</td>
<td>&lt; 0.008 - 0.08</td>
<td></td>
</tr>
<tr>
<td>Caspofungin</td>
<td>0.015 - 8</td>
<td>0.15</td>
<td>0.015 - 0.06</td>
<td></td>
</tr>
<tr>
<td>5-Flucytosine</td>
<td>&lt; 0.06 - 64</td>
<td>0.06</td>
<td>&lt; 0.06 - 0.06</td>
<td></td>
</tr>
<tr>
<td>Posaconazole</td>
<td>&lt; 0.008 - 8</td>
<td>0.008</td>
<td>&lt; 0.008 - 0.03</td>
<td></td>
</tr>
<tr>
<td>Voriconazole</td>
<td>&lt; 0.008 - 8</td>
<td>&lt; 0.008</td>
<td>&lt; 0.008 - 0.008</td>
<td></td>
</tr>
<tr>
<td>Itraconazole</td>
<td>&lt; 0.015 - 16</td>
<td>0.015</td>
<td>0.015 - 0.06</td>
<td></td>
</tr>
<tr>
<td>Fluconazole</td>
<td>&lt; 0.12 - 128</td>
<td>0.12</td>
<td>0.12 - 0.5</td>
<td></td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>&lt; 0.12 - 0.5</td>
<td>0.25</td>
<td>0.12 - 0.25</td>
<td></td>
</tr>
</tbody>
</table>

Minimum Inhibitory concentration (MIC) is the lowest concentration of an antimicrobial that will inhibit the growth of a microorganism. MIC<sub>S</sub> and MIC<sub>50</sub> are concentrations that respectively inhibit 50% and 90% of C. albicans isolates.

Table 3: Antifungal susceptibility of Candida albicans isolated from the oral cavities of HIV and cancer patients, and normal healthy individuals.

<table>
<thead>
<tr>
<th>Antifungal agent</th>
<th>Candida albicans Isolates</th>
<th>Clinical break point</th>
<th>Epidemiological cutoff values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>SDD</td>
<td>I</td>
</tr>
<tr>
<td>Anidulafungin</td>
<td>HIV Cancer Normal</td>
<td>205 0 0 0 1 (0.49)</td>
<td>205 1</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Micafungin</td>
<td>HIV Cancer Normal</td>
<td>205 0 0 0 0</td>
<td>204 2</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Caspofungin</td>
<td>HIV Cancer Normal</td>
<td>204 0 0 0 2 (0.97)</td>
<td>204 2</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5-Flucytosine</td>
<td>HIV Cancer Normal</td>
<td>200 0 0 0 0</td>
<td>194 12</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Posaconazole</td>
<td>HIV Cancer Normal</td>
<td>199 0 0 7 (3.4)</td>
<td>199 7</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Voriconazole</td>
<td>HIV Cancer Normal</td>
<td>203 0 1 2 (0.97)</td>
<td>201 5</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Itraconazole</td>
<td>HIV Cancer Normal</td>
<td>202 2 0 2 (0.97)</td>
<td>202 4</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>HIV Cancer Normal</td>
<td>202 0 0 4 (1.94)</td>
<td>198 8</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amphotericin B</td>
<td>HIV Cancer Normal</td>
<td>206 0 0 0</td>
<td>206 0</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

S-sensitive, SDD-sensitive dose dependent, I-intermediate, R-resistant, WT-wildtype, Non-WT-non wild type, ND-not yet defined. Wild-type strains: Those without mutational or acquired resistance mechanisms (sensitive) Non wild-type strains: Those having mutational or acquired resistance mechanisms (possibly resistant).

In 2002, in Tanzania, where 250 isolates of C. albicans were tested, there was no resistance to fluconazole whereas 4% of isolates were resistant to itraconazole and 0.54% azole resistance has been reported from Tunisia. More recently, 50% resistance of C. albicans to fluconazole has been reported in southern parts of South Africa. Antifungal drug resistance varies in the several African countries. A study in Nigeria in 2011 and recently from Ethiopia reported 16% resistance to fluconazole in C. albicans whereas a resistance among isolates from Cameroon was as high as 50%.

Less than 1% of strains that were tested in this study were resistant to the echinocandins i.e. anidulafungin, micafungin, and caspofungin (Table 3). This is consistent with other reports that ranged from 0% to 5%. The reason may be that these drugs have only recently become available in Africa.

Seven isolates (3.4%) of C. albicans were found to be resistant to posaconazole which is unexpected (Table 2). It is the most recently approved triazole with a broad spectrum activity against Candida, Aspergillus, Cryptococcus and many other fungi and is usually reserved for the treatment and prophylaxis of invasive forms of fungal infections. The breakpoints for posaconazole are very close to one another and they are not well described (S < 0.06 and R >0.06). These values are based on pharmacokinetic data epidemiological cut-off values and clinical experience and therefore they are reviewed regularly. However, in our study for posaconazole the number of resistant strains and the non-wild type (3.4%) were identical, showing good correlation between the two methods of analysis. This also means that these non-wild type isolates may have acquired or innate mutational resistance mechanism and therefore may or may not show a clinical response to the antifungal therapy. In addition, during surveillance these epidemiological cut-off values are useful in detecting the emergence of potential resistance. This phenomenon has been recorded by Pfaffer et al. (2011) whose study recorded that the epidemiological cut-off values for posaconazole increased three times from 2001 to 2009 (1.1 to 3.2%).

Although a previous South African study reported that 8.4% of C. albicans were resistant to amphotericin B, no resistance was detected in the present study. Furthermore, it is known that patients previously exposed to fluconazole for a long time period harbour more fluconazole-resistant C. albicans than patients who are fluconazole-naïve. Unfortunately it was not possible to collect data on the history of previous antifungal exposure in all the HIV patients.
However, that history was available for the cancer patients and the normal individuals. No antifungal drug resistance was found in the *C. albicans* isolates from the oral cavities of cancer patients or individuals in the healthy individuals. They had not been exposed to antifungal drugs prior to the respective collection of samples. In addition there was no prophylactic prescription of antifungal agents for patients undergoing either radiation therapy or chemotherapy in the Oncology Departments in this study.

Four fluconazole resistant strains of *C. albicans* were isolated from HIV positive patients. Two isolates were resistant to all four azole drugs whereas the remaining two isolates were either intermediate or dose dependent on two azole drugs but were resistant to fluconazole. Prophylactic Itraconazole is known to induce resistance to fluconazole. In addition, the use of ketoconazole and miconazole reduces the susceptibility to fluconazole. In our study, the use of miconazole and ketoconazole may or may not show a clinical response to the antifungal therapy. In our results all the antifungal drugs except for posaconazole showed high epidemiological cut-off values compared with the clinical break points. This means that in our study population drug resistance is developing which will require regular studies or continuous surveillance.

Strains categorized as resistant according to the clinical break points, are associated with a high likelihood of therapeutic failure. Non-wild type strains have acquired or innate mutational resistance mechanisms and therefore these strains may or may not show a clinical response to the antifungal therapy. In our results all the antifungal drugs except for posaconazole showed high epidemiological cut-off values compared with the clinical break points. This means that in our study population drug resistance is developing which will require regular studies or continuous surveillance.

In conclusion, the rate of antifungal drug resistance among *C. albicans* isolated from the oral cavities of immunocompromised patients is low in Johannesburg, South Africa. Multiple azole resistance was noted in HIV positive patients. Therefore, alternative antifungal drugs should be considered in non-responsive patients. In addition, high ECV suggested the likelihood of development of drug resistance and therefore ongoing surveillance is needed.

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Competing interest: None declared

References

The perceptions of South African dentists on strategic management to ensure a viable dental practice

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L Snyman,† S E van der Berg-Cloete,§ J G White,∥

ABSTRACT

Objectives: How do dentists perceive the influence of the external environment on, and what is their confidence in, planning the strategic management of their practices?

Methods: A cross-sectional survey using an anonymous online questionnaire was conducted among private dental practitioners, members of the South African Dental Association. Stata release 11 was used for descriptive data analysis, including determination of frequencies.

Results: The majority of the respondents work 40–44 hours, see more than 70 patients per week and are fairly satisfied with those numbers. Only 27.56% of practices confirmed written vision/mission statements. One third (33.78%) were only moderately confident they could plan and execute strategies to ensure a viable practice. Almost a tenth (8.11%) does not feel confident at all. Medical schemes, disposable income of patients and dentist-patient communication were the most significant challenges. Clinical practice was more satisfying than the business side.

Conclusion: Dental practices are increasingly complex, with a myriad of challenges. Ideally the dentist as owner/manager/leader, should be able to strategise management of the external and internal environments to achieve the vision, mission and objectives of the practice. Dental schools, in collaboration with SADA, should work towards equipping dentists with the necessary management and strategic thinking skills to ensure success.

Key words: Dental practice management, strategic management, External forces

INTRODUCTION

The business environment in which dental practices operate is becoming increasingly complex, and to ensure a viable and successful career, dentists should be equipped with management skills as well as clinical expertise. Dental practitioners in the private sector are facing a host of challenges. Guaranteed medical fund pay-outs declined from 15% in the early nineteen nineties to approximately 2% in 2012. Changing disease patterns, increased consumerism, advancing technology and unfavourable exchange rates affecting the import of dental materials complicate the situation even further. Three out of four American dental practices have reported declines in production levels since the 2008 recession. The situation in South Africa is not known but it might just be that our colleagues are finding themselves in similar situations.

Unlike other business and corporate leaders who are prepared through formal business training to succeed in a complex economic environment, dentists receive little or no such training in dental school. According to Levin, many dentists practise for years without having a clear strategy or specific goals of how to keep the practice growing and succeeding; they merely go to work, hoping to have a great day with few problems. Unfortunately in today’s competitive dental economy, dentists can no longer afford such an attitude. Good management skills and especially strategic thinking skills, are becoming a prerequisite for success.

The profitability of small businesses like dental practices is influenced by the market environment in which the industry (dentistry) operates, as well as by the individual competitive market forces. Crafting and executing strategy are the heart and soul of managing a business enterprise. Insightful analysis of a business’s external environment is a prerequisite for crafting a strategy that is an excellent fit with the situation, is capable of building competitive advantage, and which holds good prospects for boosting business performance. If elements of competition can be defined, strategies can be formulated to better deal with market forces. Businesses that explicitly formulate strategies usually perform better in a competitive environment. There is also evidence that strategic planning by health care organisations improves performance. According to Lau strategic planning is one of the key business concepts applicable
to the successful dental practice, and “just as a dentist diagnoses and treatment plan patients, so too should his business “diagnose and treat mental plan * its future”. One often hears colleagues in private practice complain about how difficult it has become to survive and maintain a viable practice, given all the challenges that they have to face. The question that surely comes to mind is how skilled and confident are dentists to plan and execute strategy to ensure the viability of their practices? Do they even engage in strategic planning or are they merely working year after year just hoping for the best?

AIM
The study set out to investigate the perceptions held by dentists regarding the influence of the external environment on the strategic management of a dental practice as well as their confidence in being able to plan and execute strategy to ensure the viability of those practices. The objectives were to determine:

- how busy are dentists in South Africa,
- how strategically orientated they are,
- what external forces/challenges dentists perceive to have the most significant effect on practices in South Africa, and
- what strategies dentists employ to counteract these external forces/challenges.

METHODS
Permission to conduct the research study was obtained from the Research and Ethics Committee of the Faculty of Health Sciences, University of Pretoria (160/2014). Data for this study was collected via a self-developed questionnaire that was hosted online at SurveyMonkly (www.surveymonkey.com). A cover letter that explained the purpose of the study and which invited dentists in private practice to participate was sent by the South African Dental Association (SADA) to all members on SADA’s electronic database. The cover letter contained the link to the online questionnaire. Those who agreed to participate were routed via a link in the letter to the questionnaire. Due to the initial low response rate two additional reminders were sent and the due date for participation was extended by four weeks.

The questionnaire comprised 29 questions, of which only three were qualitative in nature where dentists had to express their opinions. The questions were clustered in different sections to elicit demographic information, details of the practice, the busyness of the practice, strategic orientation of the dentist, and strategic issues in the practice. Most questions required respondents to select an answer from multiple categories.

The software package Stata Release 11 was used for data analysis which was mainly descriptive in nature and included a determination of frequencies. The Chi-square / Fisher Exact test was used to test for associations between selected demographic, practice characteristic and strategic approach variables. Significance was set at the 0.05 level.

RESULTS
The survey was sent to 3367 SADA members via e-mail. A total of 252 responses were received by the final, extended cut-off date, constituting a 7.48 % response rate. It was decided to eliminate 18 respondents who completed only the demographic details, but failed to answer any additional questions. Analysis was therefore conducted on 234 (6.95%) valid responses. These 234 responses included general dentists (n=221) and specialists (n=13). Although the apparent response rate is very low, one should take into consideration that the SADA database contains the e-mail addresses of members that are working in the public sector, members outside the borders of South Africa, Oral Hygienists as well as Dental Therapists. It is therefore not really possible to determine or comment on the response rate when it was only dentists in private practice who were invited to participate.

Demographics (Table 1)
The majority of the respondents were male (67.09%), and ranged in age between 31 and 60 years of age. Most of the respondents were from the Western Cape (38.89%)

<table>
<thead>
<tr>
<th>Year qualified</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-1970</td>
<td>3</td>
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</tr>
<tr>
<td>1981-1990</td>
<td>58</td>
<td>24.79</td>
</tr>
<tr>
<td>1991-2000</td>
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</tr>
<tr>
<td>2001-2010</td>
<td>75</td>
<td>32.06</td>
</tr>
<tr>
<td>&gt;2010</td>
<td>14</td>
<td>5.98</td>
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<tr>
<th>Qualification</th>
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<tbody>
<tr>
<td>General dental practitioner</td>
<td>221</td>
<td>94.44</td>
</tr>
<tr>
<td>Dental specialist</td>
<td>13</td>
<td>5.56</td>
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<table>
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<tr>
<th>Province</th>
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<tbody>
<tr>
<td>Eastern Cape</td>
<td>21</td>
<td>8.97</td>
</tr>
<tr>
<td>Free State</td>
<td>10</td>
<td>4.27</td>
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<tr>
<td>Gauteng</td>
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<td>38.89</td>
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<td>3.42</td>
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<tr>
<td>Northern Cape</td>
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<td>2.14</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>15</td>
<td>6.41</td>
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<tr>
<td>Western Cape</td>
<td>41</td>
<td>17.52</td>
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<tr>
<th>Alma Mater</th>
<th>n</th>
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<tr>
<td>University of Limpopo (Medunsa)</td>
<td>11</td>
<td>4.70</td>
</tr>
<tr>
<td>University of Pretoria</td>
<td>104</td>
<td>44.44</td>
</tr>
<tr>
<td>University of Stellenbosch</td>
<td>29</td>
<td>12.39</td>
</tr>
<tr>
<td>University of Western Cape</td>
<td>36</td>
<td>15.38</td>
</tr>
<tr>
<td>University of Witwatersrand</td>
<td>41</td>
<td>17.52</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>5.56</td>
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<table>
<thead>
<tr>
<th>Type of practice</th>
<th>n</th>
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<tbody>
<tr>
<td>Solo practice</td>
<td>139</td>
<td>59.66</td>
</tr>
<tr>
<td>Partnership</td>
<td>47</td>
<td>20.17</td>
</tr>
<tr>
<td>Other</td>
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<td>20.17</td>
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</table>

*N=233 (1 missing response)
respondents completed their studies at the University of Pretoria (44.44%), followed by the University of Witwatersrand (17.52%) and the University of Western Cape (15.38%). A total of 94.44% of respondents were general dental practitioners, while only 5.56% were dental specialists. Among the 13 dental specialists who responded, six were Orthodontists, three were Maxillo-Facial and Oral surgeons, two were Periodontists and two Prosthodontists. The majority of respondents had their primary practice located in Gauteng (38.89%), followed by the Western Cape (17.52%) and Kwazulu-Natal (16.24%). The business model of the majority of respondents was a solo dental practice (59.66%), while 20.17% indicated that they operate in partnerships and 20.17% operated in other business models which mainly included being in association with other dentists or working for Medicross or Intercare.

**Busyness of the practice**

Almost a third of the respondents (32.76%) work on average between 40 to 44 hours per week, while 20.26% work between 45 and 49 hours per week, 13.36% work 50 to 54 hours per week and a total of 6.9% of respondents indicated that they work more than 55 hours per week (Figure 1). Results indicate that the majority of respondents (21.55%) see on average more than 70 patients per week, and that 19.4% of respondents see 41 to 50 patients per week (Figure 2). Only a small percentage of respondents, namely 6.47%, see less than 20 patients per week.

When asked about the busyness of the practice, almost half of the respondents (49.14%) indicated that they were satisfied with the number of patients, while 16.28% indicated that they are too busy to accommodate all the patients requesting treatment. By contrast, just over a third of respondents (34.48%) replied that they are not busy enough and need more patients (Figure 3).

Respondents were divided in their opinion on the profitability of their practices (Figure 4) with 39.22% indicating that their net profit increased over the past three years, and almost an equal percentage of respondents (35.78%) indicating that their net profit decreased over the last three years. A quarter of respondents (25.00%) indicated that their net profit remained the same over the last three years.

**Strategic orientation**

Just more than a quarter of respondents (27.56%) had a written vision/mission statement for their practice. When asked how confident they feel to plan and execute strategy/strategies to ensure a viable practice, the majority of respondents (33.78%) were only moderately so, while almost a tenth of respondents (8.11%) did not feel confident at all. However, 6.67% of respondents did indicate that they were extremely confident in strategizing for a viable practice (Figure 5).

No statistically significant associations were demonstrated between demographic variables and the existence of a vision/mission statement, or between demographic variables and the confidence of respondents to plan and execute strategy (p>0.05). Furthermore, no statistically significant association was demonstrated between the existence of a vision/mission statement and the busyness of the practice (p=0.281). Respondents who indicated that they had a written vision/mission statement were asked to answer additional questions regarding their practices’ strategic orientation (Table 2). Most of the respondents “agree” or “strongly agree” that their staff understand the vision/mission of the practice, and that the goals of the practice reflect the mission. The goals of the practice are set both as short-term (1 year) and longer term (3-5 years) objectives, describe quantifiable and measurable targets and the practice systematically measures actual performance versus expected performance.
goals. The majority of respondents “agree” or “strongly agree” that having a clear strategy is critical for the success of the practice.

Identifying strategic issues
Respondents were asked to rate on a scale of 1 to 5 (where 1 is “least impact” and 5 is “most impact”) the most relevant challenges that they face in practice. They were somewhat divided in opinion on the challenge posed by the proposed National Health Insurance (NHI), with 26.09% rating it as 1 (“least impact”) and almost an equal percentage (23.37%) according a rating of 5 (“most impact”) (Table 3). Disposable income of patients is seen as a major challenge with 48.91% of respondents rating this as a 5 and 28.80% rating it a 4. The pay outs of Medical schemes are probably the most serious challenge faced by respondents, receiving a rating of 5 by 50.54% and a 4 by 21.20% of respondents. Dentist-patient communication also featured as important with 22.83% of respondents recording a rating of 5 and 22.28%, a rating of 4. “Other dentists” (competitors) do not seem to be a challenge with 32.07% of respondents considering this deserving of either a 1 or a 2.

Respondents were asked to identify and to rate in importance (where 1 is “least impact” and 3 is “greatest impact”), the three most relevant challenges influencing the attraction and retention of patients in their practices. The disposable income of patients is seen as the challenge having the greatest impact (72 votes), followed by medical schemes’ pay-outs (54 votes) and dentist-patient communication (43 votes) (Table 4).

When asked what strategies they have in place to counter the three challenges identified as most significantly affecting the attraction and retention of their patients, a number of respondents confessed that they have none (n=27) or simply did not answer the question (n=6). Other respondents indicated that in dealing with problems of limited disposable income, they try to educate patients on the value (medical/social) of a healthy/attractive mouth, charge rates according to patient demographics, try to work within a patient’s budget, do the best treatment that patients can afford, do less costly work, have payment plans available and allow down payments, give written quotations and discuss alternative treatment options with patients, help with interest-free finance and assist patients to procure loans from First Health Finance.

The pay outs of medical schemes were also an important challenge faced by respondents who reported a variety of strategies. Some indicated that they charge fees that medical schemes will pay, that authorization is secured from schemes before treatment, that the medical scheme benefits are ascertained prior to treatment. Further, practitioners reported that they try to know the rules of the different medical schemes, and that there is a regular follow up with medical schemes regarding payments. Other respondents clearly stated that they have cash only

Table 2: Strategic orientation of respondents with a vision/mission statement *

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>All staff understand the mission/Vision</td>
<td>2 (3.33)</td>
<td>6 (10.00)</td>
<td>3 (5.00)</td>
<td>24 (40.00)</td>
</tr>
<tr>
<td>Goals of practice set both as short-term (1 year) and longer-term (3-5 years) goals</td>
<td>2 (3.33)</td>
<td>8 (13.33)</td>
<td>5 (8.33)</td>
<td>25 (41.67)</td>
</tr>
<tr>
<td>The goals reflect the mission</td>
<td>2 (3.33)</td>
<td>1 (1.67)</td>
<td>3 (5.00)</td>
<td>31 (51.67)</td>
</tr>
<tr>
<td>Goals describe quantifiable and measurable targets</td>
<td>1 (1.67)</td>
<td>11 (18.33)</td>
<td>11 (18.33)</td>
<td>25 (41.67)</td>
</tr>
<tr>
<td>Goals list quality, time frame and cost targets.</td>
<td>4 (6.67)</td>
<td>13 (21.67)</td>
<td>7 (11.67)</td>
<td>28 (46.67)</td>
</tr>
<tr>
<td>Practice systematically measures actual performance vs goals</td>
<td>3 (5.00)</td>
<td>11 (18.33)</td>
<td>10 (16.67)</td>
<td>24 (40.00)</td>
</tr>
<tr>
<td>Having a clear strategy is critical for the success of my practice.</td>
<td>3 (5.00)</td>
<td>1 (1.67)</td>
<td>6 (10.00)</td>
<td>21 (35.00)</td>
</tr>
</tbody>
</table>

*N = 60 (2 missing responses)

Table 3: Challenges faced by respondents in practice *

<table>
<thead>
<tr>
<th>Challenge</th>
<th>1 Least impact</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Most impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Proposed NHI</td>
<td>48 (26.09)</td>
<td>28 (15.22)</td>
<td>41 (22.28)</td>
<td>24 (13.04)</td>
<td>43 (23.37)</td>
</tr>
<tr>
<td>Disposable income of patients</td>
<td>7 (3.80)</td>
<td>5 (2.72)</td>
<td>29 (15.76)</td>
<td>53 (28.80)</td>
<td>90 (48.91)</td>
</tr>
<tr>
<td>Medical schemes’ pay-outs</td>
<td>13 (7.07)</td>
<td>12 (6.52)</td>
<td>27 (14.67)</td>
<td>39 (21.20)</td>
<td>93 (50.54)</td>
</tr>
<tr>
<td>Demanding patients</td>
<td>11 (5.98)</td>
<td>42 (22.83)</td>
<td>56 (30.43)</td>
<td>38 (20.65)</td>
<td>37 (20.11)</td>
</tr>
<tr>
<td>Uneducated patients</td>
<td>9 (4.89)</td>
<td>47 (25.54)</td>
<td>53 (28.8)</td>
<td>44 (23.91)</td>
<td>31 (16.85)</td>
</tr>
<tr>
<td>Other Dentists (competitors)</td>
<td>59 (32.07)</td>
<td>59 (32.07)</td>
<td>39 (21.20)</td>
<td>18 (9.78)</td>
<td>9 (4.89)</td>
</tr>
<tr>
<td>Legal and policies(e.g. NCA, CPA)</td>
<td>18 (9.78)</td>
<td>36 (19.57)</td>
<td>47 (25.54)</td>
<td>44 (23.91)</td>
<td>39 (21.20)</td>
</tr>
<tr>
<td>Personnel Management</td>
<td>18 (9.78)</td>
<td>25 (13.59)</td>
<td>55 (29.89)</td>
<td>54 (29.35)</td>
<td>32 (17.39)</td>
</tr>
<tr>
<td>Dentist-patient communication</td>
<td>19 (10.33)</td>
<td>39 (21.20)</td>
<td>43 (23.37)</td>
<td>41 (22.28)</td>
<td>42 (22.83)</td>
</tr>
</tbody>
</table>

*N=184 (50 missing responses)
practices to avoid working with medical schemes, and simply require patients to pay first and then to claim from the medical schemes. Some participating dentists educate patients as to where funders stand regarding expensive choice treatment and then explain why and how their fees were higher than those that medical schemes were prepared to reimburse, while others indicated that they stay involved with SADA and engage in SADA activities as a group to stand up against the challenge of disparity between fees and allowances.

Strategies employed by respondents to counteract the challenge of dentist-patient communication included engaging more with patients on their expectations, spending more time with patients discussing treatment plans and securing the trust of patients in proposed treatments, making use of intra-oral cameras, study models and visual communication to enhance understanding from patients, using the initial visit to build good dentist-patient rapport, training personnel to be able to answer patients’ questions, having detailed communication policies in place for patient marketing and education, and to regularly attend management and communication courses. One respondent observed that he/she employs Xhosa-speaking personnel to translate for patients and to help in their dental education.

The majority of respondents (35.87%) rated their satisfaction with the business aspect of their practices as only 3 on a scale from 1 to 5 where 1 is "not satisfied at all" and 5 is "completely satisfied" (Table 5). Only 7.07% rated this evaluation a 5. In contrast, 52.17% of respondents rated their satisfaction with the clinical aspect of the practice a 5 and 32.61% gave this a 5. Respondents are clearly more satisfied with the clinical, than with the business aspect, of the practice.

### DISCUSSION

Strategic planning is a key business concept applicable to the successful dental practice\(^6\) and the current study is the first in South Africa that attempts to investigate the perceptions of dentists on strategic management and to ensure a viable dental practice amidst the challenging external environment. Due to the low response rate, the results of this study should not be generalised to the private dentist population of South Africa. An additional limitation of the study was the online nature of the questionnaire which led to exclusion of dentists who do not have internet access. Bias could also have been introduced by using a convenience sample of dentists who are members of SADA, thereby excluding non-members who possibly may have a different perspective, not reflected by the results of this study. One should also be cautious in drawing definite conclusions, since some of the questions had a very high number of non-responses (as many as 50). Nevertheless, the study does present an indication of the challenges currently faced by private practitioners in South Africa.

The majority of the respondents work 40-44 hours per week, see more than 70 patients per week and are fairly satisfied with the number of patients they see. Only 34.48% of respondents indicated that they are not busy enough and need more patients, in contrast with research done in 1999 among private dental practitioners in South Africa which indicated that 55.8% of respondents were not sufficiently busy and required more patients.\(^7\) Although the current study does not differentiate between general dentists and dental specialists, results are in line with findings from the American Dental Association Health Policy Resources Centre’s Survey of Dental Practices which found 37% of general dentists and 36% of dental specialist describing themselves as "not busy enough" in 2012.\(^8\) It has been recommended over the years that dentists should do more “comprehensive dentistry”, deliver an exceptional service, and also improve their communication and marketing skills in order to increase patient flow and net profit.\(^1,7,19,20\) The mere fact that the respondents of this study are fairly satisfied with the number of patients and that the majority indicated that their net profit increased, can perhaps be an indication that more dentists are focusing on these types of recommendations. Their responses regarding strategies employed to counteract challenges that influence attraction and retention of patients strengthen this assumption even further.

### Table 5: Satisfaction with business and clinical aspect of practice \(^*\)

<table>
<thead>
<tr>
<th>Satsfication</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business aspect (e.g. Planning and executing strategy, managing personnel, managing finances, administration related to Medical Aids etc.)</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>10</td>
<td>5.43</td>
<td>37</td>
<td>20.11</td>
<td>66</td>
<td>35.87</td>
</tr>
<tr>
<td>Clinical aspect (Clinical treatment of patients)</td>
<td>0</td>
<td>0.00</td>
<td>3</td>
<td>1.63</td>
<td>25</td>
</tr>
</tbody>
</table>

\(^*\)N=184 (50 missing responses)
The fact that 35.78% of respondents indicated that their net profit decreased in the last three years can however be of concern. Although the reasons for this should be properly investigated, it might be assumed that one could be increasing costs. It is a well-known fact that it is becoming more difficult to contain practice overheads due to rising supply costs (e.g., exchange rate of the Rand) and competitive labour markets. Rising expenses make it more difficult for solo practitioners to be competitive in the marketplace, and cause people to question whether this practice mode will remain viable in the future. Research has indicated that the number of solo practices in the USA is declining steadily, and this trend is expected to continue as more cost-efficient larger practices predominate.

Group practices and corporate practices are new delivery models that are on the increase in the USA. Economies of scale arise when activities can be performed more cheaply at larger volumes and from the ability to distribute certain fixed costs over a greater sales volume. Research has indeed shown that there might be some advantages of scale in larger dental practices. The majority of respondents in this study (59.66%) still operate as solo practices, but the question remains as to whether this is still a viable practice model. SADA undertook research in 2014 in conjunction with KPMG to determine the most viable future business models (e.g., single practice, group practice, franchise practice and affiliated practice) for the South African market amidst the economic shifts and the prospective NHl. Outcome and recommendations of this research are still being awaited, but the cost advantages of larger group practices should certainly be considered by new dentists entering the South African market.

According to Montgomery, strategy guides the development of the identity and purpose of the business over time. Businesses that explicitly formulate strategies usually perform better in a competitive environment. There is also evidence that strategic planning by health care organisations improve performance. The importance of strategic leadership and the value of vision and mission statements have been well documented in the literature. Yet, only 27.56% of respondents in this study confirmed the presence of written vision/mission statements for their practices. Results indicated further that nearly 60% of respondents feel only moderately or less confident to plan and execute strategy/strategies to ensure a viable practice. This can also be another reason for the decrease in net profit as indicated by 35.78% of respondents. A lack of confidence to plan and execute strategy/strategies to ensure a viable practice can be attributed to the fact that dentists receive very little or no business training in dental schools. To address this shortcoming, dental schools will have to include business training as part of the curriculum and, in collaboration with SADA, could offer courses in strategic management to dentists. No statistically significant association was demonstrated in this study between the existence of a vision/mission statement and the busyness of the practice (p=0.281). However, it is still recommended that dentists, as the owners/managers/leaders, should be able to accommodate and integrate both the external and internal environments of the practice in formulating and implementing a strategy to ensure that the vision, mission and strategic objectives are achieved, ultimately leading to superior practice performance.

Medical schemes’ pay outs, disposable income of patients and dentist-patient communication were identified as the most significant challenges faced by respondents, also affecting patient attraction and retention most significantly. The proposed NHl was also identified as a significant challenge by some respondents, probably due to uncertainty on how it will affect the patient base in future. Medical schemes’ pay outs for dental care have declined steadily over the last almost 30 years, from 12.6% in 19851 to a mere 2.6% in 2013. The frustration of having to deal with a lot of administrative hassles, late payments from funds, difficulty in obtaining authorisation for procedures etc., probably contribute to the identification by some dentists of medical schemes as the most significant challenge facing practice. The constraints of limited disposable income of patients also pose a huge challenge, and respondents rated it the challenge that most significantly affects the attraction and retention of patients. Although the disposable income of South Africans has actually increased, household debt has risen to 75.8% of disposable income in the second quarter of 2013. Rising inflation, higher petrol and electricity costs, and escalating property rates and taxes put consumers under even more pressure to carefully consider their spending, and often dental treatment might be low on their priority list. Although there are no clear-cut answers on how to deal with these challenges, it seems that respondents are finding ways to cope, mainly by concentrating on educating patients regarding the value of good oral health, doing work that patients can afford, knowing the rules of the different medical schemes, and regularly following up with medical schemes regarding payments. Good dentist-patient communication has been proven important in providing dental care, and leads to increased patient satisfaction and motivation, just as inadequate or negative dentist-patient communication can create barriers to care and other undesirable outcomes. It is clear that respondents find dentist-patient communication a significant challenge in practice. The multicultural population of South Africa, together with our eleven official languages, probably creates additional barriers to good communication. While some respondents realize the importance of taking time to build good patient rapport, together with the use of visual aids in improving communication, there are other respondents who simply don’t know how to deal with this challenge. These respondents will clearly benefit from additional training in communication skills and techniques, a gap that can again be filled by dental schools and by SADA.

Respondents in this study appear to be more satisfied with the clinical aspect of practice than with the business aspect. This came as no real surprise, since similar results have been reported by other researchers. Although the reason for this finding was not investigated in this study, it can probably again be attributed to the fact that dentists receive little or no business training in dental school, leaving them not prepared to manage a practice, and ultimately leading to dissatisfaction with the business aspect of dentistry. Traditionally dentistry is seen as a “caring profession”, it is about helping people and therefore the management of patients and producing high quality, technically demanding dentistry leads to more job satisfaction than managing the business. Learning business skills by trial and error, as respondents in one study stated, can be quite a painful experience.
CONCLUSION
Many dentists are not equipped to handle the strategic planning which has become essential to manage the challenges of contemporary dental practice. Dental schools, in collaboration with SADA, should work towards training students and dentists in the necessary management skills, especially strategic thinking skills, to ensure success amidst the challenging external environment.

Acknowledgement:
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Declaration: No conflict of interest declared.

References
5. Van Wyk PJ, White JG. Impact of Medical Schemes Act on the utilisation of dental services. XXXVII Scientific Congress of the International Association of Dental Research (South African Division); 11 & 12 September; Cape Town, South Africa, 2003.
ZOOM teeth whitening has a new distributor in Southern Africa

The in-chair teeth whitening market in Europe has changed significantly during the last few years since the European Union (EU) adopted a rule of allowing a maximum of 6% hydrogen peroxide. This was done to protect the public from non-dental professionals using peroxide for whitening.

The Scope of Practice of dentists specifically allows Dentists to perform tooth whitening, implicit then is the restriction on others offering the service. Some practitioners and/or companies are still trying to bypass this rule by using certain tactics, for example, stating that the patient is applying the material him/herself or switching on the light.

TEETH WHITENING – Due to the performance of teeth whitening services by persons who are not appropriately qualified, the scope of the dental professions had to be reviewed with a view to protect the interests of the public. If bleaching is not correctly performed the resultant effects could be a loss of tooth sensitivity and loss in effective gum functioning. The HPCSA’s Medical and Dental Board considered the matter and resolved that only dentists, dental therapists and oral hygienists may perform teeth whitening as they are adequately trained and competent. - Extracted from HPCSA Media statement, 13 October 2009

A hairdresser or beautician’s scope of practice does not allow to examine teeth to assess if the patient is a suitable candidate for whitening, neither are they allowed to administer such a product.

Philips who owns Zoom and Britesmile as a result of that ruling decided not to continue with two similar brands. Materials in the procedure kits and the lights, both use LED, and are identical.

Recently a decision has been taken to discontinue Britesmile worldwide but to continue to market, Zoom. Zoom is being used on a much larger scale globally and well known by being promoted on programmes such as “Extreme Makeover” with Bill Dorfman, founder of Discuss Dental.

At this stage most Britesmile dentists are changing to Zoom, who always had much success in South Africa. Britesmile was also very successfully marketed locally, being the first light-activated, more expensive in chair procedure in South Africa. Others followed later.

Zoom whitening has now, on its website (www.zoomwhitening.co.za), published a list of associated dentists who use this procedure to ensure patients are able to find a practitioner to perform the procedure.

Philips is also getting involved in making it more affordable for practices to offer a high tech teeth whitening system with immediate results.

Zoom used to have the reputation of causing severe sensitivity, but the new LED lamp, which has three settings, low, medium and high, plus adding ACP (amorphous calcium phosphate) to the whitening gel helps to reduce the sensitivity, and improve the strength and lustre of enamel.

Marcel Hartman is the driving power behind Zoom in Southern Africa now. He brought Britesmile here 14 years ago. With his experience and the support of a company such as Philips, Zoom will see a significant growth in numbers in the coming years.

For more information: Marcel Hartman
Cell: 083 928 8900
E-mail: info@zoomwhitening.co.za
The association between area level socio-economic position and oral health-related quality of life in the South African adult population

ABSTRACT

Objective: To investigate the association between area-level socio-economic position (SEP) and oral health-related quality of life (OHRQoL).

Methods: Data collected from a nationally representative sample of the South African population ≥16 years old (n=3,003) included demographics, individual-level SEP measures and self-reported oral health status. OHRQoL was measured using the Oral Health Impact Profile-14 (OHIP-14). The General Household Survey (n=25,653 households) and Quarterly Labour Force Surveys (n~30,000 households/quarter) were used to determine area-level SEP. Data analysis included a random-effect negative binomial regression model and Blinder-Oaxaca decomposition analysis.

Results: Area-level deprivation was associated with more negative oral impacts, independent of an individual’s SEP. Other significant predictors of oral impacts included having experienced oral pain (β=1.15) and reporting previous dental visits (β=0.69). Area differences in dental attendance contributed the most (37.5%) to the observed gap in OHRQoL, explained by differences in area-level SEP, whereas individual-level SEP contributed the least (18.8%). In the more affluent areas, satisfaction with life in general and individuals’ SEP were significantly positively associated with OHRQoL.

Conclusion: To reduce inequalities in OHRQoL, proportionate development of socio-economic conditions should be prioritised, particularly there appears to be a need for greater access to oral health services by disadvantaged people in affluent areas.

Keywords: social gradient, oral health-related quality of life, socio-economic position; South Africa

INTRODUCTION

Oral health has been shown to follow a socio-economic gradient. Hence, it has been suggested that reporting averages on the general population conceals inequalities in health between sub-populations. It has been argued that variations in health between different subpopulations is a combination of both the socio-economic position (SEP) of individuals and the area-level or socio-environmental factors to which those individuals are exposed. These variables may operate independently or in a complementary manner.

Some suggest that area-based indicators are better predictors of oral health status than are measures of individual socio-economic status, and that area-based indicators add explanatory power when one is examining oral health inequalities. Others have also maintained that area-level SEP may influence oral health and general health, independent of individual-level SEP. By contrast, it has been argued that after controlling for individual-level SEP, the association between area-level

ACRONYMS

GHS: General Household Survey
HSRC: Human Sciences Research Council
OHIP-14: Oral Health Impact Profile-14
OHRQoL: Oral Health-Related Quality of Life
SASAS: South African Social Attitude Survey
SEP: Socio-economic Position

Conclusion: To reduce inequalities in OHRQoL, proportionate development of socio-economic conditions should be prioritised, particularly there appears to be a need for greater access to oral health services by disadvantaged people in affluent areas.

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SEP and individual general health\textsuperscript{13} or oral health\textsuperscript{14} is no longer statistically significant, implying that the area effect is fully explained by individual SEP.

Some inconsistencies in the findings of studies on the role of area-level SEP in health outcomes may be partly related to differences in study design. In particular, some studies investigating the role of individual- and area-level SEP on health did not use a multi-level statistical modelling approach that allows influences to be partitioned.\textsuperscript{15-16} and/or did not explore the potential effects of the interaction between area-level and individual-level SEP.\textsuperscript{17} Furthermore, differences in the nature of the SEP measure used, for example, using single-variable factors instead of a combination of variables in the form of an index, may also partly explain differences in findings – studies using only a single variable measure for individual-level SEP may leave an unmeasured dimension of individual-level SEP to be captured as part of area-level SEP.\textsuperscript{18}

The limited number of studies using a multilevel modelling approach to delineate the role of individual SEP’s in oral health have been conducted mainly in developed countries, and/or focused only on specific population groups.\textsuperscript{14,19} There is limited empirical evidence regarding the influence of social context on an index measure of oral health-related quality of life (OHRQoL) in a general adult population. Yet, it is conceivable that the social context is an important determinant of this measure of psychological wellbeing related to oral health of an individual. Very few studies on the influence of social context on OHRQoL have been conducted in sub-Saharan Africa, and especially in South Africa, where absolute deprivation commonly coexists with affluent conditions.\textsuperscript{20} This gap may present an opportunity to increase our understanding of the effects of the social context of people on OHRQoL. One recent study in South Africa focused on self-reported oral health, but did not use index measures of individual-level and area-level SEP.\textsuperscript{21} Hence, the current study used a composite measure of SEP to attempt to answer two key research questions: Does area-level SEP influence OHRQoL? To what extent does individual-level SEP account for the relationship between area-level SEP and OHRQoL, if at all?

METHODS

Study design and sample population

This cross-sectional study used a representative sample of South African adults aged 16 years and older who participated in the Human Sciences Research Council’s (HSRC) annual South African Social Attitude Survey (SASAS) for 2011 (n=3,003; 85% response rate). The detailed sampling procedure for the SASAS, which was a household survey, has been published previously.\textsuperscript{22} Briefly, the SASAS used a multi-stage cluster sampling method to obtain a representative sample of adult South Africans, based on census enumeration areas. The survey procedure was approved by the HSRC’s Research Ethics Committee.

Measures and definitions

Demographic information such as participants’ age, sex, private health insurance enrolment (Medical aid), and race was obtained from the SASAS, which is based on questions adapted from the published literature and has been used previously in the South African population. Multiple measures were gathered of individual-level SEP, self-rated oral health,\textsuperscript{23} experience of oral pain in the past six months, past dental attendance pattern, self-reported number of teeth present in the mouth\textsuperscript{6} and OHRQoL using the Oral Health Impact Profile-short version (OHIP-14)\textsuperscript{23} (Cronbach alpha = 0.94). The prevalence of oral health impacts measured using the OHIP-14 was calculated as the proportion of subjects who responded to experiencing one or more oral impacts “fairly often” or “very often”.\textsuperscript{24} Self-reported level of satisfaction with life in general was also measured using the question: “How satisfied are you with life as a whole these days?” Scores ranged from 1 (“very dissatisfied”) to 5 (“very satisfied”). Information on oral health-related risk behaviours was also elicited. Current smokers were those who indicated they smoked “daily” or “some days”. Binge-drinking was defined as indicating having four or more alcoholic drinks in a row at least once in a month. Those who indicated having fruit and vegetables “daily” or “several times a week” were considered daily/weekly consumers of fruit and vegetables.

Individual-level socio-economic position

The individual-level SEP (Cronbach alpha = 0.75) used in this study was an index of different variables that captures different aspects of the multi-dimensional nature of SEP.\textsuperscript{25} The set of individual-level SEP measures obtained from the primary survey included: years of formal education, current employment status, subjective socio-economic position on a scale of 1 to 10,\textsuperscript{26} state of repair of the home and an asset index. These different variables were used to capture the different aspects of the multi-dimensional theoretical construct of SEP (such as education, which may reflect knowledge level; current employment, state of repair of the home and an asset index to reflect material living conditions; and the subjective SEP to reflect psychosocial aspects such as a sense of relative deprivation). The asset index (Cronbach alpha = 0.91) is a summed score of best fitting items obtained following a principal component analysis of household assets owned by participants. These household items included, among others, an electric stove, TV set, radio, DVD player, vacuum cleaner, fridge, hot running water, computer and car. Given the differences in scoring of the different components measuring individual-level SEP, the values derived from each measure were standardized using z-scores prior to the principal component analysis and reliability test of the composite index/scale.

Area-level socio-economic position

Area-level SEP measures were obtained from two large nationally representative household surveys. These secondary datasets included the 2010 General Household Survey (GHS) (n=25,653 households) and four rounds of Quarterly Labour Force Surveys (About 30,000 households/quarter). Subsequently, each individual in the primary survey dataset was matched with the corresponding area-level SEP measures, using the unique municipal-level geographic codes available in all the datasets (n=179 municipal areas matched). On average, twenty respondents from the primary survey were matched to each area.

In a manner similar to the determination of individual-level SEP, a composite area-level SEP measure (Cronbach alpha = 0.88) was calculated on the basis of a theory that area-level SEP is a multi-dimensional construct. This concept was explored using a principal component analysis of a set of variables obtained from the above two main datasets. For the area-level SEP, the value obtained from each variable was also weighted using the z-score to give equal weights before conducting a principal...
component analysis. The best fitting variables that were obtained from the principal component analysis included the proportions of people with ≥12 years of formal education (“high school”/matriculation) in an area, those who were eligible for employment and were employed, those who were employed in the formal sector (measure of area-level economic development), households in an area with flushing toilets, households with piped water and those who reported using private health facilities when ill. The data from these variables were summed to indicate the measure of area-level SEP. In the final analysis, those ranked in the lowest third area-level SEP were compared with those in the upper two-third area-level SEP.

Data analysis
All data analyses were conducted in STATA version 10.0 (STATA Corp., College Station, TX, USA) statistical package. Analyses used STATA’s “survey design” features to account for the cluster-sampling design. Data analysis included chi-square statistics and the t-test for independent samples. All statistical analyses were two-tailed. The threshold for statistical significance was set at p<0.05. However, all variables significantly associated with OHR-QoL at the 20% significance level in the bivariate analysis were entered into a multi-variable adjusted regression model to assess their independent association with OHR-QoL (measured using the OHIP-14).

Several respondents scored a zero on the OHIP-14 scale and that the data were therefore highly skewed. Therefore, a random-effects negative binomial regression model was used to assess the role of area-level SEP on OHIP-14. The final model included an interaction term “Individual*Area SEP” to explore the potential modifying effect of area-level SEP on individual-level SEP. This analysis was followed by a Blinder-Oaxaca decomposition analysis to explore the proportion of the effects of area-level SEP on OHRQoL, explained to a significant level by the factors which were also independently associated with OHRQoL in the regression model. Decomposition analysis is a

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>(n)</th>
<th>Mean OHIP (95% CI)</th>
<th>p-value</th>
</tr>
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<tr>
<td>Oral pain</td>
<td></td>
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</tr>
<tr>
<td>No</td>
<td>2268</td>
<td>3.22 (2.78-3.66)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>538</td>
<td>14.33(12.86-15.80)</td>
<td></td>
</tr>
<tr>
<td>Number of natural teeth present in the mouth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All / most</td>
<td>2353</td>
<td>4.35 (2.72-5.97)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Half or less</td>
<td>331</td>
<td>13.87 (11.74-16.00)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>208</td>
<td>4.64 (4.09-5.20)</td>
<td></td>
</tr>
<tr>
<td>Past dental attendance pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>1608</td>
<td>2.96 (2.49-3.44)</td>
<td></td>
</tr>
<tr>
<td>Symptomatic</td>
<td>886</td>
<td>9.06 (7.95-10.16)</td>
<td>&lt;0.001</td>
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<tr>
<td>Regular</td>
<td>395</td>
<td>8.88 (7.11-10.64)</td>
<td></td>
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<tr>
<td>Self-rated oral health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>544</td>
<td>12.35 (10.74-13.96)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Good</td>
<td>2341</td>
<td>3.98 (3.48-4.47)</td>
<td></td>
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<tr>
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<td></td>
<td>&lt;0.001</td>
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<td>Black African</td>
<td>1817</td>
<td>5.92 (5.18-6.65)</td>
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<tr>
<td>Coloured</td>
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<td>4.62 (3.56-5.68)</td>
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<tr>
<td>Indian</td>
<td>254</td>
<td>5.21 (3.75-6.67)</td>
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<tr>
<td>White</td>
<td>371</td>
<td>3.26 (2.32-4.19)</td>
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<tr>
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<td>2127</td>
<td>5.71 (6.04-6.37)</td>
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<tr>
<td>Yes</td>
<td>762</td>
<td>4.59 (3.63-5.55)</td>
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<tr>
<td>Location</td>
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<tr>
<td>Urban</td>
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<tr>
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<td>848</td>
<td>6.53 (5.38-7.67)</td>
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<td>Gender</td>
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<td></td>
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<tr>
<td>Male</td>
<td>1202</td>
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<tr>
<td>Female</td>
<td>1700</td>
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<td>Area-level SEP</td>
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<tr>
<td>Lowest third</td>
<td>939</td>
<td>6.14 (4.98-7.29)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Middle third</td>
<td>996</td>
<td>7.11 (6.00-8.22)</td>
<td></td>
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<tr>
<td>Highest third</td>
<td>935</td>
<td>3.32 (2.75-3.89)</td>
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<tr>
<td>Individual-level SEP</td>
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<td></td>
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<tr>
<td>Lowest third</td>
<td>895</td>
<td>7.14 (6.10-8.19)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Middle third</td>
<td>929</td>
<td>5.26 (4.35-6.17)</td>
<td></td>
</tr>
<tr>
<td>Highest third</td>
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<td>Current smoker</td>
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<tr>
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<td>5.31 (4.65 - 6.00)</td>
<td></td>
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<tr>
<td>Yes</td>
<td>629</td>
<td>6.17 (5.00 – 7.36)</td>
<td></td>
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<tr>
<td>Binge-drink</td>
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<tr>
<td>No</td>
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<tr>
<td>Yes</td>
<td>179</td>
<td>6.15 (4.28-8.02)</td>
<td></td>
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<tr>
<td>Consumes fruits &amp; vegetables daily/weekly</td>
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<td>0.354</td>
</tr>
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<td>No</td>
<td>1255</td>
<td>5.70 (4.82-6.58)</td>
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</tr>
<tr>
<td>Yes</td>
<td>1617</td>
<td>5.23 (4.53-5.93)</td>
<td></td>
</tr>
</tbody>
</table>

*n does not add up to a total of 3003 because of missing data on OHIP
method of decomposing inequality in health (OHIP) into the contributing factors. This gives the extent to which different factors contribute to the observed effect of the differences in area-level SEP on OHRQoL.

RESULTS

The mean (±SD) age of respondents was 40.6 (± 16.3) years. The prevalence of oral impacts measured using OHIP-14 was 17.2% (95% CI = 14.9 - 19.6). Those who reported having experienced oral pain in the six months prior to the survey date had significantly higher OHIP scores, implying poorer OHRQoL than among those who did not experience such pain (Table 1). There was a significant negative association between the OHIP-14 scores and both individual- and area-level SEP’s. Other factors associated with the OHIP-14 scores are shown in Table 1.

Even after controlling for potential confounders, the independent association between area-level SEP scores and OHRQoL remained significant (Table 2; Model A). Furthermore, there was a statistically significant interaction between individual-level SEP and area-level SEP (Table 2; Model A).

Subsequently, the study population was stratified into two groups, namely those living in areas ranked in the lowest third SEP and those living in areas with a higher SEP. Figure 1 demonstrates that, unlike in the most deprived areas, a very steep socio-economic gradient in OHRQoL was observed in more affluent areas.

Although those with a higher SEP and those living in more affluent areas were more likely to rate satisfaction with life in general higher than those with a lower SEP and living

![Figure 1: Socio-economic gradient in oral health impact by area-level socio-economic position](image-url)
in more deprived areas (p<0.01), the ratings of satisfaction with life were significantly associated with OHRQoL only in the more affluent areas (Table 2: Model B). Similarly, fewer people in the most deprived areas had ever visited a dental clinic compared with those in the more affluent areas (31.9% vs. 48.4%; p<0.001). The observed negative association between reporting past dental attendance and OHRQoL was significantly greater among those living in the most deprived areas (Table 2: Model C).

Decomposition analysis showed that area differences in dental attendance contributed the most (37.5%) to the gap in OHRQoL explained by area-level SEP, whereas individual-level SEP contributed the least (18.8%). Area differences in racial composition accounted for 23.4% of the area differences in OHRQoL, and the proportion that self-rated their oral health as good accounted for 20.3% of these differences (Table 3).

**DISCUSSION**

This study showed that the 17.2% prevalence of oral impacts in the South African adult population is comparable to the 16.5% prevalence obtained in a national population survey of Australians using the OHIP-14,24 and is similar to the 15.3% prevalence reported in a US population survey using the NHANES-OHIP.24 All these studies had samples with a mean population age of between 41 years and 44 years. Consistent with findings from a similar Australian study,29 the current investigation found that area-level deprivation is associated with reporting more oral impacts, independent of an individual’s SEP. However, in contrast to findings from another Australian study,17 wealthier adults living in more deprived areas were not much better than their poorer counterparts compared with the difference observed in affluent areas.

Individuals with the lowest SEP in the more affluent areas tended to report worse OHRQoL than would be expected from those with the lowest SEP living in the most deprived areas. This perhaps unexpected observation may be related in part to differences in the oral disease burden and/or frame of reference underpinning self-ratings.28 This finding also supports previous suggestions that individuals with the lowest SEP in more affluent areas are more likely to experience “relative deprivation”, which has also been associated with worse general health than that seen among those experiencing the “absolute deprivation” characteristic of people with a low SEP in highly deprived areas.29 This view is further supported by our finding that satisfaction with life in general was only associated with OHRQoL in more affluent areas. Conceivably, in the presence of absolute deprivation and competing social needs, oral impacts may be regarded as less important and are thus less likely to be associated with life satisfaction (or a lack thereof) in more deprived areas than in more affluent areas.

Areas of low SEP conceivably have poorer infrastructure, which may result in limited choices for all individuals to maintain and improve their oral health, irrespective of their individual-level SEP. It was therefore not surprising that area differences amongst those who reported having sought dental care (a possible proxy output measure of the availability of infrastructure for dental services) contributed most to explaining area differences in OHRQoL.

The cross-sectional study design used in the current study limits possible inferences on causality. The use of the OHIP-14 and most of the variables in this study were based on self-reporting – the accuracy of such results depends on the extent to which respondents can recall events accurately and report them honestly. This study did not include any clinical examination of the individual respondents. OHRQoL may well have influenced the rating of life satisfaction rather than the reverse, as reported here. Nevertheless, it has been acknowledged that people’s psychosocial state (as reflected by their rating of satisfaction with life in general) may influence ratings of oral health impact.25 Furthermore, we did not ask for the reason for the dental visits or how far back participants initiated regular dental visits. The “Regular” dental attendees who rated oral impacts as high as the symptomatic dental attendees did, but lower than those who “never” visited the dental clinic, may have been people prompted to make regular dental visits based only on the oral impacts they experienced during the 12-month frame of reference in this study. However, regular dental attendance may not be associated with reporting fewer oral problems, as previously noted.26 Consistent with the findings of Crocombe et al.,26 the apparent negative impact of dental attendance and having lost all/most natural teeth was stronger in the most deprived areas, which may reflect poorer infrastructure (and thus the quality of dental services available, such that the services are mainly extraction-driven)31 in the more deprived areas than in more affluent areas.

Despite these limitations, this study, which used a large sample and a rigorous statistical approach, has demonstrated that area-level SEP was independently associated with OHRQoL and moderated the influence of individual-level SEP on OHRQoL. Taken together, these findings highlight the need for interventions to improve the living conditions of underprivileged South Africans, including developing both health- and non-health-related physical infrastructure, and promoting a culture of preventive self-care practices. The finding of a steeper socio-economic gradient in OHRQoL in more affluent areas and the loss of the oral health advantage of more affluent individuals in the most deprived areas supports the call for development programmes to embrace what has been referred to as “proportionate universalism”, a strategy proposed to ensure that development programmes are implemented on a scale and with an intensity proportionate to the level of disadvantage.32 The use of general universalism such as the National Health Insurance combined with specific universalism where additional oral health services can be provided for the more disadvantaged groups of people, would help to reduce the inequity.

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References


The emerging role of epigenetics in the pathogenesis of periodontitis - A review

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ABSTRACT
Periodontitis is a chronic inflammatory disease affecting the supporting structures of the teeth. It is a complex disease with multifactorial etiology. Numerous studies have examined the role of the genetic factors in the etiology of periodontitis. Epigenetics is the study of the mitotically and meiotically heritable changes in the gene function that cannot be explained by changes in the DNA sequence. Studies have demonstrated that epigenetic alterations contribute to a number of diseases like cancer, metabolic and autoimmune disorders. An understanding of the epigenetic mechanisms helps to develop novel therapeutic aids which target the specific epigenetic sites. This article attempts to shed light on the role of epigenetic alterations in the pathogenesis of periodontitis. The role of the bacteria-induced epigenetic alterations in the host cell, the alterations in the cytokine profile and the role of the environmental factors like smoking on the epigenome are reviewed. Technological advances have enabled us to analyse and quantify the epigenetic changes on a large scale. Drugs which specifically target the epigenetic mechanisms may be used as valuable adjuncts to conventional periodontal therapy leading the way to personalized and preventive regimes.

Keywords: Periodontitis, inflammation, epigenetic mechanisms, pathogenesis, epigenome, DNA methyltransferase.

INTRODUCTION
Periodontitis is one of the most common oral diseases in adult populations and is characterized by inflammation and destruction of the tooth supporting structures, ultimately leading to tooth loss in severe cases.1,2 Although periodontitis has a microbial etiology, its progression is multidimensional and can be influenced by several factors such as systemic diseases, environmental factors, and genetic factors.3 The individual variability in the susceptibility to periodontitis and in the response to the therapy as well can be attributed to intrinsic factors such as genetic and epigenetic factors.3 Epigenetics is the study of alterations in gene regulation not caused by changes in the DNA sequence. The term “Epigenetics” was coined by Conrad Waddington, who defined it as “the branch of biology that studies the causal interaction between genes and their product, which bring the phenotype into being.”6 The Greek prefix ‘epi’ in epigenetics means ‘on top of’ or ‘in addition to’ genetics.

ACRONYMS
- ChIP: chromatin immuno-precipitation
- COX-2: Cyclooxygenase-2
- CpG: Cytosine-phosphodiester-Guanine
- DAM: DNA adenine methyltransferase
- DNMT1, DNMT3, and DNMT3b: DNA methyltransferases
- EBV: Epstein-Barr virus
- GEC’s: gingival epithelial cells
- HAT’s: histone acetyltransferases
- HDAC’s: histone deacetylases
- HDACi: Histone deacetylase inhibitors
- HIV: human immunodeficiency virus
- HPDL: human periodontal ligament
- IFNG: interferon gamma gene
- IRAK-1: receptor associated kinase 1
- KSHV: Kaposi sarcoma-associated herpes virus
- LPS: lipopolysaccharide
- MMP-2: matrix metalloproteinase-2
- MBDs: methyl-CpG-binding domain proteins
- mi-RNA: Micro-RNA’s
- THP1: monocytic leukemia cell line
- NF-Kappa B: nuclear factor kappa-B
- SAM: S-adenosyl-L-methionine
- SCFA: short chain fatty acid
- siRNA’s: short-interfering RNA’s
- STAT: signal transducers and activators of transcription
- TAB2: TAK-1 binding protein-2
- TLRs: Toll-like receptors
- TRAF-6: tumour necrosis factor receptor-associated factor
- TSG: tumour-suppressor genes
EPIGENETIC MECHANISMS

Important epigenetic mechanisms include DNA methylation, post-transcriptional histone modifications (methylation, acetylation, ubiquitylation, and phosphorylation) that affect chromatin structure, RNA associated gene silencing and chromosome inactivation.8

A. DNA Methylation:

DNA methylation is the covalent transfer of a methyl group from S-adenosyl-L-methionine (SAM) to the 5th carbon atom of the cytosine residue in the Cytosine-phosphodiester-Guanine (CpG) dinucleotides. The methylation process occurs mostly in regions containing a high frequency of CpG dinucleotides, called “CpG islands” in the promoter region of a gene, and is associated with gene silencing in most cases.9 The process of DNA methylation is catalysed by a family of closely related DNA methyltransferases (DNMT1, DNMT3, and DNMT3b).10 The DNA methylation blocks the binding of the transcription factors to DNA. This transcriptional repression leads to “gene silencing.”11 The exposed methylation sites allow for interaction with methyl-binding proteins, such as methyl-CpG-binding domain proteins (MBDs).12 Additionally, these proteins are instrumental in assembling histone deacetylases (HDAC’s) and thus influence chromatin condensation. HDAC’s are enzymes which remove the acetyl group from histones. Thus the DNA gets wrapped more tightly around the histones.13 The closed chromatin configuration leads to gene silencing.14 Studies in the literature have shown that hypermethylation of DNA is associated with chromosomal instability and activation of transposable elements in human cancers.15 Thus, abnormal methylation patterns can lead to the development of diseases.

Histone modification

A nucleosome is the basic unit of the chromatin. It comprises a double-stranded DNA wrapped around an eight-member histone complex consisting of two copies each of H2A, H2B, H3, and H4. The histone deacetylase and acetylation of histones, the histone deacetylase inhibitors, and thus influence chromatin condensation. HDAC’s are enzymes which remove the acetyl group from histones. Thus the DNA gets wrapped more tightly around the histones.13 The closed chromatin configuration leads to gene silencing.14 Studies in the literature have shown that hypermethylation of DNA is associated with chromosomal instability and activation of transposable elements in human cancers.15 Thus, abnormal methylation patterns can lead to the development of diseases.

B. NON-CODING RNA:

The non-coding RNA’s do not encode for a protein, but they are functionally relevant RNA molecules. These include transfer RNAs (tRNA’s), ribosomal RNAs (rRNA’s), micro-RNA’s (mi-RNA’s), and short-interfering RNA’s (siRNA’s).22 Studies have reported that these non-coding RNA’s play a pivotal role in the development of oral cancer, specific syndromes, and exert influences on the immune mechanisms in the oral cavity.23,24 Micro-RNA’s and short-interfering RNA’s have been shown to regulate gene expression without altering the DNA sequence. Micro-RNA’s have been shown to negatively regulate the expression of their target genes at the post-transcriptional level, thus leading to “gene silencing”.25,26 This article attempts to review the role of micro-RNA’s in the pathogenesis of periodontitis.

As our understanding of the pathogenesis of periodontal disease continues to grow, additional potential mechanisms linking the microbial biofilm to the disease process are being described.26 This review focuses on the intriguing role of epigenetic alterations in the pathogenesis of periodontitis.

The role of epigenetic mechanisms in periodontitis.

Upon a microbial attack, the host mounts an immune inflammatory response. Recent studies have demonstrated that bacteria can affect the chromatin structure and transcriptional program of host cells by influencing diverse epigenetic mechanisms.27 Epigenetic events determine gene expression and selective activation or inactivation of genes. These events modulate the production of inflammatory mediators, the expression of cytokines and thus contribute to the pathogenesis of various infectious and inflammatory diseases.28

The role of microbial plaque-induced epigenetic changes in the pathogenesis of periodontitis.

The oral biofilm is a complex structure. Using whole genomic probes and Checkerboard DNA-DNA hybridization methodology, Sockranksy et al analysed 13, 261 plaque samples. About 40 different bacterial species were determined in the subgingival plaque and these bacteria were found to exist in complexes. Five major complexes (red, orange, yellow, green and purple complexes) were consistently observed. Of these, the red complex, comprised of Tannerella forsythia, Porphyromonas gingivalis and Treponema denticola is strikingly associated to the clinical measures of periodontal disease such as destruction-pocket depth and bleeding on probing. The orange complex consists of microbes like Fusobacterium nucleatum, Campylobacter rectus, Campylobacter showae etc. Plaque formation begins by early colonizers (streptococcus species) attaching to the pellicle-coated tooth surface. The early colonizers alter the local micro-environment and make it conducive for the intermediate (orange complex bacteria) and the late colonizers (red complex) to establish themselves and thrive in the area. Thus the plaque mass undergoes maturation.29

Studies in the literature point to the fact that putative periodontal pathogens like Porphyromonas gingivalis and Campylobacter rectus can induce epigenetic alterations in the gingival cells and tissues.29 The microbe-induced epigenetic alterations with the resultant disruption of the host innate immune mechanisms is a vital step in the disease progression.30
Plaque accumulation in the dento-gingival area elicits a host immune response in the gingival epithelium. The cells of the gingival epithelium make use of a myriad of signalling pathways to modulate the innate immune response to the various microorganisms. The toll-like receptors (TLRs) enable the gingival epithelial cells (GECs) to recognize the pathogen-associated molecular patterns. The gingival epithelial cells then produce antimicrobial peptides such as human beta defensins and chemokines that activate the adaptive immune response. Yin and Chung demonstrated that Porphyromonas gingivalis perks up the expression of antimicrobial proteins human beta defensin and CC chemokine ligand 20 (CCL20). The gingival epithelial cells treated with this microbe showed decreased expression of histone deacetylase 1 and 2 (HDAC 1, HDAC 2), and DNA methyltransferase 1 (DNMT1). P. gingivalis also induced increased methylation of the promoter region of six genes, including the immune regulator CD276, elastase 2, toll-like receptor-2 (TLR2), interleukin-12 (IL-12A), and two putative tumour-suppressor genes (TSG).

The levels of the activating histone modification H3K4me3 were found to be reduced in GEC’s incubated with Porphyromonas gingivalis. Fusobacterium nucleatum, a non-pathogen, did not induce such alterations in the GEC’s. These findings corroborate the fact that P. gingivalis is capable of suppressing gene transcription. The lipopolysaccharide (LPS) produced by Porphyromonas gingivalis induces signalling of the toll-like receptor (TLR). The study demonstrated that the TLR signalling has far-flung effects on the epigenetic profiles of genes which respond to the TLR. Keratinocytes in the gingival epithelium when exposed to P. gingivalis LPS showed decreased expression of DNA methyltransferase 1 (DNMT1), Histone deacetylase 1 and 2 (HDAC1 & 2), the key enzymes involved in epigenetic mechanisms.

Recent evidence has also pointed to another interesting aspect in the bacteria-induced epigenetic alterations. Butyrate, an HDAC inhibitor produced by P. gingivalis, causes reactivation of human immunodeficiency virus (HIV) and Epstein-Barr virus (EBV). In their study, they showed that P. gingivalis metabolites like butyric acid enhanced the replication of Kaposi sarcoma-associated herpes virus (KSHV). The bacterial supernatant contained HDAC inhibition properties. This increased the global acetylation of H3 and H4 leading to the reactivation and replication of KSHV. Thus, periodontal microbes like P. gingivalis and other opportunistic bacteria associated with the state of immunosuppression in HIV-positive individuals may collectively contribute to AIDS progression by reactivating the latent virus through HDAC inhibition. Oxidative stress is an imbalance between the production of a reactive oxygen species and the antioxidant defense, leading to tissue damage. P. gingivalis induces oxidative stress, a process which is central to epigenetic modifications.

Additional studies by Yin et al. and Chung et al. have demonstrated that epigenetic changes in P. gingivalis-stimulated dendritic cells and GECs resulted in lower levels of cytokines and chemokines secreted by these cells. Uehara et al. reported that LPS derived from P. gingivalis inhibits osteoblastic cell differentiation. DNA hypermethylation was involved in the inhibitory effect of LPS on osteoblastic differentiation of fibroblasts derived from human periodontal ligament (HPDL).

Campylobacter rectus, another putative periodontal pathogen may also induce epigenetic alterations in human cells. Bobetsis demonstrated that C. rectus downregulated the expression of insulin-like growth factor 2 (Igf2) gene via hypermethylation of Igf2 promoter in murine placenta. The reduced placental growth and foetal growth as a result of these epigenetic alterations may be involved in preterm births associated with C. rectus infection in humans. A study conducted by Miao et al. observed that Treponema denticola, another periodontal microbe, upregulated the matrix metalloproteinase-2 (MMP-2) gene. There was hypomethylation in the promoter region of the MMP-2 gene. MMP-2 is responsible for the matrix degradation and bone resorption in periodontitis. The authors suggested that adherence/internalization of T. denticola into the periodontal ligament cells may have contributed to the epigenetic alterations.

Wu et al. suggested that DNA adenine methyltransferase (DAM) may regulate the genes required for the invasion process of Actinobacillus actinomycetemcomitans. Inactivation of DAM alters the virulence properties of this microbe.

The role of microbe-induced epigenetic alterations in Herpesvirus Periodontitis.

Though periodontitis is a highly prevalent, chronic infectious disease affecting the tooth-supporting structures, the etiology is still poorly understood. The major clinical characteristics of this enigmatic disease are perplexing. Findings such as the bilateral symmetrical pattern of the disease, spontaneous remission, why periodontitis affects only few teeth, with neighbouring teeth exhibiting much less attachment loss etc., cannot be explained solely on the basis of a microbial etiology. The co-infection of viruses with the microbes and their synergistic effect on the tissues has been suggested and may offer explanations for the confounding aspects of the disease.

A number of studies have shown that herpes viruses, including Epstein-Barr Virus (EBV), Human Cytomegalovirus (HCMV) and Herpes Simplex Virus-1 (HSV-1) are detected in high numbers in patients with periodontal and endodontic disease. They act synergistically with the periodontal bacteria. The herpes viruses may impair the local host defences and thus increase the pathogenic potential of the bacteria. The bacteria in turn may increase the virulence of the herpes viruses.

The microbe-induced epigenetic modification of the viral genome may explain the link between viruses and bacteria in the pathogenesis pathway. Butyrate, produced by P. gingivalis, is an HDAC inhibitor. Bacteria-induced HDAC inhibition may reactivate the latent EBV and HIV virus. Reactivation of latent HIV virus through HDAC inhibition by P. gingivalis may contribute to AIDS progression.

To conclude, studies strongly indicate that microbe-induced epigenetic alterations in the host cells and the viral genome may play an important role in the disease pathogenesis. These alterations have far-reaching implications. They can affect the prognostic and therapeutic outcomes of the disease. For example, butyrate, a metabolite of P. gingivalis, can reactivate the latent HIV, EBV, and KSHV, thus leading to progression of virus-associated diseases. Bacteria and viruses have a synergistic action, thus increasing the
pathogenicity. The use of anti-viral drugs as adjunct to conventional periodontal therapy may provide beneficial results and is a subject for further research.

**Epigenetic changes and cytokines**

Inflammation is the central component in the pathogenesis of periodontitis. Epigenetic alterations may have an effect on the cytokine profile, and thus can determine the outcome of the disease.

Epigenetic mechanisms have been evaluated in some cytokine genes. In periodontal disease, there is an overexpression of pro-inflammatory cytokines (IL-1, IL-4, IL-6 and IL-10). Epigenetic events such as hypomethylation and histone acetylation are associated with the inappropriate over-transcription of genes. Gomez et al. observed hypomethylation in the gene of cytokine interleukin-6 (IL-6) in the tissues of individuals with periodontitis, leading to an overexpression of this cytokine in the inflamed tissues. IL-6 is a key cytokine involved in bone resorption and has been detected in high levels on patients with periodontal disease. Babel et al. in their study showed overexpression of cytokine IL-6 in the inflamed tissues of subjects with chronic periodontitis.

Interestingly, the overexpression of IL-6 might have an influence on the epigenetic changes in the cells. Studies conducted by Hodge et al., Stenvinkel et al., and Hodge et al., suggested that the overexpression of IL-6 might exert an epigenetic influence in the cells by regulating the DNMT gene or by maintaining its methylation status. Long-standing persistent inflammation and bacterial infection may cause DNA methylation which in turn inactivates the suppressors of cytokine signalling and may thus contribute to exaggerated cytokine signalling. A similar study by Hmadcha et al. showed that interleukin-1 beta causes activation of DNA methyltransferase and thus markedly suppresses the genes which code for the interleukin.

In periodontitis, the inflammatory response involves upregulation of transcription factors-nuclear factor kappa-B (NF-Kappa B) and signal transducers and activators of transcription (STAT). Oliveira et al. in their study evaluated the methylation status of DNA in the promoter region of interleukin-8 (IL-8, a chemokine) in gingival and oral mucosal cells, leukocytes in blood from healthy individuals, smokers and non-smoker subjects with chronic periodontitis. The methylation status was co-related with mRNA levels of IL-8. The study revealed that there was a higher percentage of hypomethylation of IL-8 gene in chronic periodontitis subjects in the DNA of oral mucosal cells. Cyclooxygenase-2 (COX-2) is an enzyme governing the production of prostaglandins that promote pain and inflammation. Zhang et al. evaluated the epigenetic changes in the promoter region of Prostaglandin synthase 2, the gene encoding for COX-2 in chronic periodontitis patients. The results revealed a hyper-methylation status of the gene and lower levels of COX-2 transcription in inflamed gingival biopsy cells. A study by Andia et al. in subjects with generalized aggressive periodontitis evaluated the DNA methylation status in the promoter region of IL-8 gene in oral and GEC's. The authors reported a hypomethylated status in oral and GEC's of these subjects. Zhang et al. evaluated the presence of epigenetic modifications in the promoter region of interferon gamma (IFNG) gene in gingival biopsy of chronic periodontitis subjects. Their study reported a significant hypomethylation and increased IFNG transcription. Corroborating this evidence, White et al, in their study, suggested that the expression of IFNG is regulated by the status of methylation in its promoter region. Sullivan et al. demonstrated that epigenetic alterations in the gene which codes for tumour necrosis factor alpha (TNF-α) actively regulates its expression and is present both consecutively and in response to acute stimulation of cells from the myeloid lineage. Another recent study by Zhang et al. showed that the Tumour necrosis factor alpha (TNF-α) promoter was hypermethylated at two CpG sites, resulting in decreased expression. Reversing the methylation by treatment with a demethylating agent in vitro, caused increased expression of TNF-α, indicating that the methylation indeed regulated the expression. De Souza et al., stated that variations in DNA methylation between healthy and periodontitis cases are higher in genes related to the immune-inflammatory process. DNA methylation must be modulating the chromatin regions, and consequently modulating the mRNA transcription of immune inflammatory genes associated with periodontitis. Thus DNA methylation can have an impact on the prognosis of the disease.

Studies have revealed that in addition to DNA methylation, other epigenetic changes such as histone modifications also play a pivotal role in the pathogenesis of periodontitis. Gemmell et al. stated that the nature of the lymphocytic response determines the destructive periodontitis lesion. The progression from gingivitis to periodontitis is characterized by a transition from the Th1 to the Th2 subset of the T lymphocyte. Changes in the chromatin structure occur through epigenetic mechanisms like histone modification, DNA methylation and generation of DNase I hypersensitive sites. These epigenetic modifications occur during the process of differentiation of the naive T cells into the various lineages, thus determining the destructive characteristics of the lesions. Cantley et al. in their experimental mouse model study demonstrated that treatment by histone deacetylase inhibitors (HDACi) efficiently suppressed periodontal bone loss.

The role of Micro-RNA's (mi-RNA) in the pathogenesis of periodontitis have only been recently reviewed. Comparison of the mi RNA profiles in the healthy and the periodontitis tissues revealed that the mi RNA levels were increased in the latter group. Ogata et al. used mi-RNA microarray profiling and real time PCR analysis to determine the micro-RNA expression in the inflamed and healthy periodontal tissues. The results of their study revealed that the three most overexpressed miRNA's were hsa-miR-150, hsa-miR-223, and hsa-miR-200b, and the three most under expressed miRNA's were hsa-miR-379, hsa-miR-199a-5p, and hsa-miR-214. The overexpressed miRNA's are associated with inflammatory disease, organisinal injury, abnormalities, urolological disease, and cancer. Micro-RNA's have been implicated in controlling the TLR pathway which connects the innate and the adaptive pathways of the immune response. In their experimentally induced periodontitis in apolipoprotein E-deficient (ApoE-/-) mice, Nahid et al. reported that polymicrobial infection with periodontal pathogens like P. gingivalis, T. denticola,
The study of Xie et al. 

Periodontal disease may be of interest. The results revealed that there was an increase in the mi-RNA levels in a time-dependent manner and this co-related with the downregulation of adaptor kinases IL-1 receptor associated kinase 1 (IRAK-1), tumour necrosis factor receptor-associated factor (TRAF-6), and TNF-α production by these cells. The authors concluded that the elevated levels of miR-146a downregulates IRAK-1 and TRAF-6. This may have been the reason for endotoxin tolerance. Hence, miR-146a may represent a target for therapeutic intervention.

Similar results were obtained in the study of Xie et al. miRNA-146 inhibited the secretion of pro-inflammatory cytokine through IL-1 receptor-associated kinase 1 in human gingival fibroblasts. Xie et al. examined the levels of miR-155 in monocyte-derived dendritic cells exposed to endotoxin lipopolysaccharide. An elevated level of mi-R-155 was demonstrated and it was shown to downregulate TAK-1 binding protein-2 (TAB2), which plays an important role in IL-1 signalling pathways. The authors concluded that this negative feedback loop helped modulate the inflammatory responses of dendritic cells. Xie et al. in their study determined the expression profile of micro-RNA in obese individuals with and without periodontitis. They found that there was upregulated expression of several mi-RNA’s in the inflamed gingival tissues of their patients with periodontitis and obesity. The findings suggest that inflamed periodontal tissues and obesity may share the inflammatory mi-RNA targets. Experiments have been performed implicating several inflammatory diseases and cancer. The microRNA targets may be amenable to intervention by drugs which target the specific epigenetic sites.

Tout ensemble, experimental studies have shed light on the impact of altered epigenetic patterns on the cytokine profile in patients with periodontitis. Long-standing chronic inflammation and bacterial infection may have an effect on the enzymes involved in the epigenetic mechanisms. The alterations in the cytokine profile may affect the prognostic outcome of the disease.

Role of the environmental factors in the patho-epigenetics of periodontitis.

Periodontitis is a chronic inflammatory disease. Microbial plaque, the primary etiological agent, is essential to cause the disease in a susceptible host. There are several other factors like nutrition, toxic components in the environment, tobacco smoke, alcohol and different infectious agents that can affect the disease outcome. These factors can induce epigenetic alterations in the host cells. Xie et al. have observed associations between smoking and global DNA methylation, linked with poor prognosis in lung cancer. A study conducted by Oliveira et al. revealed that there was a higher percentage of hypomethylation of IL-8 gene in the DNA of oral mucosal cells of subjects with chronic periodontitis. But there was no difference in the methylation status of IL-8 promoter in smokers and non-smoker subjects with periodontitis in this study. Smoking is an important risk factor for periodontal disease. Further studies evaluating the methylation in smokers with periodontal disease may be of interest.

Studies have elicited the role of diet and nutritional influences on the pathogenesis of periodontitis. Okano et al. stated that folate deficiency during pregnancy leads to a lack of S-adenosylmethionine, a substrate required for the enzyme DNMT (DNA methyltransferase) to methylate CpG residues during embryonic development. Increase in the methylation rate in older individuals leads to gene silencing and could thereby contribute to the development of chronic diseases. Ohi et al. in their study demonstrated hypermethylation of CpG in the promoter of the collagen-alpha 1 gene in the aged periodontal ligament.

The pathogenesis of periodontitis is complex. The above mentioned studies point to the multiple confounding factors that might play a role in the epigenetic mechanisms and thereby affect the disease outcome.

Epigenetic therapy in the management of periodontitis: personalized periodontal therapy.

Epigenetic changes occur more frequently than the genetic changes and are rendered reversible by treatment with pharmacological agents. Research in the use of pharmaceutical agents targeting the “epigenetic sites” is ongoing. Histone deacetylase inhibitors and DNA methyltransferase inhibitors have been in the vanguard of these approaches. Histone deacetylase inhibitors help in suppressing bone resorption by osteoclasts. The deacetylase inhibitors help in promoting osteoblast maturation. In their study on P.gingivalis - induced experimental periodontitis in mice, Cantley et al. evaluated the bone volume changes after administering novel compounds targeting both Class I & II HDACs (1179.4b) and MS-275, which targets specifically the Class I HDAC. The results of the study revealed that Class I and II histone deacetylase inhibitor, 1179.b, significantly reduced P.gingivalis- induced bone loss.

The above mentioned studies suggest that agents targeting the specific “epigenetic sites” can be considered as useful adjuncts in the management of periodontal disease.

Methods for analysing epigenetic mechanisms.

Technological advances have enabled the analysis of epigenetic analysis on a large scale. DNA methylation can be detected and quantified by the following techniques:

a. Bisulphite conversion.-In this technique sodium bisulphite modification of DNA enables the conversion of unmethylated cytosines to uracil, while the methylated cytosines remain unchanged.

b. Global DNA Methylation Analysis-High Performance Liquid Chromatography (HPLC) is a classical method to quantify global DNA methylation.

c. Gene-specific methylation analysis-can be characterized as either “candidate gene” or “genome-wide” approach.

The candidate gene approaches can be further divided into “sensitive” and “quantitative” approaches.

Methods for genome-wide analysis:

a. Microarray-based genome-wide analysis. Three main classes of microarray methods have been developed to map the 5-methylcytosines patterns in genomes:

1. Methods which enrich the highly methylated regions using an antibody specific for 5-methylcytosine or methyl-binding proteins.

2. Methods based on bisulphite modification.

Methylated DNA Immuno-precipitation-MeDIP

The DNA is immuno-precipitated using antimitelcytosine antibody and this immuno-precipitated DNA is hybridized to microarrays.113

Analysis of histone modifications:

The histone modification signals can be captured by chromatin immuno-precipitation (ChIP), in which an antibody is used to enrich DNA fragments from modification sites. ChIP-chip, ChIP-PET, ChIP-SAGE are some of the other ChIP based techniques.114-116 Ultra-high-throughput sequencing technologies such as Illumina/Solexa sequencing has enabled the use of a new technique called ChIP-seq. ChIP-seq is becoming one of the main approaches due to its high coverage, high resolution and low cost. In ChIP-seq, the sequence of one end of a ChIP-enriched DNA fragment is read, and it is followed by mapping the short read, called tag, to the genome assembly in order to find the genome location of the fragment.117,119

Thus technological advances have enabled geneticists to analyse and quantify the epigenetic modifications on a large scale. The use of bioinformatics to compute the epigenetic alterations lyse and quantify the epigenetic modifications on a large scale. Thus technological advances have enabled geneticists to analyse and quantify the epigenetic modifications on a large scale. These data are of enormous use in research and can be used in the development of drugs that target the epigenetic sites with greater specificity.

CONCLUSION

Periodontitis is a chronic inflammatory disease involving the supporting structures of the tooth. It is a polymicrobial infectious disease. The host tissue mounts an immune inflammatory response to combat the bacterial attack. A number of studies reveal the role of epigenetic mechanisms in the pathogenesis of periodontitis. Bacteria cause epigenetic alterations in the gingival cells and tissues. These epigenetic changes can cause “silencing/shut down” of genes involved in local defences and so the chances of survival of the microbes in the local microenvironment is significantly enhanced. They may also cause rapid re-establishment of virulent flora, thereby giving rise to refractory/resistant forms of periodontal disease.24 This emphasizes the importance of thorough surgical debride ment and complete removal of infected granulation tissue which may act as a reservoir of bacteria. It is also logical to use antimicrobials as adjuncts to non-surgical/surgical periodontal therapy to eliminate the microbes which have tissue-invasive properties. Studies have also revealed that epigenetic changes in the cytokine genes have a crucial role to play in the pathogenesis of this inflammatory disease. However it needs to be ascertained whether these epigenetic alterations lead to increased susceptibility to the disease or whether they are a consequence of the long-standing chronic inflammatory response.25 It is a “chicken or egg” scenario which is most perplexing. Periodontitis has a complex multifactorial etiology. Though microbial plaque is the primary etiologic factor, systemic diseases like diabetes, age and environmental factors such as smoking may affect the disease outcome. These confounding factors also have a role to play on the epigenome. Hence studies evaluating the epigenetic events in the pathogenesis of periodontitis should be viewed with caution. Geneticists have made terrific progress and have made tremendous advances in the understanding of the “epigenetic sites.” These drugs can be used as valuable adjuncts to conventional periodontal therapy. This type of therapeutic approach is showing great promise in the treatment of other diseases affected by aberrant epigenetic marks like cancer, lupus, and asthma, neurological disorders like Huntington’s chorea, Alzheimer’s disease and diabetes. The challenge with this approach is to specifically target the epigenetic marks which have negatively influenced the gene, leaving alone the beneficial ones that help maintain health. It has always been thought that “our genes are set in stone” and are beyond our influence. The concept that the epigenome can be altered by pharmacologic intervention is very profound and empowering. Technological advances have enabled analysis and quantification of the epigenetic changes and have been instrumental in the development of drugs which target the epigenetic sites with greater specificity.

References


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INTRODUCTION

The goals of procedural sedation (PSA) stretch far beyond providing just sedation and analgesia. Practices need to strive to treat adults and children with dignity, decreasing their anxiety levels, providing adequate pain control, preventing adverse events, while maintaining proper cardio-respiratory function. Safety is crucial.

Protection of the airway is vital to ensure patient safety. In dental sedation, the airway is usually shared by the sedation practitioner and the dentist. Understanding the importance of the airway and a basic knowledge of the anatomy are necessary. Protecting the patient against hypoxia is crucial.

This article will review critical aspects of laryngospasm (a form of airway obstruction), which may threaten patient safety, and will discuss how to rescue the patient during dental sedation.

Keywords: Laryngospasm, procedural sedation, airway

DISCUSSION

PSA has been proven to be a safe and effective alternative to general anaesthesia for anxious patients (adults and children) who are undergoing certain surgical procedures outside the in-hospital environment. PSA refers to a technique of administering sedatives or dissociative agents, with or without analgesics, that allows patients to tolerate unpleasant procedures while cardio-respiratory function is fully maintained. Behavioural management is an extremely important component of PSA.

According to Campbell et al, the risks related to office-based procedural sedation can be divided into three groups: inadequate sedation, over sedation/adverse response to sedatives or failed sedation.

Patient safety begins with patient assessment and preparation. This includes a detailed medical history, clinical assessment and a focused airway evaluation before the sedation. The patient must meet the requirements for safe practice, as only ASA 1 and 2 patients can receive treatment outside the operating theatre.

There are various tools available to establish whether the airway will be safe under sedation. This article will give practical information by defining laryngospasm, the risk factors for its development and the treatment thereof.

Laryngospasm remains an important cause of airway obstruction. It can be responsible for significant morbidity and even mortality, especially in the paediatric population. Risk factors for the development of laryngospasm can be divided into patient related factors, and procedure and sedation-related factors. Patient factors include age (young children are especially at risk), the reactive airway e.g. after a common cold, upper respiratory tract infections or exposure to smoking, and, patients undergoing procedures to the larynx or pharynx. Sedation risk factors include any stimulation of the larynx, for example using suction catheters, or the influx of blood, mucus or other secretions.

Laryngospasm is a reflex closure of the upper airway as a result of stimulation of the superior laryngeal nerve, resulting in muscle spasm. This protective reflex prevents foreign material entering the trachea-bronchial tree but can cause hypoxia. It can be partial, allowing some air through, and causing inspiratory stridor, or complete, with total absence of breath sounds.

Laryngospasm can be self-limiting, but if it persists and is left untreated, life-threatening complications can ensue. The best management is prevention. This is done by identifying patients at risk as well as careful airway management during the sedation. Secretions or blood from the patient’s mouth as well as dental devices that make use of water sprays need to be monitored at all times.

Prompt identification is the key to successful treatment and the sedation practitioner needs to be on the lookout for signs and symptoms suggestive of laryngospasm, such as: inspiratory stridor, usage of accessory respiratory or
Our next article will address ways to protect the airway during sedation. The 2015 SASA Guidelines on Procedural Sedation can be used as guidance for until help arrives. The management of laryngospasm requires application of knowledge, skills and teamwork. Simulation-based education, especially focused on airway management, is an area of significant benefit for the practitioner, who of course must undergo continuous professional education.4

The sedation practitioner’s best preparation is anticipation, recognition, and readiness to respond to an adverse event. This is the reason why we advise sedation practitioners to seek training in PSA and see that they get airway certification. Basic maneuvers e.g. jaw thrust, are usually sufficient to rescue the airway, but administration of supplemental oxygen can be important with airway obstruction.

Progressive management may be necessary and would include repositioning of the patient’s airway by various opening maneuvers, the placement of an airway tube to relieve upper airway obstruction or providing positive pressure ventilation.8

Patients with serious medical emergencies can deteriorate quickly and urgent support of the airway, breathing and circulation are essential.2 Providers need to guide their treatment with the most recent resuscitation guidelines and must be certified in airway management.9

CONCLUSION

Protocols, guidelines and training are the essential cornerstones of out-of-theatre procedural sedation.10 Sedation practitioners must be trained and well-practiced in the art of providing safe sedation and resuscitation. They must be able to rescue a patient from a potential serious medical emergency and provide appropriate care until help arrives.

The 2015 SASA Guidelines on Procedural Sedation can be used as guidance for safe sedation practice.

Our next article will address ways to protect the airway during sedation.

References


There are numerous histologically different types of focal overgrowths which may occur on the gingiva, such as the peripheral giant cell granuloma, the pyogenic granuloma and the lesions illustrated above in Figs A, B and C., which have been known by various names but may be best referred to as peripheral odontogenic fibromas. There is no universal agreement among all investigators that this lesion is in fact odontogenic in origin. The peripheral odontogenic fibroma can occur at any age, although it appears to be somewhat more common in children and young adults. The lesions are equally divided between the maxilla and mandible and over 80% occur anterior to the molar area. The clinical appearance of the lesion is characteristic but not pathognomonic. It presents as a well demarcated focal mass of tissue with a sessile or pendunculated base. It is the same colour as normal mucosa or slightly reddened (Fig. A) and in some cases areas of calcification may be visible on the radiograph (Fig. B). The lesion most commonly appears to originate from an interdental papilla. The surface may be intact or ulcerated (Fig. C). In the vast majority of cases there is no apparent underlying bone involvement.

Considerable confusion has previously existed in distinguishing between the peripheral ossifying fibroma and the peripheral odontogenic fibroma and these lesions were often in fact regarded synonymously. They are now considered to be distinct and separate entities. The peripheral ossifying fibroma occurs exclusively on the gingiva. It appears as a nodular mass, either pedunculated or sessile, that usually emanates from the interdental papilla and the colour ranges from red to pink. Most lesions are less than 2cm in size, although larger ones occasionally occur (Fig. D). The lesion predominates amongst teenagers and young adults, with peak prevalence between ages of 10 and 19. Almost two thirds of all cases occur in females. There is a slight predilection for the maxillary arch, and more than 50% of all cases occur in the incisor/cuspid region. Usually the teeth are unaffected. Radiologically, peripheral ossifying fibromas are initially radiolucent and gradually develop increasing amounts of calcification/ossification as they mature (Fig. E). In very rare cases peripheral ossifying fibroma may present simultaneously in both the upper and lower jaws (Fig. F).

Reference
Advertise your additional qualifications

S Naidoo

Advertising of a health professional’s credentials is strictly regulated with the aim of protecting both the patient’s and the health professional’s rights. The same ethical principles govern all forms of advertising, whether published in print, electronic or other media. Health professionals must refrain from self-promotion. Unethical behaviour such as the canvassing and touting for patients is strictly forbidden by the HPCSA. Nowadays, however, advertising on the Internet has become a norm and every dental practitioner is ethically and legally responsible for his or her online websites. This is made clear by the HPCSA who state “if a health care professional chooses to make known that he or she practices in a specific field, the health care professional assumes a legal and ethical responsibility for having acquired a level of professional competence within the field of expertise which must be demonstrable and acceptable to his or her peers”. By advertising services that one is not trained to provide, the principle of non-maleficence (do no harm) becomes significant.

Irrespective of the manner in which the advertisement is depicted, the advertisement must “not be unprofessional, untruthful, deceptive or misleading…” The principle of veracity is key to the claims made. This principle expresses the concept that professionals have a duty to be honest and trustworthy in their dealings with all patients including the primary obligations of respecting the position of trust inherent in the dentist-patient relationship, communicating truthfully without deception and maintaining intellectual integrity.

General dental practitioners should be aware about misleading the public on websites and to be careful about representation, either expressed or implied, regarding specialisation in a specific area. According to the HPCSA, a ‘specialist is a dentist who registered as a specialist in a specialty or related specialties and subspecialty (if any) recognised in terms of the regulations and who confines his or her practice to such specialty or related specialties and subspecialty (if any).’

In addition, a practitioner is entitled to insert on his or her professional stationery (i) specialty or subspecialty or field of professional practice (if any) and (ii) registered qualifications or other academic qualifications or honorary degrees in abbreviated form. However, fellowships of associations rather than formal academic postgraduate training may mislead the public as it may create an unjustified expectation and indicate the attainment of education or skills in the field of dentistry, if it is not subject to reasonable substantiation. Claims of superiorities whether through the use of titles, professional attainments, personal qualities, superior knowledge or quality of service may be construed as unprofessional conduct when the same quality of services can be rendered by practitioners practising in the same field.’

The HPCSA guidelines, Section 27: Specialists 27.1 Rule 25 in terms of s67 (f) dealing with regulations of the Health Professions Act 56 of 1974 state that “A medical or a dental specialist shall adhere to the regulations made under section 61(1)(f), relating to the conditions of practising as a specialist.” The regulations are as follows:

(i) the registration in terms of section 35, of the specialties or categories of registered persons;

(ii) the requirements to be satisfied, including the experience to be obtained, the nature and duration of the training to be undergone and the qualifications to be held by persons before any specialty or category may be registered;

(iii) the circumstances under which any applicant for the registration of a specialty shall be exempted from any of such requirements;

(iv) conditions in respect of the practices of persons whose specialties or categories have been registered, including conditions restricting the practice of any such person to the specialty or category registered in his or her name.”

Non-health related degrees, honorary degrees or titles used in advertising services may mislead the public who may assume the degree is related to the qualifications of the dentist as a dental practitioner. Such extraneous data should be avoided in any advertisement. A title may distinguish a practitioner for his services to the profession or to the community, but does not necessarily represent greater skill or further education. The respect for patient autonomy requires one to tell the truth. Deceiving patients about what one is able to offer him/her shows a lack of respect for patients and their autonomy. In addition, it is an infringement of their rights and the principle of justice is also violated if a sense of fairness does not prevail. Beneficence refers to doing good and the active promotion of goodness, kindness and charity. In acquiring the knowledge and skills we claim to possess and providing these to the patient, the obligation of beneficence is satisfied. However, this principle is clearly breached if a dentist makes unjustified claims to be able to provide ‘extraordinary’ care in addition to general dental care if he/she lacks the knowledge and skills to do so. Furthermore, by advertising services that one is not trained to provide, the risk-benefit ratio is affected and the concept of harm to the patient and the principle of non-maleficence (do no harm) becomes significant.

References


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

1. Caries removal in deciduous teeth using an Er:YAG laser: a randomized split-mouth clinical trial


The issue of total versus partial removal of caries when preparing primary teeth for restoration due to a caries attack has been scientifically resolved in favour of the latter. Thus, the philosophical approach to caries removal in primary teeth is related to using minimally invasive techniques that lead to the arrest of the dental caries process in a tooth followed by treatment and/or placement of a restoration that is able to keep the tooth healthy and functional in the oral cavity.

Partial caries removal involves the removal of infected dentine, which is a softened, necrotic, and moist tissue that carries a large amount of bacteria. Affected dentine contains significantly less bacteria, is resistant to removal, is capable of remineralization and is left behind. This procedure has been successfully performed in primary and permanent teeth with the advantage of removing a minimum of the remaining sound tooth structure, avoiding pulp exposure, preserving the vitality of this tissue, and preventing the progression of lesions.

The Er:YAG laser can be used for caries removal, when its wavelength (2.94 μm) coincides with the peak of water absorption and hydroxyl radicals of hydroxyapatite. This promotes the effective ablation of the carious tissue via microexplosions from the evaporation of the water contained in the mineralized tissue. This allows for conservative caries excavation without extending the preparation into sound tooth structure. Furthermore, it does not generate the noise, pressure, or vibration of conventional rotary devices, and requires less local infiltrative anesthesia making dental treatment much less traumatic, especially for children.

Valério and colleagues (2016) from Brazil reported on a clinical randomized study (split-mouth) that sought to evaluate the efficiency of the Er:YAG laser according to the time needed for caries removal in deciduous molars. The null hypotheses to be tested were (1) that caries removal using the Er:YAG laser is of similar effectiveness and efficiency as bur preparation, (2) that the remaining dentine has the same number of microorganisms, and (3) that the clinical longevity of the restorations after one year is similar between the two methods of caries removal.

MATERIALS AND METHODS

The two interventions tested for caries removal were: (1) the Er:YAG laser (250 mJ/4 Hz) and (2) bur preparation (low speed turbine-control). Forty two children (n = 42) with 84 counterpart primary molars with active carious lesions and cavitation reaching the dentine, and located at the occlusal surface (class I), took part in this trial. Twenty-nine children were evaluated one year after the restorative procedure. The experimental design used a randomized complete block, and the response variables used to test the efficiency of the caries removal were evaluated by means of the time needed for the procedure, the effectiveness of the partial caries removal as assessed by visual and tactile information, microbiological analysis by counting Lactobacillus sp and S. mutans and clinical (modified USPHS method) and photographic analyses of the restorations.

Clinical examinations were performed under adequate light, followed by standardized radiographic examination with bitewing radiographs. Children were included if they had at least two active carious lesions into the dentine that were located on the occlusal surfaces (class I) of contra lateral deciduous molars, with vital pulps and no sealants, amalgam, glass ionomer cement, or composite resin restorations. The selected teeth all had positive responses to a thermal pulp test.

Children were excluded if they clinically presented with tooth pain, spontaneous sensitivity, fistulas, swelling, and
mobility or if they radiographically presented with furcal or periapical radiolucencies, increased periodontal space or internal/external dental reabsorption.

Teeth were randomly assigned to the experimental group (Er:YAG laser) or the control group (bur preparation) by coin toss. The different methods of caries removal were performed in separate sessions using a standardized protocol for both treatments.

The treatment efficiency of the control and experimental groups was evaluated according to the time required for partial caries removal (infected dentine removed; affected dentine preserved) in the deciduous molars.

To evaluate the effectiveness of the procedures, one calibrated examiner, who was blinded to which method was employed, performed a tactile and visual examination. During the tactile and visual examination, a blunt instrument with an active tip was used to evaluate the caries removal from the surrounding walls according to the hardness clinical criterion and at the pulpal wall following the clinical criteria for consistency and texture. The examiner scored the tissue as either A (infected dentine) or B (affected dentine).

Immediately after caries removal by the Er:YAG laser or bur preparation, the remaining dentine was collected with sterile curettes and sent for microbiological analyses.

Depending on the depth of the carious lesion, an indirect pulp cap was performed. For deep cavities, calcium hydroxide cement (Dycal) was used, followed by glass ionomer cement (Ketac Molar). In medium cavities, only glass ionomer cement (Ketac Molar) was used. The restorations were finished occlusally using composite resins (Filtak Z350) and occlusal adjustment was performed with carbon paper. The children returned after seven days for the final polishing of the restorations with abrasive tips.

The restored teeth were carefully evaluated by means of clinical and photographic analysis at two time points: seven days after the restorative procedure (baseline) and one year after the restorative procedure. The clinical analysis was performed by one examiner (blind test) by means of visual and tactile examination with a blunt instrument with an active tip, according to the modified USPHS criteria. These criteria require the analysis of retention, marginal discoloration, secondary caries, and marginal adaptation.

The restorations were classified into three categories:

- **Alpha**—when the evaluated criteria did not present problems and the restoration was in perfect condition;
- **Bravo**—when the evaluated criteria included small failures, but the restorations were still clinically acceptable; and
- **Charlie**—when the evaluated criteria included relevant failures, such that the restorations needed to be replaced.

**RESULTS**

The results showed that the efficiency (in seconds) of the Er:YAG laser for caries removal in deciduous molars was statistically lower ($p = 0.019$) than that for bur preparation. Both methods of caries removal were found to be equally effective when measured from the pulpal wall of deciduous molars. For caries removal in the surrounding walls, the results showed that the bur preparation method was more effective ($p = 0.0001$).

The counts of *mutans streptococci* and *lactobacilli* in the remaining dentine collected after preparation did not differ ($p < 0.05$) between the two treatments.

The clinical and photographic analysis of the restorations were performed at two time points: seven days after the restorative procedure (baseline) and one year after the treatment. The results demonstrated that there were no statistically significant differences between the restorations placed after caries removal with the Er:YAG laser or the bur, as evaluated according to USPHS criteria. These criteria included retention, marginal discoloration, secondary caries, and marginal adaptation ($p \leq 0.05$).

**CONCLUSION**

The authors concluded that bur preparation (using drills with low-speed rotations) is more efficient for caries removal in primary teeth than laser. Both the Er:YAG laser and the bur preparation methods were effective for caries removal from the pulpal wall; however, for the surrounding walls, the bur preparation was found to be significantly more effective. The amount of *S. mutans* and *Lactobacillus sp* found on the affected dentine in the pulpal walls was similar after caries removal by both methods. The restorations placed after the caries removal using either the bur preparation or the Er:YAG laser were clinically acceptable according to USPHS criteria and photographic assessment after a one-year period.

**IMPLICATIONS FOR PRACTICE**

The results from this trial suggest that the conventional method of caries removal remains the gold standard.

**References**

2. Pain after single-visit root canal treatment with two single-file systems: a prospective RCT

Contemporary root canal preparation techniques employ the use of engine-driven nickel-titanium instruments that operate based on two kinematics—rotation or RECIPROCatin. Most commonly used NiTi instruments operate with two types of movement: first is continuous rotating full sequence and second is RECIPROCatin. Torsion and flexion occur with continuous rotating NiTi instruments while preparing root canals, which can lead to instrument fracture. To avoid this, RECIPROCatin movement was proposed. This movement minimizes the stresses on the instrument by counterclockwise (cutting action) and clockwise (release of instrument) movements. RECIPROCatin movement claims to mimic manual movement and reduces various risks associated with continuous rotating file systems. However, RECIPROCatin systems with small and equal clockwise (CW)/counterclockwise (CCW) rotation angles have decreased cutting efficiency, thus making progression into the canal more laborious.

Single file systems using RECIPROCatin movements are being used more often by clinicians and examples include RECIPRO and WaveOne

An extensive literature search demonstrated that no study till date has evaluated the posttreatment pain after instrumentation of root canals with a single-file rotary or RECIPROCatin system. Neelakantan & Sharma (2015) from India reported on a prospective multicentre clinical trial that sought to establish the influence of instrumentation technique (single-file RECIPROCatin or single-file rotary) on posttreatment pain (incidence, degree, and duration).

MATERIALS AND METHODS

640 patients were enrolled into this multicentre trial which involved two centres and two calibrated and experienced operators using a matched pair design.

For inclusion, patients were in the 25–40 year old age group, had two mandibular molars (in different arches) with a diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis, had a positive response on cold testing with ethyl chloride spray; and could tolerate rubber dam placement, had preoperative pain categorized as severe on the modified visual analogue scale (range of 8–10). Patients were excluded if they displayed radiographic evidence of a peripapical lesion, were a retreatment case, were on medication for chronic pain, had teeth with difficult root canal anatomy (curvatures >30°, resorption, radiographic evidence of calcification, or open apices), had two or more adjacent teeth requiring root canal therapy, had more than two mandibular molars requiring root canal therapy, had the presence of sinus tracts or the absence of occlusal contacts or were medically compromised patients.

The clinical and radiographic data of the patients were assessed by a team of three endodontists who were blinded to the experimental protocols. A total of 16 patients were excluded because they did not meet the criteria for inclusion.

A standardised pre-operative technique was used for the initial preparation and the access cavity opening. The tooth was then allotted to one of the instrumentation techniques based on a sealed envelope method by a dental assistant who was blinded to the experimental protocols. The other tooth to be treated was automatically enrolled under the second instrumentation system. Both teeth requiring root canal treatment were treated the same day with a minimum time interval of four hours.

Group 1 (n=624): Root canal preparation was done with the RECIPRO system with strict adherence to the manufacturer’s instructions using 3% sodium hypochlorite (Parcan, Septodont) as the irrigant.

Group 2 (n=624): Root canal preparation was done with the One Shape system (Micro-Mega) following the manufacturer’s instructions. Coronal preflaring was done with Endoflare files, after which the glide path was created. Following this, the One Shape file was used to shape the root canals.

For both systems, the VDW Gold RECIPRO motor (VDW) was used with the appropriate settings as recommended by the manufacturer. While the RECIPRO was operated in the “RECIPRO ALL” mode, One Shape was used at a speed of 400 rpm and 2.5 N torque.

Apical patency was maintained throughout the shaping process using a size 10 K file along with copious amounts of irrigant solution ~3% NaOCl (allowed to remained in canal for 5min after which it was flushed out with saline) and 2mL of 17% ethylenediaminetetraacetic acid (EDTA) solution, which was allowed to remain in the canal for 2min. The EDTA was flushed out with saline and canals were dried with paper points. The roots canals were obturated using gutta-percha points and a mineral trioxide aggregate sealer (MTA Plus) by the warm vertical condensation method. Following radiographic confirmation of the obturation, coronal seal was provided with a high-strength glass ionomer cement (Amalgomer). If any evidence of extrusion of root filling material was noticed radiographically, patients were excluded from the study (n=5). No occlusal reduction was performed.

All patients in the study were given a pain chart to be completed to record the incidence of pain (yes/no), level of posttreatment pain, and duration of pain (days). They were asked to submit the forms after one week. Patients were prescribed an optional medication of ibuprofen (400mg, 8–12h). Patients were asked to record the information if they took the medication. If the patient was
unable to locate the source of pain, they were excluded from the study. A modified visual analogue scale (VAS) was employed for assessment and statistical comparison of pain scores: score 0, absolutely nothing; scores 1–3 (mild), very weak discomfort or mild pain but requiring no intervention and not influencing ordinary activities of daily life; does not require analgesics; scores 4–6 (moderate), moderate pain which is distracting for the patient and occasionally negatively influences the patient from performing his normal daily activities; the pain is relieved with analgesics; scores 7–10 (severe), this score range covered very severe and extremely severe/unbearable pain that forced the patient to give up his/her daily activities and needed rest. This pain is not relieved by analgesics.

RESULTS
The mean age of the patients included in this study was 31 ± 2 years. The number of patients excluded from the analysis because of sealer extrusion was five. Fourteen patients were lost to follow-up, and hence, the total number of patients included in the analyses was 605 (311 males and 294 females, i.e., 51.4 and 49.6%, respectively).

The mean baseline pretreatment pain in the RECIPROC group and One Shape group were 8.9 ± 1.82 and 8.3 ± 1.65, respectively, with no significant differences (P > 0.05).

There was significant difference in the incidence of postoperative pain between the two groups (P = 0.001).

The number of patients who had no pain in the RECIPROC and One Shape group were 507 and 462, respectively. However, for patients who had pain (98 in the RECIPROC group and 143 in the One Shape group), the intensity showed significant difference, with patients in the One Shape group (40.5% of the patients having pain) reporting more values of “severe” pain on the VAS scale compared to the RECIPROC group (P = 0.001). The same 40.5% patients (58 out of 143 patients) also reported having taken analgesics, and this was significantly higher than the percentage of patients in the RECIPROC group (19 out of 98 patients; 19.3%) (P = 0.001).

The percentage of patients having mild, moderate, and severe pain in the RECIPROC group was 71.4, 19.3, and 9.18%, respectively, whereas the intensity of pain in the One Shape group was 22.3% mild, 37.1% moderate, and 40.5% severe. There was significant difference in the number of patients who had mild (P < 0.001), moderate (P < 0.002), and severe (P < 0.001) pain between the two groups. Disregarding the severity of pain, the mean duration of pain in the RECIPROC and One Shape group was 1.37 ± 0.85 and 1.61 ± 1.23 days, and hence, there was no significant difference between the two groups in duration of pain (P = 0.074). However, when duration was related to the severity of pain, there was no significant difference in the duration of postoperative pain between the two groups when the pain was mild (P = 0.301), but One Shape showed significantly longer duration of moderate (P = 0.001) and severe pain (P = 0.002). Of the 98 patients, only 6 patients reported severe pain longer than two days in the RECIPROC group.

CONCLUSION
The authors concluded that the use of RECIPROC instrument system showed significantly less intensity and longer duration of moderate and severe posttreatment pain compared with the single-file rotary system (One Shape) in patients with symptomatic irreversible pulpitis with apical periodontitis.

IMPLICATIONS FOR PRACTICE
This was a clinical trial with a huge sample size which implies that the result reported is not due to chance but to real differences in the interventions tested. The trial results suggest that RECIPROCaition produces less postoperative pain than the single-file rotary system used in this trial.

Reference

ERRATUM
The Editor regrets that an error occurred in the CPD Section in the November 2015 issue. Question Five required ONE answer but there were in fact TWO correct answers.

Details:
5. Identify the incorrect statement.

Procedural sedation is:
- An alternative to GA
- Involves advanced techniques in administering combinations of drugs
- Drug induced depression of consciousness Patient still responds to verbal commands
- May be administered by nurses
- Requires active intervention to maintain the airway

Procedural sedation may NOT be administered by a nurse, nor is intervention required to maintain the airway.

Apologies to all CPD enthusiasts!
CPD Questionnaire

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

GENERAL

Antifungal susceptibility of *Candida albicans* isolated from the oral cavities of patients with HIV infection and cancer. (p 8)

1. The oral cavities of HIV positive patients can be colonized with
   a. *Candida albicans*
   b. *C. albicans*, *C. dubliniensis*, *C. glabrata*, *C. parapsilosis*, *C. tropicalis*, *C. famata*
   c. *C. krusie*, *C. glabrata*, *C. kefyr*
   d. *C. albicans*, *C. parapsilosis*

2. In HIV positive patients, oral *C. albicans* carriage is 30% higher than in normal healthy individuals.
   a. True
   b. False

3. HIV positive patients and cancer patients frequently use fluconazole and therefore resistance to this drug in *C. albicans* isolated from these patients is 30%.
   a. True
   b. False

4. In South Africa, antifungal drug resistance is very low and therefore ongoing surveillance is not required.
   a. True
   b. False

5. In *C. albicans*, cross resistance among azole drugs can occur.
   a. True
   b. False

Dentists’ perceptions on strategic management to ensure a viable dental practice in South Africa. (p 12)

6. Economies of scope arise when activities can be performed more cheaply at larger volumes and from the ability to spread out certain fixed costs over a greater sales volume.
   a. True
   b. False

7. Household debt in South Africa has risen to 75.8% of disposable income in the second quarter of 2013, indicating that a large portion of household income goes to servicing debt.
   a. True
   b. False

8. The percentage of respondents that work between 40-44 hours per week is:
   a. 20.26%
   b. 33.67%
   c. 32.76%
   d. 23.76%
   e. 14.22%

9. To counteract the challenge that disposable income of patients pose, respondents indicated that they do the following:
   a. Educate patients on the value (medical/social) of a healthy/attractive mouth
   b. Charge rates according to patient demographics
   c. Do the best treatment that patients can afford
   d. Do less costly work
   e. All of the above

10. Rising expenses makes it more difficult for solo practitioners to be competitive in the marketplace, and cause people to question whether this practice mode will remain viable in the future.
    a. True
    b. False

Oral health and subjective psychological well-being among South African Adults: findings from a national household survey (p 20)

11. The observed negative association between reporting past dental attendance and OHRQoL was significantly greater among those living in the most deprived areas.
    a. True
    b. False

12. The current investigation found that area-level deprivation is associated with reporting more oral impacts, independent of an individual’s social economic position (SEP).
    a. True
    b. False

13. It is possible that, in the presence of absolute deprivation and competing social needs, oral impacts may be regarded as of great importance.
    a. True
    b. False

The emerging role of epigenetics in the pathogenesis of periodontitis-A review (p 26)

14. Epigenetics is the study of changes in the gene function that can only be explained by changes in the DNA sequence
    a. True
    b. False
15. Abnormal DNA methylation patterns can lead to chromatin condensation, gene silencing and the development of disease.
   a. True
   b. False

16. It has been shown that bacteria can affect the chromatin structure and transcriptional program of host cells by influencing diverse epigenetic mechanisms.
   a. True
   b. False

Maxillo-Facial Radiology Case 137 (p 38)

17. Peripheral odontogenic fibroma occurs posterior to the first molar tooth.
   a. True
   b. False

18. Fifty percent of peripheral ossifying fibroma occur in the incisor/cuspid region?
   a. True
   b. False

Procedural Sedation (p 36)

19. The signs and symptoms of laryngospasm may include: inspiratory stridor, usage of accessory respiratory or abdominal muscles, absence of breath hypoxia and cyanosis.
   a. True
   b. False

20. Basic manoeuvres e.g. jaw thrust, while providing 100% oxygen with a positive pressure mask are usually sufficient to rescue the airway in laryngospasm.
   a. True
   b. False

ETHICAL

Advertising your additional qualifications (p 39)

21. In terms of the Health Professions Act of 1974, a practitioner shall be allowed to advertise his/her services... provided that the advertisement is not unprofessional, untruthful, deceptive or misleading”.
   a. True
   b. False

22. Beneficence refers to doing good and the active promotion of goodness, kindness and charity.
   a. True
   b. False

23. According to the HPCSA guidelines relating to the conditions of practicing as a specialist.
   a. the requirements to be satisfied, including the experience to be obtained, the nature and duration of the training to be undergone and the qualifications to be held by persons before any specialty or category may be registered;
   b. the circumstances under which any applicant for the registration of a specialty shall be exempted from any of such requirements;
   c. conditions in respect of the practices of persons whose specialties or categories have been registered, including conditions restricting the practice of any such person to the specialty or category registered in his or her name.”
   d. All of the above

24. If a sense of fairness does not prevail in the treatment of patients, the principle of autonomy is violated.
   a. True
   b. False

25. From an ethical perspective, the principle of autonomy requires the dentist to:
   a. “Tell the truth”
   b. “Respect the privacy of others”
   c. “Protect confidential information”
   d. “Obtain consent for interventions with patients”
   e. All of the above

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

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

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or via fax to 086 683 0392

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### SATURDAY 19 MARCH 2016

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<td>DAVID GRIER - When the going gets tuff, the tuff gets going</td>
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<tr>
<td>12:00 - 12:45</td>
<td>HOWARD FARRAN - Uncomplicated Business</td>
<td></td>
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<tr>
<td>12:45 - 14:15</td>
<td>LUNCH BREAK</td>
<td></td>
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<tr>
<td>14:15 - 17:00</td>
<td>Dentist &amp; Dental Technicians</td>
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<tr>
<td></td>
<td>DANIELE RONDONI</td>
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<tr>
<td></td>
<td>Bases in morphology for mimetic composite in anterior region; correct form and individual color</td>
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<tr>
<td>19:00</td>
<td>GALA DINNER</td>
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</tbody>
</table>

### SUNDAY 20 MARCH 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture centre 1</th>
<th>Lecture centre 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 - 08:00</td>
<td>REGISTRATION</td>
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</tr>
<tr>
<td>08:00 - 10:15</td>
<td>HOWARD FARRAN - 1 day Dental MBA (Full Day Programme)</td>
<td>NAZARIY MYKHAYLYUK - MicroVision prosthetics. Full mouth reconstruction protocol</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>TEA BREAK</td>
<td></td>
</tr>
<tr>
<td>11:15 - 12:00</td>
<td>HOWARD FARRAN - continue</td>
<td>STAVROS PELEKANOS - Abutment solution for single implants in the aesthetic zone</td>
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<tr>
<td>12:30 - 13:15</td>
<td>SIMONE GRANDINI - Simplicity in direct anterior restorations</td>
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<tr>
<td>13:15 - 14:45</td>
<td>LUNCH BREAK</td>
<td></td>
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<tr>
<td>14:15 - 17:00</td>
<td>HOWARD FARRAN - continue</td>
<td>NUNO SOUSA DIAZ - Orthodontics in Adult Patients - a fundamental piece for an interdisciplinary treatment approach</td>
</tr>
<tr>
<td>18:00</td>
<td>SOCIAL EVENT</td>
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</table>

### MONDAY 21 MARCH 2016 HUMAN RIGHTS DAY

<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture centre 1</th>
<th>Lecture centre 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00 - 09:00</td>
<td>MARK BOWES - Aesthetic Dentistry in the Modern Dental Practice</td>
<td>DESI MOODLEY &amp; ALASDAIR MCKELVIE - 1. Complications of Local Anaesthetics in Dentistry</td>
</tr>
<tr>
<td>09:00 - 09:30</td>
<td>HOWARD GLUCKMAN - Surgical and Prosthodontic development of the single Implant in the Aesthetic zone</td>
<td>ALASDAIR MCKELVIE - Five of the best</td>
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<tr>
<td>09:30 - 10:00</td>
<td>TEA BREAK</td>
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<tr>
<td>10:00 - 10:30</td>
<td>HOWARD GLUCKMAN - continue</td>
<td>GEORGES TAWIL - Chlorhexidine usage</td>
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<td></td>
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<td>1. Ethological treatment (how to manage acute phase)</td>
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<td>2. And supportive care phase on going</td>
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<tr>
<td>10:30 - 11:30</td>
<td>JOHN BRONNER - New concepts for implant-supported crowns, what have we learnt from our successes and failures</td>
<td>ANNE O'CONNELL - Advances in Paediatric Dentistry - aesthetic crowns</td>
</tr>
<tr>
<td>11:30 - 12:30</td>
<td>BRUNCH BREAK</td>
<td></td>
</tr>
<tr>
<td>13:15 - 14:00</td>
<td>NAZARIY MYKHAYLYUK - Use of ceramic veneers. Aesthetic upgrade</td>
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<tr>
<td>14:00 - 14:45</td>
<td>STAVROS PELEKANOS - Ceramic Veneers and onlays. How the development of materials and techniques has changed contemporary prosthodontics</td>
<td></td>
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<tr>
<td>14:45 - 15:00</td>
<td>LUCKY DRAW CLOSE</td>
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</tbody>
</table>

A comprehensive programme overview available at www.sadacongress.co.za
A fantastic learning opportunity awaits the dental profession

Conference & Exhibition 19 - 21 March 2016

The South African Dental Association presents:

Venue
Gallagher Convention Centre
Midrand, Johannesburg

Organiser
South African Dental Association

Scientific Contributors
Mark Bowes, Howard Gluckman
Paul van Zyl, Mark Wertheimer,
Nadeem Osman

Enquiries
Website: www.sadacongress.co.za
E-mail: congress@sada.co.za

CPD points:
20 Clinical & 2 Ethical

Speakers
Ulundi Behrtel
Jonathan Blake
Mark Bowes
Paul Brandt
John Bronner
Imran Cassim
Nuno Sousa Dias
Howard Farran
Carlo Ferretti
Jameel Gardee
Simone Grandini
Howard Gluckman
David Grier
Paulo Kano
Lizelle Loock
Tony Mc Collum
Alasdair McKelvie
Nadia Mohamed
Desi Moodley
Rajeshree Moodley
Nazariy Mykhaylyuk
Anne O’Connell
Jeanne Oosthuysen
Jon Patricios
Stavros Pelekanos
Maria Phalime
Erich Raubenheimer
Daniele Rondoni
Errol Stein
Charlotte Stilwell
Georges Tawil
Nic van Reede van Oudthoorn
Sybrandt van Reede van Oudthoorn
Mark Wertheimer
Livio Yoshinaga

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