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There has been enough time after the 2016 Congress to reflect on the multi-faceted structure that is demanded in the building of such an enterprise. From the first conceptual foundation to the final realisation of the last idea, it is a work of inspiration. The Organising Committee led by Marilize van der Linde is warmly congratulated on their achievement. And yet the Congress never actually ends, for the messages received are carried beyond and into practice by the delegates, thereby enhancing South African dentistry. It is always intriguing to view the programme dispassionately. We are after all a small profession, dealing intensely with a small focus of attention. BUT, stand back a little, take the open view and there will develop a clear realisation of just how broad and deep and infinite are the implications of our responsibilities in caring for our patients. One of the more important responsibilities lies in the selection of the information offered. As independent practitioners it is open to our choice as to what changes we may effect post-Congress … that procedure so well outlined by the lecturer in Hall A… or that guidance detailed by the eloquence in Hall B? That is the quintessential essence of Congress attendance. Contrary opinions, differing approaches, controversy and contradiction. Of considerable fascination was the observation that at one side of the 2016 Congress venue a lecturer was extolling, with wonderful evidence, the benefits of working with microscopes, whilst at the other end and with impressive energy and humour, another presenter was challenging the rationality of using such advanced, complicated .. and expensive, equipment! Delegates could select……. and determine to some extent how their practices may then evolve.

Every issue of the Journal is a microcosm of a Congress. The reader may elect to read (attend) a paper of particular interest ..or may wish to explore a new focus. The net effect is the same… determine and consider the data , decide how this may be applicable to daily practice. So when the Journal presents papers on the more abstruse topics in Dentistry, these are no less of import than an explicit clinical guideline. In this issue, a paper dealing with the relative penetration of hydrogen peroxide in endodontics has immediate clinical impact… considering the expanded role of the cells rests of Malassez will contribute to an understanding of the biology of our field and enhance respect for the complexities of the tissues on which we rely to ensure healthy mouths.

Are we blessed …or cursed… with the imperative to constantly seek new knowledge?

Dentistry raises enquiries in even the most bizarre of circumstances. Residing close to Hoedspruit are two famous living things… Jessica the Hippo and a 2000 year old Baobab tree. They are linked, somewhat tenuously, by both having the term ‘pachy’ in their scientific references.. pachyderm.. ‘thick skin’ for the hippo, pachypodia –‘thick leg’ for the tree.

Whilst the Baobab may best be known for its ‘upside down’ appearance when in winter the bare branches resemble nothing so much as a complex system of roots (the upside down tree), Jessica Hippopotamus allows human contact to the extent of a kiss on the nose!! She has been living with her human hosts these past many years and shows every sign of extreme contentment with her life! BUT she has a malocclusion!! The upper lateral incisors are distally tipped! In fact this discrepancy does allow greater confidence when she is being fed by hand, for there is a gap in the occlusion through which a tasty sweet potato disc may be tossed! The etiology of the displaced laterals is obscure. But the biologic principles of orthodontics would apply equally well to hippopotamus amphibius as to sapiens homo. There would be one most relevant factor… the hippo canines and incisors are open pulp teeth and grow continuously, occlusive abrasion keeping them within bounds, and in the case of the canines, extremely sharp!! So, a challenge to research.. do open pulp teeth actually respond well to tooth moving forces?? (Dilaceration is the likely result.) .

There is always some dental stimulation, whether in oscillatory contact with a hippo… or in intellectual contact with erudite visiting lecturers at a Congress. Either way, continuous growth in the discipline is ensured.
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“The cell rests of Malassez” has always had a rather romantic ring to it. many would agree. Itconjures up an image of convivial cells warmly snuggling as they take their leisure after completing a good job! And almost certainly this takes place on an island paradise!

Reality triumphs, however, and the cells are unequivocally called into vigorous action ….. none of this resting, if you please. This harsh practicality is explored in the opening paper this month. Recent work has revealed that the homeostasis of the periodontal membrane is a prime responsibility of these gatherings of cells. Research has “elucidated their functional role in maintaining the periodontal ligament at a constant width and also their role in regeneration of periodontal tissues.” Present in the cells are bone resorbing factors, growth factors, chemokines and related proteins associated with bone remodelling. Osteopontin and bone sialoproteins are secreted by the cells of Malassez in the root region of mature and developing teeth, and regulate mineralization. These cells are most active metabolites!

A fanciful, but defendable, analogy may be drawn with our Chairside Assistants who for many years have been an integral part of Dental Practice, quietly supporting the delivery of dental care but without holding a defined role. Perhaps they too have been “hiding their lights under a bushel”??? …. or should it be, at least for cell rests, under the basement membrane?? Chairside Assistants are absolutely integral to most dental practice, whether private or institutional.

Let’s take advice from Seneca the Younger and reflect back a little to a study undertaken by Nemutandani and submitted as a Research Report in 2007. An investigation was conducted by circulating a questionnaire to 73 dental assistants who were employed in Limpopo Province. At that time there were 38 public hospitals in the area with dental facilities. Almost half of the respondents (49.1%) were untrained assistants, 22% were auxiliary nurses, 18.6% were “correspondence-trained” assistants who had been trained via distance learning and had no practical clinical training. Only 10.2% of the respondents had received training at a technikon or university. (Note: The HPCSA still appears to be
set on recognising only Dental Assistants who have been trained at an accredited Technikon or University.) More than 90% of the dental assistants employed in public hospitals of Limpopo Province in 2007 had received no formal training in their occupation.

These untrained assistants reported the highest percentage (65%) of sharps injuries (either one or more than one injury reported). Almost two-thirds (65%) of untrained assistants reported one or more occupational blood exposure in the previous six months. About 45% of the distance-trained assistants reported experiencing one or more occupational blood exposures in the previous six months, while 9% had experienced five or more exposures. Almost two-thirds (65%) of untrained assistants reported one or more occupational blood exposure incidents in the previous 6 months.

Perhaps these were amongst the data that persuaded the Health Professions Council that there was a need to regulate and standardise the training of Dental Chairside Assistants. The relevant criteria, as is well known, were to be determined by the Minister.

Progress has been erratic over the intervening years, and as explicitly detailed in SADA Communique 2016 015, dispatched on 22nd March, there is still no finality on the draft regulations which will govern the role and scope of these team workers. However the deadline of 31st March for registration still stands.

Now, explore the latest documents and statements about the National Health Insurance scheme (Version 40, 10th December, 2015)… repeated reassurances are made that this far reaching health measure will be introduced.. yet the documents contain sparse details on Oral Health and leave the Oral Care Team floundering uncertainly, their future perhaps in the balance.

What is our reference? Globally, oral disease affects most adults and as many as 90% of schoolchildren. Oral diseases are a significant burden on overall health, with the greatest burden falling on disadvantaged and poor populations. The principal problems are: dental caries, periodontal diseases and oral cancer. - FDI released the second edition of its Oral Health Atlas at the 2015 Annual World Dental Congress in Bangkok, Thailand. The new edition, called The Challenge of Oral Disease – A call for global action, serves as an advocacy resource for all oral healthcare professionals and anyone with an interest in oral health.

The Atlas highlights the extent of oral diseases worldwide and reflects on policies and strategies addressing the global burden. It presents a summary of key oral health issues – including
  • the impact and burden of oral diseases, such as tooth decay, periodontal disease, oral cancer and more;
  • major risk factors and the common risk factor approach;
  • inequalities in oral health;
  • oral disease prevention and management;
  • oral health challenges; and
  • ensuring oral health is on the global health and development agendas.

Consider this fact… Dental Decay is the most prevalent disease factor affecting the most number of people.. estimated at 3,054 million worldwide. Next in frequency comes Migraine headaches (1,013 million) then, to be noted, Severe Periodontal Disease at 743 million, followed by Diabetes (549 million) and Asthma (334 million).


**Oral Disease is a problem!!**

The world, including South Africa, recognized Oral Health in the FDI sponsored World Oral Health Day on 20th March.

(See more at: http://www.worldoralhealthday.com/global-celebrations-for-a-smile-for-life-on-world-oral-health-day/

The Dental Association has consistently, vigorously and with integrity promoted concepts directed at enhancing oral health . Included in these activities are the endeavours to secure recognition for the profession and all the Oral Health Care team. And yet....

Is there a sense of paradox in these juxtapositioned facts...yes, there are telling statistics and relevant comparisons.. yes, there are declared intentions and plans.. and yet oral care and the profession carrying responsibility for that care seem to relegated to the traditional concepts of the cell rests of Malassez….a quiet and unobtrusive cluster!. Why not release the true strength of the profession?
Epithelial cell rests of Malassez: from quiescent remnants to front-runners in periodontal homeostasis and regeneration. A brief review

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HD Miniggio¹, EJ Raubenheimer²

ABSTRACT
In recent years, research has been directed towards elucidating the physiological role played by the epithelial cell rests of Malassez within the periodontal ligament and surrounding alveolar bone. These unique structures were, for many years, considered to be quiescent remnants of development, but are now emerging as key role-players in the maintenance of periodontal health and are also implicated in bone resorption through secretion of bone resorption mediators. Reviews on this topic are infrequent in the dental literature and the notable advances regarding the cytokine profile of the epithelial cell rests of Malassez and their autocrine and paracrine roles in the periodontal tissues make it opportune to review their physiological roles in maintaining periodontal health. Furthermore, experiments have established that epithelial cell rests of Malassez contain stem cells that can undergo epithelial-mesenchymal transitions, placing these cells at the centre of periodontal regeneration.

Key words: epithelial cell rests of Malassez, epidermal growth factor, periodontal homeostasis, periodontal regeneration, paracrine signaling, bone remodeling

METHODS
A literature search was performed on 17th February, 2015, using the term “epithelial cell rests of Malassez” which produced 159 results. From these results, articles were selected that were in English, dating from 1817, and were related to this review. A total of 23 articles were selected and included in the reference.

INTRODUCTION
A thorough understanding of the biological basis of maintenance of periodontal health is indispensable to many aspects of clinical dentistry in order that adequate dental treatment may be provided. Epithelial cell rests of Malassez (ERM) are integrated in the periodontal ligament and have been found to secrete several growth factors, cytokines, chemokines, adhesion molecules and associated proteins.¹ We present here recent advances regarding the characterization of the cytokine profile of ERM which validates their important function in periodontal ligament homeostasis with an emphasis on their role in alveolar bone remodelling. We also highlight the capacity of ERM to undergo epithelial-mesenchymal transitions, which indicates their involvement in periodontal regeneration.

Epithelial cell rests of Malassez were first described by Augustin Serres in 1817.² Later Louis-Charles Malassez provided a full description of their morphology and distribution in 1884 and noted that these epithelial cells persist to form part of the adult periodontal ligament.³ Epithelial cell rests of Malassez are characterised as bundles of epithelial cells with darkly stained nuclei that are arranged as an interconnected network throughout the periodontal ligament (Figures 1 and 2).

Epithelial cell rests of Malassez originate from the degeneration of Hertwig’s epithelial root sheath to form quiescent cell rests that persist as the sole epithelial cells in the periodontium.⁴ For many years following their discovery they were considered inert remnants with little or no physiological role in the periodontal ligament.⁵ More recent experiments have elucidated their functional role in maintaining constant the width of the periodontal ligament and their additional role in the regeneration of periodontal tissues.⁶ Characterization of the cytokine profile of ERM have brought to light important bone resorbing factors, growth factors, chemokines and related proteins which are directly implicated in the process of bone remodelling.⁷ Furthermore, adhesion

ACRONYMS
EGF: Epidermal growth factor
ER: Epithelial cell rests of Malassez
MCP₁: Monocyte chemoattractant protein-1
M-CSF: Macrophage-colony stimulating factor
OPG: Osteoprotegerin protein
RANK: Receptor activator of nuclear factor kappa-B
RANKL: Receptor activator of nuclear factor kappa-B ligand
TGF-β: Transforming growth factor beta
TNF: Tumour necrosis factor
TRAF 6: TNF receptor-associated factor 6

¹ Hilde Doris Miniggio: BDS, MSc. Unit 5 Oral Biology, Sefako Makgatho Health Sciences University, Oral Health Centre, Setlogelo Drive, Ga-Rankuwa.
² Erich Johann Raubenheimer: PhD, DSc. Unit 2 Oral Pathology, Sefako Makgatho Health Sciences University, Oral Health Centre, Setlogelo Drive, Ga-Rankuwa.

Corresponding author
Hilde Doris Miniggio:
P.O. Box 3323, Molekwa, Pretoria. Tel: 012 521 4882,
Fax: 012 521 4274, Cell: 072 869 4045, E-mail: hilde.hendrik@smu.ac.za

1. Hilde Doris Miniggio: BDS, MSc. Unit 5 Oral Biology, Sefako Makgatho Health Sciences University, Oral Health Centre, Setlogelo Drive, Ga-Rankuwa.
2. Erich Johann Raubenheimer: PhD, DSc. Unit 2 Oral Pathology, Sefako Makgatho Health Sciences University, Oral Health Centre, Setlogelo Drive, Ga-Rankuwa.
molecules such as osteopontin and bone sialoproteins which regulate mineralization, are secreted by ERM in the root regions of mature and developing teeth. These considerations have led to the postulate that one of the principal roles of ERM in the periodontal ligament involves paracrine signalling to the surrounding alveolar bone. This would explain their role in maintaining a constant periodontal ligament space and would also explain their proliferation and implication in induced tooth movements.

Bone is a metabolically active specialized form of connective tissue that undergoes continuous remodelling through a tightly regulated interaction between two equivalent and opposing events, specifically, bone resorption of pre-existing bone by osteoclasts, followed by new bone formation by osteoblasts. Bone matrix contains primarily type I collagen and in lesser amounts type V collagen which together constitute approximately 90% of the total bone matrix proteins. Following completion of bone formation, a physiological process known as bone remodelling is responsible for maintaining bone mass, for the repair of fractures as well as sustaining calcium and phosphorous homeostasis. The successive bone-degradation and bone-formation sequence and the observation that under physiological conditions bone mass is kept constant, has led to the postulate that the two opposing processes regulate each other. Current understanding of the process of osteoclastogenesis stems from extensive studies of the interactions between several ligands and cell surface receptors.

### RANKL/RANK EXPRESSION IN OSTEOCLASTS AND OSTEOBLASTS

Macrophage-colony stimulating factor (M-CSF) and several transcription factors are required for the final transformation of haematopoietic stem cells to osteoclasts. Formation of osteoclasts is dependent on the receptor activator of nuclear factor kappa-B ligand (RANKL), the osteoclastogenic cytokine, which belongs to the tumour necrosis factor (TNF) superfamily and which is produced by various cell types including osteoblasts, osteocytes as well as lymphocytes. Receptor activator of nuclear factor kappa-B (RANK) is the cell bound receptor for RANKL found on the surface of preosteoclasts. Binding of RANKL to its receptor RANK initiates a series of signalling pathways that are mediated by TNF receptor-associated factor 6 (TRAF 6). Osteoblasts control osteoclastogenesis through the secretion of osteoprotegerin (OPG) protein which is also a member of the TNF receptor superfamily and is identical in structure to the extracellular domain found in RANK, thereby acting as a decoy receptor by binding directly to RANKL and inhibiting osteoclast activation and bone resorption (Figure 3).

### ERM AND BONE REMODELLING

Epithelial cell rests of Malassez have the ability to maintain their structure within the periodontal ligament through the constant release of a polypeptide known as epidermal growth factor (EGF). Epidermal growth factor was identified by Stanley Cohen in 1962 and has been associated with odontogenesis and tooth eruption. Epidermal growth factor represents a mediator for cell differentiation, proliferation and cell growth. The receptor for this growth factor (EGFr) is made up of transmembrane proteins that activate tyrosine kinase intracellularly and trigger cellular events that lead to cell division that explains their role in regeneration of periodontal tissue. Epithelial cell rests of Malassez are able to proliferate and to sustain their structure through autocrine signalling by the constant release of EGF that is responsible for their growth and integrity.

Epidermal growth factor released by the ERM is directly implicated in osteoclastogenesis and hence bone resorption through the inhibition of osteoprotegerin (OPG), a well-established decoy receptor for RANKL. Concomitantly EGF enhances the expression of monocyte chemoattractant protein-1 (MCP1) due to the proximity of ERM to surrounding alveolar bone and the continuous secretion of EGF which will have a resorptive effect on the adjacent alveolar bone with the net effect of alveolar bone remodelling in order to maintain the periodontal ligament space at a constant, that is approximately 0.25 mm.
The connective tissue that separates ERM from adjacent bone cells is believed to provide the essential dilution site for EGF, preventing this polypeptide from reaching the EGF receptors on bone cells in high concentrations thereby avoiding excessive bone resorption. It is interesting to note that the junctional epithelium, the sulcular epithelium and the connective tissue attachment of the tooth are kept at a constant remove away from the alveolar bone crest, otherwise known as the biological distance. It is believed that this serves as the metabolism site for EGF as this polypeptide is only able to interact with its receptors on bone cells for a limited time and a minimum of one quarter of the receptors are required to be activated in order for EGF to have resorbing effects on the alveolar bone. This also clarifies why an operative or restorative procedure that impinges upon the biological distance will cause resorption of alveolar bone crest, due to the higher concentration of EGF that reaches the bone cell receptors. The junctional epithelium proliferates and migrates apically following the operative or restorative procedure and releases EGF in order to maintain its structure. This migration of the junctional epithelium increases the concentration of EGF in the micro-environment of the alveolar bone crest thereby causing bone resorption.

Epithelial cell rests of Malassez have also been shown to proliferate when stimulated by induced tooth movements. The proliferation of ERM increases the amount of secreted mediators, particularly EGF that induces bone resorption as well as the renewal and reorganization of the cells within the periodontal ligament including cementogenesis on the resorptive tooth surface. Experiments have demonstrated that Hertwig’s epithelial root sheath, under the influence of transforming growth factor beta (TGF-β), is capable of undergoing epithelial-mesenchymal transition. Furthermore, evidence suggests that ERM contain a subpopulation of stem cells which are capable of undergoing epithelial-mesenchymal conversion into mesenchymal stem-like cells with multi-lineage potential. These multi-potent epithelial stem cell populations have the potential to differentiate into, amongst others, osteoblasts, adipocytes and chondrocytes, and have been shown to be implicated in cementogenesis. These epithelial-mesenchymal conversions provide a supply of progenitor cells that have the capacity to migrate to sites of injury and thus play a pivotal role in the induction of periodontal regeneration.

In the absence of EGF release, ERM would lose their ability to self-stimulate and maintain their structure within the periodontal ligament. In addition, paracrine signalling through the secretion of mediators of bone resorption would not take place, impacting on the process of bone remodelling around the tooth and leading to the tooth assuming the traits of ankylosis. Therefore, the persistence of ERM in the periodontal ligament is essential to the maintenance of periodontal homeostasis.

**CONCLUSION**

Epithelial cell rests of Malassez are functional components of the periodontium that fulfil key physiological and regenerative functions to ensure periodontal integrity. These include:

- Prevention of the formation of alveolodental ankylosis by constantly secreting bone resorptive mediators thereby preventing mineralisation of the periodontal ligament;
- Participation in the process of periodontal regeneration by providing a stem cell supply which can migrate to sites of resorption and injury and stimulate cementogenesis;
- Participation in tooth movement by increasing EGF production in periodontal tissues and helping to repair root resorption areas while stimulating cementogenesis.

Due to the numerous physiological and regenerative functions that ERM perform within the periodontal ligament, the authors suggest that the current nomenclature of epithelial cell “rests” should be replaced by the term epithelial “network” in order to emphasize the central role that these cells play in the homeostasis of the tooth supporting apparatus.

**Acknowledgement**

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SA dentists receive certification by World Clinical Laser Institute

At the 2-day International Laser Dentistry workshop held recently at Melrose Arch Johannesburg, 38 leading South African dentists received international Certification from the The World Clinical Laser Institute and Germany’s Aachen University Dental Laser Centre. Hosted by SciVision, importer of Biolase dental laser technology, and guest speaker – internationally acclaimed author and President of the World Laser Dentistry Federation, Professor Norbert Gutknecht, the workshop delivered superlative international pedigree to the local dentals. Skills gained at the workshop are now poised to bring advanced, pain reduced dental treatment to South African consumers.

Prof. Gutknecht comments, “With more than 25 years’ laser research experience, I am excited to share my dental laser knowledge with leading South African dentists, and in turn, your public. I highly appreciate the fact that SciVision is so strongly focussed on education it’s dentists on the latest trending technology.

The most important aspect of laser dentistry is having an adequately qualified dentist to use a laser on a patient, in a successful way. For the South African market, laser dentistry offers reduced pain during treatment, stimulated treatment of children who are normally afraid of dentists, while giving practitioners the ability to treat all patients with less pain.

In infectious cases, lasers have a high disinfecting potential - enabling dentists to treat a wider variety of patients which they would not have been able to treat with conventional methods. Our intention is to use lasers as an integrative dental tool so as to improve the overall outcome of general dentistry, paediatric dentistry, orthodontics, periodontology and surgery. South Africa is the ideal market to focus on the use of dental lasers as it has dedicated, highly skilled and progressive dentists in good facilities. I’m optimistic that South Africa will soon be the strongest in the world in terms of using lasers in dentistry.” (Interview with Prof. Gutknecht - https://www.facebook.com/scivision/videos)

Rhoadie Garrana – WITS University: Department of Oral Medicine & Periodontology says, “It was a great privilege being able to spend two days with Professor Gutneikcht from Aachen University where he shared the advantages of incorporating laser Technology into the field of Dentistry. I believe the Waterlase and Epic laser have the potential to become valuable adjuncts in various dental fields where they provide management options as well as disinfection and healing promotive properties. The technology available has opened up a door to a new realm waiting to be explored. The literature has so far been promising and the course highlighted the potential of incorporating laser therapy into day to day therapy. This technology is rapidly progressing and I have no doubt that it will become an invaluable tool in the future of dentistry. Thank you Scivision for a great opportunity.”

According to Peter Doubell, CEO of Scivision, laser technology is an essential tool for innovative dental practitioners wishing to treat patients in a modern and pain reduced manner. Doubell infers that lasers enable new dental treatments and operating methods, as well as complementing and supporting existing therapeutic dental methods. “With patients increasingly seeking alternative therapies, our Biolase dentists can meet these expectations by providing patients with less invasive solutions with added benefits when compared to more traditional methods,” he says.

Dr Preshaylin Govender adds, “I had the privilege of attending the prestigious Scivision workshop which was a great learning experience which I have already applied to my practice with great success. The lectures given by Prof. Gutknecht were of high calibre - his professionalism and 25 years of laser research knowledge reminded us that practicing with lasers drives practitioners to achieve dental results on a higher level.”

Dr Herman Botha adds, “As new dental laser user I was thrilled at the opportunity to attend the course with Professor Gutknecht. His depth of knowledge on biophysics and laser treatments was simply outstanding. I am inspired and have more confidence and understanding in treating my patients using laser.”

For more information on Scivision and Biolase technology, visit http://www.scivision.co.za or visit www.biolasedentist.co.za for a list of Biolase dentists countrywide.
Penetration of hydrogen peroxide into the pulp chamber after conventional and laser-assisted bleaching

ABSTRACT

Background: Bleaching is a conservative approach to improve tooth colour. Laser irradiation accelerates the process by activating the hydrogen peroxide (HP) bleaching agent. However, there is little data examining whether this might result in pulp injury by enhancing HP penetration and diffusion. This study measured HP penetration into the pulp chamber with different bleaching techniques.

Methods: Fifty extracted central maxillary incisors were collected, disinfected, root treated and stored in sterile saline solution. The pulp chambers were filled with an acetate buffer solution. Bleaching was performed with one of four methods: 1. Conventional in-office bleaching; and accelerated bleaching using 2. Neodymium:yttrium-aluminium-garnet (Nd:YAG), 3. 1w Diode, and 4. 1.5w Diode lasers. A fifth control Group received no treatment. The buffer solution was drained and stained by colourimetric spectrophotometry to determine optical densities, which were analyzed by one-way ANOVA followed by Tukey honest significant difference (HSD) test.

Results: The greatest penetration occurred with the conventional in-office bleaching procedure (2.232 ± 0.39μg), while the least was seen with Diode (1w) laser-assisted bleaching (0.31 ± 0.28μg). Conclusion: Provided the manufacturer’s recommendations are followed, laser acceleration does not exacerbate penetration of HP into the pulp chamber.

Key words: hydrogen peroxide, tooth bleaching, Nd:YAG laser, Diode laser

INTRODUCTION

Bleaching is a simple, conservative, non-invasive, and inexpensive way of lightening tooth colour, and is a popular way of enhancing beauty and youthfulness. New methods and materials are currently being developed and introduced.

Bleaching may either be done in-office or at home by the patient. Hydrogen peroxide (HP) at a concentration in the range of 10%-40% or other chemicals capable of producing HP (e.g., carbamide peroxide, sodium perborate) are most commonly used to oxidize organic materials, inducing tooth colour change. Perhydroxyl radicals can break down large compounds into simpler molecules, with weaker light reflecting properties, thus giving a brighter appearance to the teeth. About 30%-35% HP application for up to 30min is considered standard in order to minimize any surface changes to the enamel. Bleaching gels should have a ph of...
9.8–10.5, which enhances perhydroxyl radical production while reducing reactive oxygen radicals.7

Power bleaching is one approach that contributes to the efficacy of bleaching procedures.8 This method was pioneered by Abbot, who used high-intensity light to accelerate the whitening process.9 This was later followed by other acceleratory methods.10,12 The application of laser light, specifically 810 or 980nm Diode laser, and Nd:YAG with 1064nm wavelength, has been found to possess photochemical whitening effects.13

Two theories are proposed to explain the action of light on bleaching efficacy: (1) light and heat might accelerate HP breakdown14,15 and (2) light and heat might facilitate HP penetration into tooth structure.16

According to these theories, the laser-accelerated bleaching methods may encourage more HP penetration into pulp, which would induce oxidative stress,17 inhibition of pulpal enzymes,18 inflammatory pulp reaction,19 and subsequently postoperative dental hypersensitivity.20

The present study aimed to quantify the penetration of HP into the pulp chamber during different in-office bleaching methods, including laser-accelerated approaches.

MATERIALS AND METHODS

Fifty central maxillary human incisors were collected during a three-month period. They had been extracted due to periodontal problems, and all patients had provided informed consent to their use. Teeth were cleansed of soft tissues and calculus; and the absence of cracks, abrasion, or defects was verified by stereomicroscope (Nikon, SMZ800, Japan). The specimens were soaked in saline solution until required.

Using a separating disk (Shofu, Japan), the root of each specimen was truncated 2mm apical to the cemento enamel junction (CEJ). Pulp chambers were cleaned using headstrom files (Maillefer, MI, USA), irrigated with saline, and then widened using a round bur to allow micro-pipette access.

A standard size (4 × 6mm) area was marked on each tooth surface by applying two coats of nail varnish to the surrounding surface.

After drying the pulp chambers with paper cones, the specimens were fixed vertically on a wax plate. A micro-pipette was used to place 50μl of acetate buffer solution 2M (pH 4.5) into each pulp chamber. This solution served to stabilize any HP penetration into the pulp chamber.21–25

The 50 specimens were subdivided at random into five Groups of 10 teeth each.

Group A: Conventional in-office bleaching

The bleaching gel Opalescence Boost PF (40% - Ultradent Products Inc., South Jordan, UT, USA) was applied as a 2mm layer on the marked-out area. After twenty minutes, the acetate buffer was extracted from the pulp chamber by micro-syringe for examination/analysis.

Group B: Nd:YAG laser-assisted bleaching

The bleaching gel was applied as a 2mm layer on the marked-out area. Two minutes after application of the gel, Nd:YAG laser (Fotona, Slovenia, Fidelis - 1064nm, 2.5w, 25Hz) irradiation was administered using a 320μm fiber, for three exposures of 30 seconds each, with 1min between each laser application. Three minutes after the last laser treatment, the acetate buffer was extracted. Hence the total time of bleaching was 8min and 30sec which was in accord with the manufacturer’s instruction.

Group C: Diode (1w) laser-assisted bleaching

The bleaching gel was applied as a 2mm layer on the marked-out area. Two minutes after application of the bleaching gel, Diode laser (Wuhan, gigga model: DEN7A, China- 810nm, 1w, continuous wave) irradiation was administered using a 4mm fibre, in the same way as for Group B, resulting in a total time of bleaching of 8min and 30sec.

Group D: Diode (1.5w) laser-assisted bleaching

The same procedure was followed for Group D, but using a 1.5w power Diode laser. Again the total time of bleaching was 8min and 30sec.

Control Group: No bleaching treatment

Specimens underwent no treatment; the buffer solution was extracted for testing after 20min.

For each tooth, the extracted solution was transferred into a micro-tube. The pulp chamber was then irrigated twice with 50μl distilled water, and that 100μl was also transferred to the tube. One hundred micro litres of 0.5mg/ml leuco-crystal violet (Aldrich; Sigma-Aldrich Chemie GmbH, Steinheim, Germany) and 50μl of 1mg/ml horseradish peroxidase enzyme (Sigma; Sigma Chemical Co., St Louis, MO, USA) were added to the micro-tube, which was then filled with 2700μl distilled water, bringing the contents to 3ml volume. The process was followed for every specimen. The resulting blue solutions were examined with an UV-visible spectrophotometer (Novaspec 2, Pharmacia) at a wavelength of 596 m at room temperature, to measure the optical density (OD).26 The ODs which were obtained were then converted to micrograms using the spectrophotometer calibration curve, which was drawn up from the values resulting from spectrophotometer evaluation of different HP concentrations. The results were analyzed with one-way ANOVA, followed by Tukey’s HSD test for pairwise comparison between Groups.

RESULTS

The deepest HP penetration was observed in Group A (2.232 ± 0.39μg) while the lowest values were observed in Group C (0.31± 0.28μg) (Table 1).

Table 1: Means and standard deviations of hydrogen peroxide penetration in the four Test Groups and the Control Group.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Mean pulp chamber H₂O₂ (μg ± SD)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A: Conventional bleaching</td>
<td>10</td>
<td>2.23 ± 0.39</td>
<td>1.60</td>
<td>2.76</td>
</tr>
<tr>
<td>Group B: Nd:YAG laser activation</td>
<td>10</td>
<td>1.16 ± 0.47</td>
<td>0.61</td>
<td>1.94</td>
</tr>
<tr>
<td>Group C: Diode 1w laser activation</td>
<td>10</td>
<td>0.31 ± 0.28</td>
<td>0.01</td>
<td>0.94</td>
</tr>
<tr>
<td>Group D: Diode 1.5w laser activation</td>
<td>10</td>
<td>0.40 ± 0.24</td>
<td>0.17</td>
<td>0.88</td>
</tr>
<tr>
<td>Control Group: untreated</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
The amount of HP that had entered the buffer solution of the control Group was negligible (0.001µg) on the spectrophotometer absorption curve; this was deemed to be due to mild contamination in procedural errors and was considered as zero.

A statistically significant difference was found between each pair of study Groups (P < 0.001) except for Groups C and D (P = 0.954) (Figure 1).

The highest HP penetration was observed in Group A. This might be the result of the extended bleaching gel application time, allowing more penetration into dental structures, and inducing a destructive effect on dental structure that further increases permeability.

The present findings are in agreement with other studies that have reported that application of Nd:YAG or LED laser during the bleaching process increased HP penetration as compared with their control Group which received no activation protocol. The bleaching gel application period was the same in the three test Groups in their study, making the results clinically irrelevant, because the purpose of activating agents is to achieve better results in a shorter time.

Another finding was that HP penetrated to a greater extent in the Nd:YAG laser Group. This laser is reported to be capable of greater activation of the bleaching gel, due to the fact that its wavelength is higher than that of the Diode laser (1064 vs. 810–830nm), which reduces its penetration depth but allows absorption in the bleaching gel. Most of the laser energy therefore heats the gel, resulting in higher HP release. Pulpal penetration may therefore be expected. However, 1w and 1.5w Diode lasers did not significantly alter the penetration rates, showing that, at those wavelengths, altering the laser power has little significance.

Haywood showed that 35% HP can reach the pulp tissue within 15 min, a finding similar to that found in this study.

DISCUSSION

One of the common complaints after bleaching treatment is tooth sensitivity. It has been suggested that this might be the result of HP penetration through the pulp chamber or due to an increased temperature of the pulp during power bleaching. HP might cause the release of inflammatory mediators and stimulate sensory nerves. It thus appears to be of importance to select a method that minimizes HP penetration into the pulp.

Recently, many activating methods have been introduced for in-office bleaching, in order to achieve better results in shorter times. These include laser irradiation. However the safety of such methods is not clear.

The lasers used in the present study all operate in the infrared spectrum, and possess photochemical properties. It is obvious that the bleaching gel must contain pigments and therefore Opalescence Boost PF, which contains red pigments in the form of carotene, was selected. The time of gel application for each Group was the minimum time recommended by the manufacturers. Although the manufacturers declare that activation of the bleaching gel, as applied in this study, is not necessary, research has shown that the use of a Diode laser or LED light enhances the gel’s whitening effect, reducing the duration of treatment.

According to physical laws, the amount of diffusing substance depends directly on the surface area through which it can diffuse, and, inversely, on the diffusion distance. Consequently, application areas of equal surface area were outlined with nail polish, and teeth of the same size were selected for inclusion in the study.

Many different spectrophotometric methods have been used to quantify the amount of HP in micrograms. The leuco crystal violet (LCV) method is fast, simple, and sensitive. It is based on oxidation reaction of LCV buffer solution in the presence of HP and horseradish peroxidase as a catalyst. The crystal violet ion forms a blue solution that absorbs at 590 nm and remains stable for several days. HP was detected in the pulp chambers of all bleached Groups. This is in accordance with other studies. Hard dental tissues have a high degree of permeability. HP penetrates dental tissues as it has a low molecular weight, in addition to the ability to denature proteins and replace ions, which amplifies the depth and amount of penetration.

The present in vitro study, obviously, merely offers a possible window into what might happen in vivo, which has yet to be clarified. There are at least two possible in vivo mechanisms that could act to stop the penetration of HP molecules, namely: positive pulp pressure and the osmotic pressure of the bleaching gel. In addition to these possibilities, vital pulp possesses defense systems that protect it, including the enzymes peroxidase and catalase, which would be beneficial if HP molecules succeeded in reaching the pulp tissue. Moreover, according to Bawles et al., for HP to have a negative impact on pulp enzymes, its concentration must reach 50000 µg. Among the possible negative side effects of HP penetration into the pulp, only reversible side effects, for example sensitivity, have been reported.

CONCLUSION

This study appears to show that, provided the manufacturer’s recommendations are followed, using laser activation for bleaching will not result in increased HP penetration into the dental pulp system.

Acknowledgments: Thank you to Benedicenti Stefano and Angiero Francesca, University of Genoa, Department of Surgical Sciences and Integrated Diagnostics, Genoa, Italy for their collaboration in this research.

Conflicts of Interest: None declared
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References


Glucocorticosteroids in the treatment of immune mediated oral diseases

ABSTRACT

Glucocorticosteroids are indispensable agents in the treatment of mucocutaneous immune-mediated diseases because of their anti-inflammatory and immunosuppressive properties. Short-term use of glucocorticosteroids is relatively safe, but long-term use may have serious adverse effects. Prednisone is the glucocorticosteroid most widely used systemically. It is inexpensive, and because of its intermediate duration of activity the risk of suppression of the hypothalamic-pituitary-adrenal axis is reduced.

Abrupt discontinuation of long-term glucocorticosteroid may cause withdrawal symptoms including malaise, low-grade fever and mood alterations, and at times may allow the return of the acute symptoms of the disease. Accordingly, termination of long-term use of glucocorticosteroids should be done gradually by tapering down the dose.

This appraisal discusses core mechanisms of action of glucocorticosteroids and describes the appropriate dosage regimens of the drug in relation to immune mediated oral diseases.

Key words: Prednisone, hypothalamus pituitary adrenal axis, cortisol

INTRODUCTION

Endogenous cortisol (hydrocortisone), is a glucocorticoid physiologically produced by the adrenal gland cortex. It functions as a regulator of protein, carbohydrate and lipid metabolism, and of inflammatory and immune reactions. The production of cortisol is induced by pituitary adrenocorticotropic hormone (ACTH) which itself is under the positive control of hypothalamic corticotropin-releasing factor (CRF). In turn, cortisol controls the secretion of pituitary ACTH and hypothalamic CRF via negative feedback loops (Figure 1). Under basal conditions, the adrenal cortex secretes 20-30mg of cortisol per day in a circadian rhythm, most in the early morning before waking, with secretion diminishing during the course of the day. Under conditions of stress, cortisol production may reach 200-300mg per day. Changes in the pattern of sleep may affect the circadian rhythm and hence the cycle of cortisol secretion.

Ninety percent of cortisol is carried in a protein-bound form in the plasma, most of it bound to α1-globulin (transcortin), the rest to albumin. The remaining 10% of plasma cortisol is free and this is the active fraction of the steroid that enters the target cells and exerts the biological effects. The plasma half-life of cortisol is somewhat more than one hour, and the tissue half-life is less than 12 hours (Table 1).

As plasma transcortin is fully occupied by endogenous cortisol, exogenous glucocorticosteroids bind with low-affinity to albumin which can carry substantial amounts, raising the plasma level above the physiological range of glucocorticosteroids. The resulting negative feedback inhibits secretion of CRF and ACTH with suppression of the hypothalamic-pituitary-adrenal (HPA) axis, which in turn suppresses the physiological activity of the adrenal cortex.
making it liable to atrophic changes, with secondary adrenal insufficiency. The degree of such secondary adrenal cortical insufficiency is unpredictable but is related to the dose, duration of use and to the potency of the exogenous glucocorticosteroid, and may persist for more than nine months after cessation of use of the drug.2

Subjects with adrenal cortical insufficiency secondary to the use of medicinal glucocorticosteroids have a reduced capacity to tolerate stress, and should therefore be given supplemental doses of glucocorticosteroids during stressful infectious or surgical events.4 However, recently it has been stated, that for patients at risk of adrenal suppression owing to corticosteroid treatment, and who are undergoing dental or oral surgical procedures under either local or general anaesthesia, corticosteroid supplementation is not necessary.5

Adrenal insufficiency secondary to medicinal glucocorticosteroids may be minimized by using, whenever possible, a single morning dose of a relatively short-acting agent, or by using an intermediate-acting agent on alternate mornings. With the reduction of the exogenous glucocorticosteroids, substantial functional recovery of the adrenal cortex occurs on the day ‘off’, reducing the risk of development of adrenal cortex insufficiency.3

MECHANISM OF ACTION OF CORTICOSTEROIDS

Glucocorticosteroids enter cells passively and bind to cytoplasmic receptors, forming a receptor-steroid complex which translocates to the nucleus and there interacts with specific DNA sequences, regulating the expression of gene encoding proteins that function as biological modulators. The interaction with transcription factors such as activator protein (AP)-1 and nuclear factor (NF)-κB, downregulates cytokine production and inflammatory processes.1,4,6

Structurally, all glucocorticosteroids share a basic cyclopentenophenanthrene ring. Modifications to this basic steroid ring structure bring about different mineralocorticoid (sodium retention properties), anti-inflammatory or immunosuppressive effects and each modified steroid has a different biological half-life. Hydrocortisone has substantial mineralocorticoid capacity, but the synthetic glucocorticosteroids prednisone and prednisolone exert only a slight sodium retention effect, and methylprednisolone has none at all (Table 1).2

The synthetic cortisone-analogue prednisone is converted to biologically active prednisolone by the enzyme 11β-hydroxysteroid-dehydrogenase-1 (11β-HSD1) in the liver, but also in adipose tissue, brain, fibroblasts, muscles and immune cells.7-9 Any patient with disease of these tissues and in whom this conversion is likely to be impaired should, if treatment is necessary, receive prednisolone rather than prednisone.

Short-term treatment with glucocorticosteroids may arbitrarily be defined as treatment lasting no more than three to four weeks, while long-term treatment lasts over a period longer than four weeks, and may continue for months or years.3 Short-acting glucocorticosteroids are effective for 8-12 hours, intermediate-acting for 24-36 hours and long-acting for more than 48 hours (Table 1).2

| Table 1: Glucocorticoid properties. This table compares the range of action and the posology (study of doses) of short, intermediate and long-acting corticosteroid agents.2,26 |
|----------------|-----------------|--------------|-------|--------|----------------|
| **Agents**    | **Anti-inflammatory properties** | **Sodium retaining properties** | **Tissue half-life (days)** | **Plasma half-life (min)** | **Approximate equivalent dose in mg** |
| Short-acting  | Cortisone | 0.8 | 0.8 | <½ | 30 | 25 |
|               | Cortisol (hydrocortisone) | 1 | 1 | <½ | 90 | 20 |
| Intermediate-acting | Prednisone | 4 | 0.8 | <1½ | 60 | 5 |
|                | Prednisolone | 4 | 0.8 | <1½ | 200 | 5 |
|                | Methylprednisolone | 5 | 0.5 | <1½ | 180 | 4 |
|                | Triamcinolone | 5 | 0 | <2 | 200 | 4 |
| Long-acting   | Betamethasone | 25 | 0 | <3 | 200 | 0.60 |
|                | Dexamethasone | 30 | 0 | <3 | 200 | 0.75 |
but the biological activity gradually diminishes as the agent is metabolised. Prednisone is the most commonly used medicinal glucocorticosterone because it is effective over a wide range of clinical conditions, it is inexpensive, is well tolerated, has minimal mineralocorticoid effect and is suitable for both short- and longer-term treatment. 3

ANTI-INFLAMMATORY AND IMMUNOSUPPRESSIVE EFFECTS OF GLUCOCORTICOSTEROIDS

At physiological concentrations, glucocorticosteroids have little anti-inflammatory effect, but at medicinal (supraphysiological) concentrations, they affect the functions of biomembranes including those of endothelial cells, mast cells and monocytes, and of lysosomes (Table 2). 1,3,4 The production of pro-inflammatory cytokines, inflammatory mediators and other inflammatory factors are also reduced, further suppressing the inflammatory processes (Table 3). 1,3,4

GLUCOCORTICOSTEROIDS

IMMUNOSUPPRESSIVE EFFECTS OF MEDICINAL GLUCOCORTICOSTEROIDS

The side effects of short-term glucocorticosteroid prescribed for the treatment of oral manifestations of immunopathogenic mucocutaneous diseases are spontaneously reversible, but those of long-term administration are more serious, and may be long lasting (Table 5). 11,12 Some subjects are at greater risk of the side effects as, for example those with liver disease who do not have the capacity to adequately metabolize the drug, and those with hypoalbuminemia who will have increased levels of free serum glucocorticosteroids. 3

Table 2: Effects of medicinal doses of glucocorticoids on membranes. 3,4

| On endothelial cell membranes | - Inhibition of vascular permeability leading to: |
| - reduction in oedema |
| - reduction in intercellular migration of leukocytes |
| - reduction in fibrin deposition |
| On mast cell membranes | - Inhibition of mast cell degranulation leading to reduced release of mast cell–derived inflammatory mediators (i.e. histamine, serotonin) |
| On monocyte cell membranes | - Leading to inhibition of monocyte functions (i.e. migration, phagocytosis) |
| On lysosomal membranes leading to | - Inhibition of release of hydrolytic enzymes |
| - Inhibition of fusion of lysosomes and phagocytic vacuoles |

Physiologically, glucocorticosteroids have a regulatory effect on the number of lymphocytes in the peripheral blood, but medicinal concentrations of glucocorticosteroids may lead to an accumulation of T lymphocytes and to a lesser extent of B lymphocytes in lymphoid tissue at the expense of the peripheral blood, resulting in a transient lymphopenia. 13 The immunosuppressive effects of medicinal glucocorticosteroids are listed in Table 4.

Table 3: Inflammatory modulation effects of medicinal doses of glucocorticoids, listing the actions on the inflammatory mediator cascade. 3,4

| - Inhibition of expression of major histocompatibility complex (MHC) class II molecules in response to interferon stimulation |
| - Inhibition of upregulation of expression of adhesion molecules in response to inflammatory stimuli (i.e. neutrophils, endothelial cells) |
| - Inhibition of secretion of complement components |
| - Decreased production of prostaglandins |
| - Decreased production of proinflammatory cytokines (i.e. IL-1, IL-6, TNF-α) |

Table 4: Immunosuppressive effects of medicinal glucocorticoids. 10

| - Inhibition of production of certain cytokines (IL-2) with consequent inhibition of T cell activation |
| - Inhibition of cytotoxic CD8+ T cell responses |
| - Inhibition of helper CD4+ T cell responses |

Table 5: Frequent side effects of systemic medicinal glucocorticoid administration. Note: while some side effects appear similar, long-term side-effects are more severe 11,12

| Short-term administration | - Weakness |
| - Fluid retention |
| Long-term administration | - Suppression of the HPA axis |
| - Infection |
| - Cataract, glaucoma |
| - Cushionoid changes, obesity |
| - Hyperlipidaemia |
| - Mood and personality changes |

| - Osteoporosis |
| - Peptic ulcer, nausea, vomiting |
| - Hyperglycaemia |
| - Weight gain |
| - Muscle atrophy |
| - Growth retardation in childhood |
| - Hypertension |

Postmenopausal women, and elderly subjects with decreased physical activity, are inherently vulnerable to osteoporosis, and consequently are at greater risk of developing osteoporosis from medicinal glucocorticosteroids. 3 If the step-wise reduction in dosage after long-term use of medicinal glucocorticosteroids is too rapid, some subjects will experience withdrawal symptoms which may include arthralgias, headache, mood changes, lethargy and nausea. 3

After discontinuation of long-term treatment with glucocorticosteroids, full recovery of adrenal cortical function may take up to a year. When stressful events, such as surgical procedures, are anticipated, or arise unexpectedly (infections, physical or mental trauma, dehydration), supplemental doses of glucocorticosteroids may be needed. 3 However, the severity of suppression of the HPA-axis (Figure 1) varies from case to case and the time required for its functional recovery after discontinuation of the steroid also varies unpredictably. 4

Some contraindications for the use of glucocorticosteroids 13 are shown in Table 6. It is noteworthy that HIV infections or even AIDS are not contraindications to the use of short-term glucocorticosteroids. 3

Table 6: Some contraindications to the use of systemic medicinal glucocorticoids. 13

| - Systemic fungal infections |
| - Active tuberculosis |
| - Active peptic ulcer disease |
| - Psychosis or severe depression |
| - Acute glomerulonephritis |
| - Myasthenia gravis |
| - Chronic liver disease |
GENERAL PRINCIPLES OF TREATMENT WITH GLUCOCORTICOSTEROIDS

There are no strict evidence-based guidelines for the use of glucocorticosteroids in the treatment of immune mediated blistering, erosive or ulcerative oral diseases. Whether to use topical or systemic agents, and the dosages and durations of the drug regimens to be prescribed, are decisions based largely on expert opinion and on personal experience, with attention to several basic rules. Despite the wide range of agents available (Table 7) intermediate acting prednisone remains the systemic drug of choice in oral mucosal diseases, since it has little undesirable mineralocorticoid effect. A wide range of glucocorticosteroids for topical use is available, each having specific degrees of potency, and different durations of activity (Table 8). Most oral mucosal diseases requiring the use of topical application or sublesional injections of glucocorticosteroids can be satisfactorily managed with quite a small spectrum of agents, as will be outlined below.

In severe acute cases of immune mediated blistering, desquamative, erosive or ulcerative oral diseases, treatment can start with a dosage of prednisone of 1-1.5mg/kg/day; and for less severe to milder cases with 40-60 mg per day, according to the judgement of the clinician. For best clinical results and to maintain both a more uniform serum level and a more consistent therapeutic level, daily amounts of prednisone are given in three doses. Each patient receiving orally administered glucocorticosteroids should be provided with a typed schedule, setting out the number of tablets to be taken, morning, noon and evening, to avoid confusion.

It is important to complete any course of systemic glucocorticosteroids, even at quite low dosages, with a gradual tapering-off to allow the adrenal cortex to recover from the negative feedback effect of the drug on hypothalamic CRF and on pituitary ACTH (Figure 1). There are several ways to manage this tapering-off process, but for the thrice-a-day dosage regimen outlined above, a rule of thumb is that the greater the initial dosage and the longer the course of treatment, the longer and more gradual should be the tapering-off process. The lesser midday and evening doses should be reduced first, and then the morning dose.

As the immune-mediated oral diseases, the subject of this article, are nearly always 'managed' rather than cured, and depending on the response to the treatment, the morning dose may sometimes be continued as a maintenance regimen at the lowest level sufficient to contain the disease. This might be anywhere between 2.5mg and 20mg of prednisone, as determined by trial and observation. After the course of systemic corticosteroid treatment, maintenance can often be with a topical glucocorticoid preparation, or by intermittent sublesional injections with slow-release methylprednisolone.

USE OF GLUCOCORTICOSTEROIDS IN THE MANAGEMENT OF IMMUNE-MEDIATED ORAL DISEASES

A recent literature review suggested that acute cases of oral pemphigus vulgaris should be treated with initially high doses of 80-100 mg/day prednisone; and oral erosive lichen planus with starting doses of 20-30 mg/day until the acute symptoms subside, and thereafter with tapering-down doses. In the experience of the authors, a chronic maintenance dose of 5 to 15 mg/day of

<table>
<thead>
<tr>
<th>Active Agent</th>
<th>Tablets/Suspensions</th>
<th>Injections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betamethasone</td>
<td>0.5mg tablets (Celestone®; Betanoid®)</td>
<td>3mg/mL (Solupan®)</td>
</tr>
<tr>
<td></td>
<td>0.6mg/5mL suspension (Betanoid®; Steromien®)</td>
<td>4mg/mL (Betanoid®; Lenasone®; Pharma-Q Betamethasone®)</td>
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<tr>
<td>Dexamethasone</td>
<td></td>
<td>4mg/mL (Decason®; Dexasone®; Mylan-Dexamethasone®; Pharma-Q Dexamethasone®)</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>10mg tablets (Covocort®)</td>
<td>100mg/2mL (Solu-Cortef®; Cortact®)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500mg/4mL (Solu-Cortef®)</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>4, 16mg tablets (Medrol®)</td>
<td>40,80mg/mL (Depo-Medrol®)</td>
</tr>
<tr>
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<td></td>
<td>40mg/mL, lidocaine hydrochloride</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10mg/mL, (Depo-Medrol® with Lidocaine)</td>
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<tr>
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<td></td>
<td></td>
<td>500mg/8mL (AP-Methylpred®)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40mg, 500mg, 1g/vial (Mylan-Methylprednisolone®)</td>
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<td>Prednisone</td>
<td>5mg tablets (Panaforcort®; Meticorten®; Be-Tabs Prednison®; Trolic®)</td>
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<td>20mg tablets (Pulmison®)</td>
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<td>5mg/mL suspension (Pulmison® Paediatric)</td>
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<td>Prednisolone</td>
<td>5mg tablets (Lenisolone®; Prelone®)</td>
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<tr>
<td></td>
<td>15mg/5mL suspension (Aspelone®; Adco-prednisolone®; Prieflam®; Prelone®)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Select systemic glucocorticoid preparations available in South Africa. Most require prescriptions.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Agent</strong></td>
</tr>
<tr>
<td>Betamethasone</td>
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<tr>
<td>Dexamethasone</td>
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<tr>
<td>Hydrocortisone</td>
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<td>Methylprednisolone</td>
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</tbody>
</table>

"MSD South Africa, Midrand, South Africa; Aspen Pharmacare, Woodmead, South Africa; Pharma-Q, Johannesburg, South Africa; "Zydus Healthcare SA, Potchefstroom, South Africa; Mylan South Africa, Modderfontein, South Africa; "Adcock Ingram, Bryanston, South Africa; "Pfizer South Africa, Sandton, South Africa; "Runbaxy (Sun Pharma), Centurion, South Africa; "Gulf Drug Company, Mount Edgecombe, South Africa; "Boehringer Ingelheim Pharmaceuticals, Randburg, South Africa; "Cipla SA, Bellville, South Africa
prednisone is usually needed for long-term control of oral pemphigus vulgaris. Oral mucosal pemphigoid is often refractory, and a higher long-term dosage of prednisone may be necessary to control the disease. Subjects with recurrent aphthous stomatitis, erosive lichen planus and mucosal pemphigoid can initially be treated with topical or sublesional corticosteroid injections, and systemic treatment is necessary only if there is no favourable response to local treatment.

Topical glucocorticosteroids are available as creams, ointments, gels, and lotions (Table 8). The type of preparation affects the local availability of the active agent and the capacity of the tissue to absorb it, but this must be balanced against how well the preparation will remain at the site of application. As with systemic glucocorticosteroids, the general rule is that higher potency glucocorticosteroid preparations should be used for short periods and, once there has been some favourable clinical response, other less-potent glucocorticosteroids should be prescribed for maintenance.

Severe immunopathogenic oral diseases may be treated with both topical and systemic glucocorticosteroids. The very potent agent clobetasol propionate, when correctly applied three to five times a day as a cream or an ointment over two to three weeks, may be as effective as systemic glucocorticosteroids in the treatment of erosive oral lichen planus and oral mucosal pemphigoid. However, similar beneficial results can often be obtained with less-potent steroid preparations such as betamethasone dipropionate or betamethasone valerate (Table 8).

Generally, very potent topical glucocorticosteroids should not be used continuously for a period longer than three weeks, and high, medium or low potency topical agents should not be used for longer than three months, to avoid side effects. For immune-mediated oral conditions, it is seldom necessary to continue the use of the drug for that long to obtain a satisfactory result, though maintenance doses may have to be continued for longer.

Widespread lesions affecting the mouth or oropharynx may be treated four or five times a day with an aerosol of beclomethasone dipropionate or budesonide, which is usually intended for the treatment of asthma, or with disodium betamethasone aqueous solution (0.5mg dissolved

<table>
<thead>
<tr>
<th>Potency</th>
<th>Generic name</th>
<th>Delivery vehicle and trade name</th>
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<tr>
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Hydrocortisone acetate 1%  
Hydrocortisone acetate 0.5%  
Hydrocortisone 1%  
Hydrocortisone 0.5%  |  
cream (Biocort®; Stopitch®)  
cream (Dilucort®)  
cream (Procutan®; Vari-Hydrocortisone®)  
cream (Skinclam®)  |
| Class 2: Moderately Potent |  
Fluticasone propionate 0.05%  
Fluticasone propionate 0.005%  
Betamethasone valerate 0.1%  
Diflucortolone valerate 0.1%  
Betamethasone dipropionate 0.05%  
Flucinolone acetonide 0.025%  
Beclomethasone dipropionate 0.025%  |  
cream (Cutivate®)  
cream, ointment, lotion (Locoid®)  
topical (Locoid Crealo®)  
cream (Betnovate®; Repivate®; Adco-Betamethasone®; Vari-Betamethasone®)  
ointment, lotion (Betnovate®; Lenovate®; Persivate®)  
ointment, gel, cream (Synalar®)  
cream, ointment (Cortoderm®)  |
| Class 3: Potent |  
Betamethasone valerate 0.1%  
Methyprednisolone aceponate 0.1%  
Betamethasone dipropionate 0.05%  
Mometasone furoate 0.1%  |  
cream (Betnovate®; Repivate®; Adco-Betamethasone®; Vari-Betamethasone®)  
ointment, lotion (Betnovate®; Lenovate®; Persivate®)  
cream, ointment, lotion (Elocon®)  
cream (Aspen Mometasone®; Mometagen®)  |
| Class 4: Very Potent |  
Clobetasol propionate 0.05%  |  
cream, ointment (Dermovate®; Dovate®; Xenovate®)  |

1Akacia HealthCare, Isando, South Africa; 2Adcock Ingram, Bryanston, South Africa; 3Aspen Pharmacare, Woodmead, South Africa; 4Specpharm Holdings, Halfway House, South Africa; 5MSD/Schering-Plough South Africa, Midrand, South Africa; 6Selexpharma, Sandton, South Africa; 7GlaxoSmithKline South Africa, Bryanston, South Africa; 8Astellas Pharma, Bedfordview South Africa; 9Cipla SA, Bellville, South Africa; 10Glenmark Pharmaceuticals South Africa, Midrand, South Africa; 11Bayer, Isando, South Africa; 12Mylan South Africa, Midrand, South Africa.
in 10ml warm water, four times a day.[24] Any topical agent used in the mouth should be left in situ for as long as possible; and accordingly the patient must be instructed not to eat, drink, rinse the mouth or brush the teeth for 40 to 45 minutes after each dose.

Opportunistic oral infection with candida is not an uncommon complication of the use of topical glucocorticosteroids and if it occurs, oral candidosis can be controlled with topical antifungal agents.[19] Should glucocorticosteroids and if it occurs, oral candidosis be controlled with topical antifungal agents. Should treatment with a topical glucocorticosteroid continue for more than ten days, it is advisable to treat patients concurrently with a topical antifungal agent of the clinician’s choice as a prophylactic measure.[21,22] In the experience of the authors, it may then be convenient to apply the topical steroid in the form of a cream or a gel together with a topical fungicidal gel such as miconazole gel, four to five times a day; or to use a commercially available preparation (Table 9). These preparations are primarily intended for dermatological conditions, and if used in the mouth, should be applied after drying the affected mucosa with gauze.

CONCLUDING REMARKS

Glucocorticosteroids are effective agents for the treatment of immune-mediated blistering, ulcerative, erosive or desquamative oral diseases. The relative potency of glucocorticosteroids is determined by their basic structure, and by their affinity for intracellular receptors.

To achieve the goals of treatment and to minimize adverse effects, glucocorticosteroids with the least mineralocorticoid activity and in the smallest effective dose should be used for the shortest duration of time necessarily to resolve the condition. Whenever possible shorter-acting rather than longer-acting glucocorticosteroids should be used. Long-term (more than three to four weeks) use of as little as 10mg of systemic prednisone per day can suppress the HPA-axis, although this is unpredictable and unusual.

Uncommonly, even the use of short-term potent topical glucocorticosteroids or of long-term less potent glucocorticosteroids can suppress the HPA-axis. When long-term treatment with glucocorticosteroids is anticipated, the patient must be appropriately informed about the possible side-effects and adverse effects of the treatment, and should be given a steroid warning card to carry at all times. It may be helpful if the patient could be advised regarding the costs involved.

Conflict of interest: No conflict of interest declared

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

66% Reduction in dentin hypersensitivity from baseline after 8 weeks*†

20% Reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste*5

Helps control dental plaque*4,5

29% Improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste*5

Supports good gingival health*4,5

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Clinically proven relief from dentin hypersensitivity pain2,3

Helps control dental plaque4,5

Supports good gingival health4,5

Up to 66%

Reduction in dentin hypersensitivity from baseline after 8 weeks*1,3

20%

Reduction in plaque build-up after 24 weeks compared to regular fluoride toothpaste*5

29%

Improvement in gingival inflammation after 24 weeks compared to regular fluoride toothpaste*5


For any product safety issues, contact GSK on +27 745 6001 or 0800 118 274
Patterns of previous tooth loss in patients presenting at five different types of dental practice

ABSTRACT
Introduction: In an Orthodontic and a Periodontal practice the most frequently missing teeth were the third molars followed by the mandibular M1 and the maxillary PM1.

Objective: To record the incidence of absent teeth/missing teeth amongst patients attending differing dental practices.

Materials and methods: Data recording age, gender and missing teeth (jaw and side) were drawn from the records of the initial consultations of patients attending five practice types: orthodontic (n 194), periodontal (n 202), prosthodontic (n 137), general dental practice (n 115) and Oral Hygiene Clinic (n 156). Excluded were patients under age 20 and those attending for oral medicine consultation (no dental charting).

Results: Mean ages (group, sd) ranged from 34.7y (orthodontic 9.8y) to 50y (prosthodontic 12.2y). Jaw side had no effect on missing teeth in any group (Z test). M3 were the most frequently missing teeth, followed by maxillary PM1, mandibular 1, PM1 and PM2. Age in decades effected the most dominant influence, followed by Practice Group, with gender having a weak effect on M3 data (linear logic analysis).

Conclusions: Molars and premolars were the most frequently absent teeth. Different dental patient populations experience differing patterns of tooth loss, although the reasons are not readily identified.

Key words: Missing teeth, practice type.

INTRODUCTION
This study followed a previous project which examined the dental records in a periodontic practice and an orthodontic practice. That study found that the most frequently missing teeth in both groups of patients were the third molars, followed by the mandibular first molars and then the maxillary first pre-molars.1 The absence of the maxillary first pre-molar conjured a variety of orthodontic scenarios, while the absence of a first molar alerted the clinician to the possibility of clinical implications from dental, periodontal and occlusal stand-points. An example of this was seen in a previous study where molar tooth position and alignment was assessed in relation to periodontal health.2 It has also been shown that there is a possibility that the early loss of maxillary pre-molars could lead to subsequent periodontal break-down.3 In the mandible, a clinical observation led to a study of the position and orientation of the first molar in relation to the severity of furcation involvement and possible tooth loss.4

LITERATURE REVIEW
The implications of tooth loss were looked at by Hirschfeld,5 who was concerned with the sequelae of losing mandibular first molars. He wrote that the loss of this tooth could result in “kaleidoscopic changes”; amongst these being the mesial tipping of the second and third molars and collapse of the anterior part of the dental arcade. Similar observations were made by Ramfjord.6 From an orthodontic standpoint, Proffit said “loss of posterior teeth, usually first permanent molars, is a frequent problem in adults”.7 He continued to say “since the first molar is so frequently lost, one sees the second and third molars tipped mesially, rotated, and in a position that is conducive to neither long-term health nor to simple restorative procedures.”

Much has been written in recent years of the reasons for tooth loss.8,10. Danielson et al.11 mentioned that 64.4% of missing teeth were mandibular, with the molars making up 95.3% and the first molar accounting for 40.1%. In their group of 17 to 36 year olds, impaction of the third molar was the main reason for extraction. Shigli et al.13 examining an Indian population, recorded that the mandibular first molar was most often extracted due to dental caries, while the maxillary central incisor was most frequently lost due to periodontal disease. In a Kenyan population the most
commonly missing teeth were the lower molars followed by the maxillary molars.14 Similar findings were recorded for young Brazilian populations.15,16

In the United States of America a survey conducted in 2004 by the National Institute of Dental and Craniofacial Research recorded that adults in the age range 20 to 64 years old had an average of 24.92 remaining teeth...ie seven teeth had been lost. Ten percent of the sample aged 50 to 64 years of age had no remaining teeth. The prevalence of tooth loss had however decreased since the 1970’s.17 Globally, the WHO estimated in 2012 that about 30% of people aged 65 to 74 have no natural teeth.18 A similar survey conducted in Australia reported that 6.4% of the population aged 15 years or older were without any teeth.19

Whilst there are several studies on the relationship between socio-economic factors and the loss of teeth, there does not appear to have been any endeavour to consider loss of teeth in relation to the type of practice the patient consults.

OBJECTIVE
To record missing teeth amongst patients attending five dental practice types: general dental practice, orthodontic practices, a periodontal practice, a prosthodontic practice and the Oral and Hygiene Clinic (Dental Hospital, University of the Witwatersrand).

MATERIALS AND METHODS
The choice of practices and the variation of types of dentistry were determined on the basis of ensuring a reasonable spread of the various categories of dentistry together with the selected practices having a reputation for excellence of records. The general practice and the clinic were included to ensure that there was an adequate range of socio-economic factors to balance the possibility that specialist practices could predominantly reflect the more affluent in society. The sample comprised the records of the first visit to the respective practice of adult patients over the age of 20 years and in each practice the records were accumulated sequentially. The age, gender of the patient and his/her missing teeth were recorded from the details collected at the initial consultation. Exclusion criteria were: patients under the age of twenty years and those who had been referred for an Oral Medicine consultation to the Oral Medicine/Periodontal practice, as tooth charting was not carried out for these latter patients.

The following numbers of patient records were examined in each group: General practitioner: 115, Orthodontic: 156, Periodontal: 198, Prosthodontic: 137 and Oral Hygiene: 156.

Statistical analysis was completed using SAS for Windows. Version 9.1 (SAS Institute Inc, Cary, NC, USA). Tests used were the Z test and the linear logistic analysis (Proc Catmod). The dependent variable was the frequency of missing teeth; whilst the independent variables were jaw, side, patient’s age in decades, practice type and gender. The level of statistical significance was set at p<0.05.

RESULTS
The patient records studied by decade (age) and practice type are listed in Table 1. In the Tables, in each cell, the first numeral is the tooth number of the most frequently missing tooth e.g. 6 = first molar, while the percentage after this indicates the frequency of that tooth being found to be missing.

Mean ages (n, sd) of the sample were general practice 38.1y (115, 12.1y), orthodontic practice 34.7y (156, 9.8y), periodontal practice 47.8y (198, 11.0y), prosthodontic practice 50y (202, 12.2y) and oral hygiene clinic 44.6y (127, 15.5y).

The graphs in Figure 1 demonstrate as a percentage the incidence of missing teeth in each of the samples drawn from the five practice types. The overall impression is the rising incidence with increasing age of the absence of some posterior teeth. A noticeable peak is seen recording the absence of upper premolars in patients in the periodontal practice, also reflected in the orthodontic practice but here for both upper and lower arches. A rather intriguing observation refers to the patients in the oral hygiene group where the older patients had suffered considerable deprivation of teeth in the maxilla. Lower incisors appeared to be the least frequently missing in all practice types.

The highest frequency of missing maxillary teeth by decade and practice type is shown in Table 2 (third molars were not included). The most frequently missing tooth in the general

<table>
<thead>
<tr>
<th>Practice type</th>
<th>20-29y</th>
<th>30-39y</th>
<th>40-49y</th>
<th>50-59y</th>
<th>60-79y</th>
<th>Combined sample</th>
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<tr>
<td>General dental</td>
<td>4</td>
<td>28%</td>
<td>55%</td>
<td>71%</td>
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<td>67%</td>
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<tr>
<td>Oral hygiene</td>
<td>7</td>
<td>25%</td>
<td>23%</td>
<td>56%</td>
<td>79%</td>
<td>46%</td>
</tr>
<tr>
<td>Orthodontic</td>
<td>4</td>
<td>22%</td>
<td>35%</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>Periodontal</td>
<td>4</td>
<td>40%</td>
<td>36%</td>
<td>21%</td>
<td>41%</td>
<td>59%</td>
</tr>
<tr>
<td>Prosthodontic</td>
<td>-</td>
<td>33%</td>
<td>31%</td>
<td>59%</td>
<td>72%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Table 1: Number of patient records studied by age in decades and practice type.

Table 2: Highest frequency of missing maxillary teeth by decade and practice type. The numbers in bold are tooth types e.g. 7 = second molar. Identical frequencies show two tooth types e.g. 57. (Third molars are excluded from these data but 82% of the combined sample were missing one or more of these teeth).
Figure 1: Graphs demonstrating the relative loss of teeth recorded in each of the dental practices according to age. (Note No data for the 20 to 29 year old sample in Prosthodontics and no data for the 60 to 70 year old sample in Orthodontics).
The whole sample… a considerable loss as evidenced by Table 5 is presented to reflect the number of teeth lost by significant effect only for the third molars in both jaws. Gender had a significant effect only for the third molars in both jaws. In the maxilla the most commonly missing teeth in the 30’s and 40’s decades are the premolars, and this may indicate previous dental interventions, such as extractions to resolve crowding, with or without orthodontic treatment. The spreads of ages amongst the sample are what one would expect, with a lower age range in the orthodontic practices. The periodontal group included a higher number of patients in the forty to sixty year olds, while the prosthodontic practice sample had the highest prevalence of patients in the fifth decade. The patients in the oral hygiene clinic showed a relatively even spread through the decades, as indeed did the general dental group.

It is observed that the patterns of tooth loss are characterized amongst younger patients who may have sought orthodontic treatment and in contrast, amongst older patients who would be seeking periodontal and prosthodontic care. The data from the mandibular arch showed the most frequently absent tooth to be the first premolar. The loss of these teeth with advancing age decreases the number of posterior occluding pairs available for function. Replacement with conventional crowns and bridges is only possible if there is a distal abutment. Replacement using implants is not always possible, leaving the less effective option of distal extension partial dentures.

This has been an observational study, so that the causes of tooth loss have not been included. It is difficult to compare these observations with other studies of missing teeth, as this investigation recorded only the absence of teeth in five practice types. There are, however, similarities with the findings of Danielson et al. who reported that caries was the dominant reason for the extraction of molars, and periodontal disease the cause of the loss of premolars.

<p>| Table 3: Highest frequency of missing mandibular teeth by decade and practice type. The numbers in bold are tooth types e.g. 4;6. (Third molars are excluded from these data but 82% of patients were missing one or more of these teeth). |</p>
<table>
<thead>
<tr>
<th>Practice type</th>
<th>20-29y</th>
<th>30-39y</th>
<th>40-49y</th>
<th>50-59y</th>
<th>60-79y</th>
<th>Combined sample</th>
</tr>
</thead>
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<td>General dental</td>
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<td>18%</td>
<td>6</td>
<td>30%</td>
<td>7</td>
<td>55%</td>
</tr>
<tr>
<td>Oral hygiene</td>
<td>7</td>
<td>25%</td>
<td>7</td>
<td>24%</td>
<td>6</td>
<td>48%</td>
</tr>
<tr>
<td>Orthodontic</td>
<td>4</td>
<td>23%</td>
<td>6</td>
<td>23%</td>
<td>6</td>
<td>38%</td>
</tr>
<tr>
<td>Periodontal</td>
<td>4:5</td>
<td>15%</td>
<td>6</td>
<td>25%</td>
<td>6:7</td>
<td>30%</td>
</tr>
<tr>
<td>Prosthodontic</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>17%</td>
<td>6:7</td>
<td>43%</td>
</tr>
</tbody>
</table>

<p>| Table 4: A linear logistic analysis determined the statistically significant effects (&lt;0.05) of the variables (d=decade/age, p=practice type, g=gender) on the loss of teeth, recorded for each tooth type. Hence for example, the loss of a lower six was influenced more by age, whilst the loss of a maxillary premolar was influenced more by age but practice type also had a bearing. Gender had a significant effect only for the third molars in both jaws. |</p>
<table>
<thead>
<tr>
<th>Maxillary teeth</th>
<th>Significant effect</th>
<th>Mandibular teeth</th>
<th>Significant effect</th>
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<tr>
<td>1</td>
<td>d &gt; p</td>
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<td>-</td>
</tr>
<tr>
<td>2</td>
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<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>d</td>
<td>3</td>
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<tr>
<td>7</td>
<td>d</td>
<td>7</td>
<td>d &gt; p</td>
</tr>
<tr>
<td>8</td>
<td>d &gt; p &gt; g</td>
<td>8</td>
<td>d &gt; p &gt; g</td>
</tr>
</tbody>
</table>

The highest frequency of missing mandibular teeth by decade and practice type is shown in Table 3 (as in the maxillary groups, the third molars are not included, but when the practice types were combined, 82% of these teeth were missing). In the orthodontic practices the first molar was the most frequently absent tooth in the thirty year to fifty year old patients, in the other practice types it was the premolars that were the most often missing. In the total sample, it was the first premolar that was missing most frequently. Clearly when maxillary or mandibular teeth are missing it is most likely that it is the premolars or molars which will have been lost.

The Z-test showed no significant effect of jaw, or side, on the frequency of missing teeth in any practice type. Table 4 shows the linear logistic analysis determining the statistically significant effects of the independent variables: decade, practice type and gender. Age in decades was the most common factor followed by practice type. Gender had a significant effect only for the third molars in both jaws.

Table 5 is presented to reflect the number of teeth lost by the whole sample…. a considerable loss as evidenced by the realization that the 804 patients were together missing 7048 teeth, an average of nearly nine teeth per patient!

| Table 5: Data reflecting the total number of teeth missing amongst the combined sample |
|---------------------------------|----------|----------|----------|----------|----------|--------|
|                               | General Practitioner | Oral Hygienist | Orthodontist | Periodontist | Prosthodontist | TOTAL |
| Patients                       | 115       | 156      | 194       | 202       | 137       | 804    |
| Maxillary Teeth                | 963       | 881      | 583       | 728       | 807       | 3962   |
| Mandibular Teeth               | 816       | 661      | 354       | 578       | 677       | 3086   |
| Total                          |           |          |           |           |           | 7048   |
CONCLUSIONS
When data for the third molar were excluded, overall the most frequently absent tooth in all the groups was the maxillary first premolar, then the mandibular first molar, next the mandibular premolars. Loss of maxillary first premolars could be due to periodontal disease, crowding and orthodontic needs. The loss of the maxillary first molar is of concern as its loss could be a precursor of periodontal breakdown.

Acknowledgements: Sincere appreciation to our dental colleagues (Prof E Stein, Drs M Wertheimer, R Ormerod and G Melman) for making their records available to us.

References
17. Fact Sheet no 318 April 2012 World Health Organisation.

DENTAL PROTECTION APPOINTS NEW DENTAL DIRECTOR
Dental Protection has appointed Raj Rattan MBE as the new Dental Director, to succeed Kevin Lewis who steps down in summer 2016. Mr Rattan has over 30 years’ experience in dental practice and has been associated with Dental Protection for over 20 years, first as a dentolegal adviser and more recently as a senior dentolegal consultant.

Mr Rattan is also Strategic Associate Dean at the London Deanery and he uses his extensive knowledge and experience to inform and open debate through his published articles, books and international lectures on risk management, quality assurance and practice management. In 2008, Mr Rattan was appointed MBE in the Queen’s New Year’s Honours List for services to dentistry and he is former Policy Adviser to the Department of Health.

Speaking on his appointment, Raj Rattan said:
“It is a huge privilege to be given the opportunity to lead a very talented team who are dedicated to dentistry. There are over 100 members of staff and consultants in Dental Protection in the UK, with an enormous breadth of expertise and experience. We also have colleagues who serve dental members in Africa, Asia, Australia, New Zealand and the Caribbean. Members should be reassured that if they face a difficult situation that arises out of their practice, they will receive assistance from experienced dentists with legal training, who will help them at every stage.

“Having been in practice for over 30 years, I understand our members’ fears, aspirations and the issues they are facing. We are here to support and educate members, and protect them from risk throughout their career.

“I look forward to working closely with my colleagues in helping to shape a better future for our dental members and for the profession, by listening to their concerns, working closely with key stakeholders and continuing to provide tailored courses and events. I believe that by helping dentists in their professional careers, we are also creating a happier and safer environment for patients.

“I also want to take this opportunity to thank Kevin Lewis for not only his strong leadership and personal friendship, but also his sense of purpose that has made Dental Protection what it is today. I want to build on this past success and focus on providing a world class service for our members so that together we are better prepared to meet future challenges.”

Pardeep Sandhu, Executive Director of Professional Services at MPS, said:

“I am extremely pleased that Raj is to lead our dental services; his vast experience and knowledge of the sector will be invaluable for both colleagues and members.

“For the dental profession the threat of patient complaints and litigation has never been greater, both in the UK and internationally. Thankfully, our members have access to the largest team of dentolegal advisers anywhere in the world, with a wide range of skills and expertise in every aspect of clinical and professional life. I am certain that Raj will lead Dental Protection to continue to provide the expert advice, support and education that dentists need throughout their career.”
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**Andolex-C oral gel contains cetylpyridinium chloride

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Forensic dentistry case book 6: A self-inflicted bite mark; a case report

CASE REPORT

The case presented is of a 35 year old woman who was a victim of a vicious assault. At autopsy there were 26 stab wounds to the body, numerous defence injuries, her throat was slit and there was generalised organ pallor as a result of exsanguination. The stab wounds fractured the cervical spine and injured the lungs, oesophagus, trachea as well as the arteries and veins of the neck. On the left arm were superficial lesions consistent with a bite mark (Figure 1). The bite mark was photographed and swabbed for DNA. Analysis showed the bite mark was not taken because the lesions were very superficial and there was little penetration of the skin.

The examination of the victim’s mouth showed a small red abrasion present on the upper lip near the right corner of the mouth (Figure 2). This abrasion was adjacent to the upper right canine, and was possibly caused by forceful pressure of the lip against the underlying canine. There was also an abrasion of the upper lip below the left nostril; that possibly occurred during the attack on the victim. Examination of the teeth of the victim showed no abnormalities.

The bite mark on the arm showed that there were two distinct curved patterns of lesions (Figure 1) indicating that there were two bite marks in this area.

Photographs were taken of the bite marks using an ABFO No. 2 mm scale (American Board of Forensic Odontology) to reference the size of the lesions produced by the teeth that had caused the pattern of bruises and abrasions. For analytical purposes the photographs were printed to the original size of the bite marks on the arm; i.e. 1:1 ratio.

When a bite mark occurs on the lower arm it is important to consider self-infliction as a possibility. The arm or hand is often forced into the victim’s mouth to minimize minimise screaming. In this case, when the left arm was placed adjacent to the mouth it showed that there was a distinct possibility that the victim had bitten her own arm. At this stage of the investigation no suspect had been arrested.

ACRONYM

<table>
<thead>
<tr>
<th>ACRONYM</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABFO</td>
<td>American Board of Forensic Odontology</td>
</tr>
</tbody>
</table>

The analysis of the bite marks continued with the comparison of the victim’s teeth with the bite mark. Dental impressions of the victim’s teeth were taken using President® silicone impression material. From these dental impressions upper and lower plaster of Paris study models were cast of the teeth for comparison purposes. These were used to duplicate the biting patterns of the upper and lower teeth of the victim by pressing the teeth of the study models into softened grey dental bite-registration wax. This resulted in an accurate bite pattern for the upper and lower teeth which was then compared with the actual bite mark. The patterns of the teeth in the wax are traced onto plastic foil with a permanent marking pen and then super-imposed over the bite mark to elicit concordant features (Figure 3).

The illustrations in Figure 3 demonstrate the relationship between the victim’s upper teeth and the bite mark on the left arm. The dental arch matched the outer pattern of bruises.

The lower illustration shows the tracing of the biting pattern of the victim’s upper teeth superimposed on the photograph of the bite mark. Six concordant features were identified.

RESULTS

The analysis of the bite marks in comparison with the teeth of the victim showed the following:

- Six concordant features between the upper teeth and the upper outer aspect of the bite mark
- Seven concordant features between the upper teeth and the upper inner aspect of the bite mark
- Ten concordant features between the lower teeth and the lower area of the bite mark

DISCUSSION

Forensic pathologists need to be aware at autopsy that bruises and abrasions could possibly be a bite mark. There are several important lessons from this case study.

Firstly, the time lapse between the infliction of a bite mark and when it is examined is critical. If a bite mark is analysed soon after the event the chances of making an accurate match with the perpetrator’s, or in this case, the victim’s, teeth, are greatly improved. Secondly the skin and underlying tissues of the forearm are relatively soft and malleable and allow a degree of distortion when bitten. Therefore the abrasions and bruises may be somewhat mis-shaped when compared with the teeth and the biting patterns of whoever inflicted the bite.

1. Sairita Maistry: BDS; BSc; HonB, MBCHB; Dip. For. Med (SA); FC For. Path (SA); MMED For. Path (UCT); Department of Forensic Medicine & Toxicology, University of Cape Town.
2. Vincent Michael Phillips: BDS; MChD; Dip. Max-Facial Radiol; FC Path SA (Oral Path); PhD; D.Sc; Department of Forensic Medicine and Toxicology, University of Cape Town.

Corresponding author

Vincent Michael Phillips:
Department of Oral and Maxillofacial Pathology & Forensic Sciences
Faculty of Health Sciences, University of the Western Cape. South Africa.
Tel: 021 957 3161; E-mail: vmphilips@uwc.ac.za
The ideal analysis of a bite mark is to take an impression of the puncture wounds and to cast a model; this creates an accurate replica of the bite mark which can be compared with the perpetrator’s teeth. In this case the bruises and abrasions on the arm were too superficial to justify an impression.

Photographs of the bite marks need to be printed to as close to the original size of the bite mark seen on the victim i.e. 1:1 ratio for accurate analysis. In this case, the clinical and photographic examination showed distinct crescent shaped patterns of bruises and abrasions on the skin, caused by the upper and lower teeth. The bite marks were on the inner aspect of the left forearm of the victim. This suggested that there was a distinct possibility that the arm of the victim was forced into her mouth during the attack and that the bite mark was self-inflicted.10-12

The arms are usually raised during an attack with the outer surface towards the attacker, therefore a bite inflicted by the attacker would be on the outer surface of the arm.7,8 The abrasion and bruise patterns also suggest a struggle because there were abrasions on the skin produced by the upper teeth that appear to have been dragged across the skin surface due to the victim trying to remove her arm from her mouth. The right corner of the victim’s mouth shows a lesion on the upper lip that may have been caused by the victim’s right canine during forceful insertion of her left forearm into her mouth. The bite marks in this victim were mostly abrasions with no puncture wounds, further supporting self-infliction.12 A bite mark by an attacker is usually more severe with bleeding puncture wounds.8,13

There is no consensus as to the minimum number of concordant features in bite mark analysis which are necessary to determine a complete match between the teeth of the perpetrator (or victim) and a bite mark.9 The greater the number of concordant features, the higher the probability of a match. Hence in this case the probability that the victim bit her own arm is high.13

CONCLUSION

Bite marks are frequently encountered by Forensic Pathologists at autopsy. However, analysis of a bite mark requires the expertise of a Forensic Odontologist.

This case report has demonstrated the methods used to analyse a bite mark and the need for Forensic Pathologists to be aware of bite marks and to take DNA swabs before the autopsy. The number of concordant features in this case suggested that there was a high degree of probability that the bite mark on the left forearm of the victim was self-inflicted.

References
1. Saukko P, Knight B. Knight’s Forensic Pathology. 3rd Ed. Hodder Arnold. 2004; Chap. 26 pg.527-41
ABSTRACT
Nodular fasciitis (NF) is a rapidly growing, myofibroblastic lesion with a challenging diagnosis. The deceptive clinical and histologic features of NF often lead to misdiagnoses that include malignancies. Nodular Fasciitis is benign and has a low recurrence rate after complete excision, which is the treatment of choice. Intra-oral lesions are especially rare. We describe the case of a 27 year old female who presented with localized, lobular-exophytic nodular fasciitis of the mandibular gingiva. To our knowledge, this is the ninth case to be reported occurring in this anatomic site and the forty-fifth intra-oral case.

Key words: Nodular Fasciitis, fibro-reactive lesion, gingival lesion, spindle-cell lesions

INTRODUCTION
Nodular fasciitis (NF), also known as pseudosarcomatous fasciitis or proliferative fasciitis, was first described by Konwaler in 1955.1,2 These benign, proliferative spindle cell lesions, comprised of fibroblasts and myofibroblasts, originate in subcutaneous tissue.1,2,3 Lesions are typically solitary, well-defined but unencapsulated, and undergo rapid enlargement.4,5,6 The rapid growth and lack of encapsulation often lead to a misdirected differential diagnosis in favour of malignancy, especially of the sarcomatous type.7,8

In adults, the upper extremities are the most commonly affected site.9 The head and neck region is the second most frequently affected area (7-20%), and in paediatric patients, tends to be the most commonly affected.6,8,9 Nodular fasciitis is rarely found intraorally4,9 because of the relative lack of fascia compared with other affected sites.3 The self-limiting nature of NF resulted in the description of a “transient-neoplasia”.6,7,9

CASE REPORT
A 27 year old female patient presented with a main complaint of a lump in her mouth which became painful when eating. She sought treatment from a local clinic four months after noticing the lesion and was subsequently referred to Oral Medicine for management. She reported having a recent incident-free pregnancy. Her medical history was otherwise not remarkable.

Extra-oral examination revealed palpable submandibular lymph nodes that were moveable and painless. Intra-orally the patient presented with poor plaque control evidenced by gross amounts of calculus. In the third quadrant, a large erythematous lobular lesion was found, originating from the interdental papilla between the 32 and 33 (Figures 1a and b). The exophytic lesion extended from the lingual to buccal aspects of the gingiva. Besides displacement of the 32 and the 33, nothing of significance was noted radiographically.

A differential diagnosis included pyogenic granuloma, pregnancy epulis, fibrous epulis and peripheral giant cell granuloma. Subsequent to the examination, cause-related periodontal therapy was performed, chlorhexidine 0,2% mouthwash was prescribed for use three times a day and plaque control instruction was given. An excisional biopsy was performed without complication. The lesion was sectioned and removed in two fragments measuring 2cm x 1,6cm and 1,3cm x 1cm, and the remaining gingivae was contoured to recreate the interdental tissue. The tissue segments were sent for histopathological investigation.

The patient was reviewed a week later and sutures were removed. At the two-week follow-up appointment the biopsy-site was seen to be healing uneventfully (Figure 2). The biopsy report confirmed a diagnosis of nodular fasciitis, with the specimen showing polypoid proliferations composed of spindle-shaped cells with a feather-like appearance. The cells grew in bundles and fascicles and focal collections of lymphocytes were present (Figure 3a). Special staining techniques revealed positivity of SMA and negative staining for S100 (Figure 3b).

The patient was seen again at one and four months after the review when no signs of recurrence were discerned and the submandibular lymphnodes were no longer palpable.
DISCUSSION

The reported prevalence of NF in the head and neck ranges between 7-20%.\textsuperscript{4,9} Intraoral NF is rarely encountered and the most common intraoral site is the buccal mucosa.\textsuperscript{8,9} The lip, tongue, floor of the mouth and gingivae are also intraoral sites with documented involvement.\textsuperscript{6,8} The actual prevalence of intraoral NF is unknown and only 44 reports were found in the literature.

Previously NF was thought to be reactive in nature. Infection and hormonal influences have also been suggested as initiating factors.\textsuperscript{1,6,8} However, genetic research proves that NF undergoes a clonal expansion process.\textsuperscript{7} The recent discovery of a fusion gene shows that there are rearrangements of the USP6 locus with the formation of an MYH9–USP6 fusion gene.\textsuperscript{7}

Although gender predilection is not demonstrated, our review shows that intraoral NF appears to be more prevalent in female patients and the significance of this is not yet apparent.\textsuperscript{1,2,4} Affected patients are usually in their 3rd to 5th decades of life.\textsuperscript{2,8,9}

Diagnostic techniques vary when dealing with NF mainly because it may mimic malignancies. Clinicians have used incisional biopsies when the diagnosis was uncertain and excisional biopsies when the lesions were smaller and appeared well localized which is often the case when dealing with intraoral NF.\textsuperscript{9,10}

The histological appearance of nodular fasciitis can be described as deceptive, due to its non-specific and, even though well demarcated, infiltrative nature.\textsuperscript{6} The lesion also has a rich vascularity and is mitotically active.\textsuperscript{4,6} This rapid growth and histological features make nodular fasciitis a mimicker of malignancies such as sarcomas.\textsuperscript{1,4} However, NF is a benign lesion and does not metastasize.\textsuperscript{4,9}

Histological examination including immunohistochemistry is essential for accurate diagnosis.\textsuperscript{2} Lesional tissue often presents with loosely arranged fascicles of spindle cells in a fibrous or myxoid stroma, which is scattered with chronic inflammatory cells.\textsuperscript{6,9} It has been described as feathery looking.\textsuperscript{7} It is also non-encapsulated but described as being well delimitated.\textsuperscript{7} Immunohistochemical assessments reveal a positive expression for smooth muscle actin, vimentin, HHF-35 and muscle specific actin\textsuperscript{1,3,5,8} and negative reaction for S100, desmin and cytokeratin.\textsuperscript{4,8}
Nodular fasciitis can be histologically subtyped or classified using two methods, firstly according to the plane of tissue involved and secondly according to cellularity of the lesion. Table 1 Sub-typing based on cellularity comprises three NF types: Myxomatous, Intermediate and Fibromatous. The histological appearance of Price’s classification correlates with the duration of the lesion, with the lesions becoming more fibrous with longer duration. The classification using different tissue planes include: subcutaneous, intramuscular and fascial. The subcutaneous type is most prevalent and the intramuscular subtype is the least defined and is most commonly mistaken for a malignancy.

To our knowledge 45 cases of intraoral NF have been reported in the oral region. Int J Oral Maxillofac Surg 2006;35:924–7. and the results for the prevalence of intra-oral NF cases as reported in the literature Table 2: Prevalence of intra-oral NF cases as reported in the literature.

CONCLUSION
A rare case of intra-oral, lobular and exophytic gingival nodular fasciitis was presented. This is the ninth case report of this condition affecting the gingiva, and the 45th documented intra-oral case, to our knowledge. The differential diagnosis of exophytic gingival lesions should include NF. Appropriate stains should be applied to avoid the possibility of misdiagnosis as a malignancy. Recurrence is rare following surgical excision.

Acknowledgement:
Prof EJ Raubenheimer for providing the photomicrographs.

Conflict of interest:
No conflict of interest declared

References

Table 1: Sub-typing of nodular fasciitis based on histologic findings.

<table>
<thead>
<tr>
<th>Type</th>
<th>According to Cellularity</th>
<th>According to plane of tissue involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1- Myxomatous</td>
<td>Myxomatous</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>Type 2- Intermediate</td>
<td>Intermediate</td>
<td>Intramuscular</td>
</tr>
<tr>
<td>Type 3- Fibromatous</td>
<td>Fibromatous</td>
<td>Fascial</td>
</tr>
</tbody>
</table>

Table 2: Prevalence of intra-oral NF cases as reported in the literature.

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of Cases (Prevalence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buccal Mucosa</td>
<td>24 (53.3%)</td>
</tr>
<tr>
<td>Gingiva</td>
<td>9* (20%)</td>
</tr>
<tr>
<td>Lip</td>
<td>6 (13.3%)</td>
</tr>
<tr>
<td>Tongue</td>
<td>4 (9%)</td>
</tr>
<tr>
<td>Floor of Mouth</td>
<td>2 (4.4%)</td>
</tr>
</tbody>
</table>

* Includes this case report.

Table 3: Nodular fasciitis cases reported to occur on the gingival mucosa.

<table>
<thead>
<tr>
<th>Year</th>
<th>Age</th>
<th>Gender</th>
<th>Max or Mand</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>48</td>
<td>M</td>
<td>Max</td>
<td>14</td>
</tr>
<tr>
<td>1981</td>
<td>31</td>
<td>M</td>
<td>Max</td>
<td>15</td>
</tr>
<tr>
<td>1982</td>
<td>46</td>
<td>F</td>
<td>Max*</td>
<td>16</td>
</tr>
<tr>
<td>1986</td>
<td>19</td>
<td>M</td>
<td>Mand</td>
<td>17</td>
</tr>
<tr>
<td>1986</td>
<td>46</td>
<td>M</td>
<td>Mand</td>
<td>13</td>
</tr>
<tr>
<td>1989</td>
<td>15</td>
<td>M</td>
<td>Mand</td>
<td>18</td>
</tr>
<tr>
<td>2006</td>
<td>47</td>
<td>F</td>
<td>Max</td>
<td>1</td>
</tr>
<tr>
<td>2014</td>
<td>18</td>
<td>F</td>
<td>Mand</td>
<td>8</td>
</tr>
<tr>
<td>2015</td>
<td>27</td>
<td>F</td>
<td>Mand</td>
<td>Current</td>
</tr>
</tbody>
</table>

* Occurrence reported as palatal.

DISCUSSION
The term Jael's Syndrome is an oblique Biblical reference to the murder of Sisera by Jael in Judges IV, 21” “Sisera was so tired that he fell sound asleep. Then Jael took a hammer and a tent-peg, went up to him quietly, and killed him by driving the peg through the side of his head into the ground.” The first report of Jael’s syndrome is attributed to Jefferson (1968) who described a severe, accidental craniofacial injury to a 16 year old boy who was impaled on a tent peg. The term was further defined by McKechnie (1986) who reported a case in which a fence post was driven through the temple of a 21 year old accident victim. Other grotesque injuries of this type have been previously reported. According to Harris et al (1988) the term Jael’s syndrome is an intentional craniofacial stab injury. To be sure, these cases do not represent tent peg homicides of a somnolent victim as in tale of Jael and Sisera. Despite this, they can be defined as Jael’s syndromes since deliberate penetrating wounds of the face resulted from an assault. What is surprising is the complete absence of serious signs and symptoms in these two patients.

Reference
The profession of dentistry has both benevolent and protective aspects with regards to duty of care to patients, to always try to do the best for the patients and to fulfill the principle of non-maleficence – to do no harm. This principle expresses the concept that professionals have a duty to protect the patient from harm. Under this principle, the dentist’s primary obligations include keeping knowledge and skills current, knowing one’s own limitations and when to refer to a specialist or other professional. All dentists, whether generalists or specialists, have both legal and ethical responsibilities to their patients – legally they need to exercise reasonable skill and care and ethically they are obligated to always put the best interests of the patients first (above personal or professional interests) and to carry out treatment to the standard of care set by the profession.

General dentists are usually the first professional patients visit, seeking an evaluation of their oral and dental needs. The general dentist may then treat the patient or may refer the patient for specialty care depending on the conditions which have been assessed and diagnosed. This is because amongst general dentists there are differing levels of expertise, exposure to post-graduate training, and confidence in undertaking the treatment of more complicated and advanced dental conditions. When necessary, timely and appropriate referral is an ethical imperative which fulfills a professional duty to a patient. Failure to inform a patient of the need for specialist consultation and/or referral could result in violation of the ethical principles.

General dental practitioners are obliged to seek consultation whenever the welfare of a patient will be protected or may benefit by utilising those who have special skills, knowledge, and experience. Patients are referred to a specialist for many reasons including the complexity of the case, definitive diagnosis, behavioural problems, the patient’s medical history, the need for specialised investigations and tests. The general dentist is expected to recognize when specialist care is more appropriate for the patient’s needs and completion of the treatment plan and should then refer appropriately. This is stated in the Health Professions Council General Ethical Guidelines for the Health Care Professions1 as follows:

5.7 Access to Care

Health care practitioners should:

5.7.1 Promote access to health care. If they are unable to provide a service, they should refer the patient to another health care practitioner or to a health care facility where the required service can be obtained.

6.1 Referrals to Colleagues

6.1.1 Act in their patients’ best interests when making referrals and providing or arranging treatment or care. They should not ask for, or accept, any undue inducement or incentive, from colleagues to whom they refer patients because it may affect or be seen to affect the health care practitioner’s judgement.

6.1.2 Treat patients referred to them in the same manner in which they would treat their own patients.

On occasion, patients may decline the offer of the general dentist’s referral to a specialist. Provided that the treatment is within the limits of the dentist’s competence, and that the patient understands that a higher standard of care might be obtained from a specialist, one would still be satisfying the requirement of duty of care. However, if one acquiesces to the patient’s request, in circumstances where the treatment falls beyond the skills, training and expertise required, and one fails to make sure that the patient understands this, then it would become much more difficult to refute any allegation of a dereliction of duty of care.2 Therefore when a patient is referred for specialist care both the referring practitioner and the receiving specialist need to ensure that they arrange a smooth transfer.

All referrals should always be conducted in a professional manner, respecting the usual professional courtesies which one would expect between two healthcare professionals. Clear and effective communication between all parties is essential in the referral process. The referring general dentist should be cognisant of the following guidelines and responsibilities to ensure that the patient is provided with the required level of professional care.
COMMUNICATION BETWEEN THE REFERRING DENTIST AND THE PATIENT

- The patient should be informed of the rationale for the referral and the procedures and protocols involved. These include the reason and purpose of the referral, the expected nature and scope of the procedures involved, and the anticipated outcome of the referral and treatment.
- The choice of a specific specialist should take into account any patient preference.
- Referral correspondence should be written in the expectation that the contents could be read by the patient, or by any professional colleague who is referred to in the text.
- The patient should be informed that all relevant information will be sent to the specialist in advance of the consultation appointment.
- The patient should be given information that will assist in the introduction to the specialist, educational material, contact details and directions to the specialist’s practice.

COMMUNICATION BETWEEN THE REFERRING DENTIST AND THE SPECIALIST

It is preferable that the referring dentist conveys, in advance, all information that will assist the specialist in providing a complete consultation to the patient. Referrals letters should include, but are not limited to:

- The patient’s name, age and contact information (address & telephone numbers)
- Clear instructions on the nature, scope and reason of the referral and expectations of the referring dentist.
- Relevant treatment and background information;
- Relevant medical history that may necessitate prophylactic antibiotic coverage or any other precautions prior to the consultation.
- Projected treatment needs following the referral.
- In addition, relevant records and materials such as radiographs, laboratory reports, models and other medical or dental information that would assist the specialist in the assessment of the patient should be included.

Problems can sometimes arise when the second dentist accepts the patient for their future care, when the original dentist was expecting the patient to be referred back. This may be on account of the patient’s stated wishes – but this process must be transparent, and the patient’s decision should be communicated back to the original dentist so as to avoid the perception that the patient may have been unfairly influenced to change dentists – an action that is widely considered to be unethical.

COMMUNICATION BETWEEN THE SPECIALIST AND THE PATIENT

The patient would need to be informed by the specialist’s practice details of the appointment time, date and the practice location. The specialist has the responsibility to provide a consultation and treatment for patients while ensuring that the procedures performed are in compliance with the overall treatment plans and goals established by
the GDP and patient. The following protocol should be considered to achieve delivery of optimal treatment and to provide continuity of care for the patient while maintaining professional etiquette between the health professionals who share the responsibility for the patient’s care:

- Treatment provided by the specialist should be limited to the nature, scope and reason outlined in the referral. If the specialist determines that additional or alternative treatment is recommended or required, she/he should discuss these issues with the patient and the referring dentist before proceeding with treatment.
- Alternatively, if the specialist, upon reviewing the referral letter and after consulting with the patient, deems that the treatment suggested by the referring dentist is not in the patient’s overall best interest, then she/he should communicate with the referring dentist and the patient to come to a mutual agreement regarding the management of the patient.
- The specialist should not duplicate and charge for procedures already performed adequately by the referring dentist.

After the consultation, the specialist should provide the patient with information to enable an informed decision regarding management of the problem. This information should include:

- A diagnosis, recommended treatment and possible prognosis
- Discussion of risks, benefits, advantages and disadvantages and costs of treatment alternatives
- The need for any future treatment, follow-up and maintenance; and
- The expectation that the patient will return to the referring dentist for on-going dental care.

**COMMUNICATION BETWEEN THE SPECIALIST AND THE REFERRING DENTIST**

- The specialist’s practice should confirm to the referring dentist receipt of the patient referral and the timing of the scheduled consultation appointment. The referring dentist should be informed if the patient fails to keep the consultation appointment.
- If the specialist believes that continued treatment over the longer term is necessary or desirable, the general dentist should be consulted about this decision and should receive regular treatment updates and reports. The specialist should also discuss with the referring dentist when the patient is expected to return to the generalist’s practice for continued treatment or maintenance.
- If treatment had been delayed or interrupted or significantly modified, the referring dentist should receive a progress report in this regard
- If the specialist deems the need for care outside his/her specialty, the general dentist should be consulted to determine whether the patient’s need will be met by the general dentist or by another specialist and, if the latter, the general dentist should be involved in the choice of the specialist to whom onward referral will be made. If there are inter-specialty referrals, the general dentist should receive detailed consultation reports and a record of all treatment rendered or recommended by the specialists.
- After the consultation, the specialist should provide the referring dentist with a detailed consultation report, including a diagnosis, treatment options, and an account of all treatment rendered or recommended. Reports should be provided in a timely manner.
- The specialist should provide the referring dentist with relevant diagnostic quality copies or duplicates of radiographs or digital images taken by the specialist.
- The specialist should provide the referring dentist with relevant copies of any diagnostic test results, consultation letters or other information obtained.
- When the requested treatment has been completed the specialist should ensure there is provision for the patient to return to the referring general dentist, unless the patient expressly requests differently without prompting or persuasion from the specialist.
- A final report should be sent to the referring dentist at the end of treatment when the patient is returned to his/her care.
- Self-referrals by patients to specialists may occur without the knowledge of a general dentist. When this occurs, the specialist should take reasonable steps to ensure that the patient is aware of the pitfalls of not having a general dentist oversee their comprehensive dental care and try to advise the patient accordingly.
- When a consultation is provided on the basis of a self-referral by the patient, the patient’s general dentist should, with the patient’s permission, be sent a report in order to keep the patient’s records current.
- In some instances, patients may not wish to return to the referring dentist, and request referral to a new general dentist. It is prudent for the specialist to inform the patient that professional ethics prevent further referral until the patient has discontinued the existing professional relationship with the original dentist. Further, it is also prudent for the specialist to not recommend a particular practitioner but to provide a list of dentists practicing in the area convenient to the patient.

**CONCLUDING REMARKS**

Interestingly, while general dental practitioners are entitled to carry out all dental procedures including those falling within the scope of specialists (provided that they have necessary education and training), specialists are restricted to practicing only within the ambit of the specialty or category in which they are registered. General dentists should recognise that there are many circumstances when patient needs, convenience and resources must be taken into account as part of the referral process. The relationship between general dentists and specialists should be governed by mutual respect, trust and professional etiquette.

**References**

2. Ethics, values and the law. DPL Dental Ethics Module 4: Duty of Care. 2009
3. Ethics, values and the law. DPL Dental Ethics Module 11: Relating to colleagues. 2009
Skeletal muscle relaxants interrupt the pain-spasm-pain cycle¹

Stop the vicious cycle of muscular spasm¹, including Temporomandibular disorder (TMD)²

Increase in muscle tone → Jaw muscle pain

References:

Proprietary name (and dosage form): NORFLEX CO Tablets.
Composition: Each tablet contains 35 mg Orphenadrine citrate and 450 mg Paracetamol.
Pharmacological classification: A.2.9 (Other analgesics).
Reference number: B 1098 [Act 101/1965]; Scheduling status: S2

Proprietary name (and dosage form): NORFLEX Tablets.
Composition: Each tablet contains 100 mg Orphenadrine citrate.
Pharmacological classification: Category: A.2.10 (Centrally active muscle relaxants).
Reference number: H 1612. [Act 101/1965].

Name and business address of applicant:
iNova Pharmaceuticals (Pty) Ltd,
Co. Reg. No. 1952/001640/07, 15e Riley Road, Bedfordview. Tel. No. 011 087 0000 www.inovapharma.co.za

For full prescribing information see South African Medicines Schedule 129 CO Tablets. For full prescribing information see South African Medicines Schedule 129 Tablets.

IN2264/16.
As technology continues its exponential increase in applications for dentistry, computer-aided design and computer-aided manufacturing (CAD/CAM) is becoming a common feature in the dental office. The transformation of the clinical situation into a three-dimensional dataset in the production process of dental restorations via CAD/CAM technology can be achieved by direct or indirect digitalization. Indirect extraoral digitalisation starts with a conventional impression that is processed to a gypsum cast and then digitalized in the dental laboratory whilst direct digitalisation does not require the use of an impression material and trays, leading to improved patient comfort and reduced technique sensitivity. Using intraoral scanners, an accurate digital record of the contours of the soft and hard tissues is possible, and a virtual, three-dimensional model is directly produced. This three-dimensional stereolithography file can then be transferred to an automated production device. Although there have been advances in impression material technology in providing adequate stability and precision, factors such as impression technique, impression trays, mixing techniques and transportation have been found to significantly influence the accuracy of the impression which impacts on the marginal fit of the restoration.

A consensus exists among various authors that marginal openings below 120 μm are clinically acceptable. CAD/CAM systems were introduced to dentistry with the aim of automating the production and standardising the quality of dental restorations. Moreover, CAD/CAM technology enables the use of new restorative materials, e.g., oxide ceramics such as yttria-stabilized zirconia, hybrid ceramics resin nano-ceramics, zirconia reinforced lithium silicate, and pre-sintered cobalt-chrome alloys, and also allows digital veneering workflow in the dental laboratory.

Ahrberg and colleagues (2016) reported on a randomized clinical trial that sought to assesses the clinical fit of CAD/CAM-generated zirconia frameworks of single crowns and three-unit FDPs after indirect and direct digitalisation, and compares the efficiency of the impression methods. Two null hypotheses were defined for this study. The first null hypothesis was that single crowns and three-unit FDPs with zirconia frameworks fabricated from direct (computer-aided impression group; CAI) and indirect digitalisation (conventional polyether impression group; CI) would show equal values for marginal and internal fit. The second null hypothesis was that no difference in working time would be found between the two methods.

**MATERIALS AND METHODS**

This prospective, randomized clinical trial from Germany consisted of 25 patients (15 females and 10 males) who had indications for indirect restorations. Seventeen single all-ceramic zirconia crowns and eight three-unit all-ceramic zirconia FDPs were fabricated and selected for evaluation of the fit between the frameworks and the abutment teeth under clinical conditions.

The exclusion criteria were as follows: a periodontal screening index >2, poor oral hygiene, bruxism, patients under the age of 18, and polyether or adrenaline intolerance. Two dentists with CAD/CAM experience in a private practice...
were assigned to treat the patients. Both examiners had undergone training in intraoral scanning; however, one dentist dropped out shortly after the study began, because of a severe health condition, and was not replaced.

The clinical procedures were standardised for all patients. Prior to preparation, all patients received local anaesthesia. Preparation of the abutment teeth was performed with distinct chamfer finish lines, where the location of the finish lines was considered optimal at an equigingival or 0.5-mm subgingival level. Guidelines for abutment tooth preparation for all-ceramic reconstructions comprised a tapering of the axial walls by 6–10°, a circumferential reduction of the tooth between 1.2–1.5 mm, and an occlusal reduction of approximately 2 mm. All edges were rounded using Arkansas stones and polishers. Temporary restorations were fabricated using a Bis-GMA Composite (Protemp 4) and seated with a non-eugenol temporary cement (Reliant Temp).

Approximately one week after preparation, the patients returned for a second appointment. The teeth were prepared for impression with two retraction cords, sizes #0 and #1 (Ultrapak), soaked in aluminum sulphate liquid (ORBAT Sensitive). The retraction cords were placed in the sulcus; the size #0 cord remained in the sulcus during the entire impression-taking procedure, and the size #1 cord was removed prior to impression-taking to allow an accurate display of the preparation and surrounding soft tissues. The same retraction cord technique was used for both the computer-aided impression group (CAI) and the conventional polyether impression group (CI).

For each patient, the impression method was randomly allocated by a sealed envelope chosen by the patient, with both the patient and examiner blinded to the group allocation. To evaluate the efficiency of intraoral scanning versus the conventional impression technique, the total working time was recorded with a stopwatch, with each step involved in the impression procedure recorded individually. The working time was defined as that time required to achieve an impression which met the acceptance criteria. Impression retakes and rescans of missing areas were recorded as additional time.

Direct digitalization was done with the Lava Chairside Oral Scanner (Lava C.O.S.). To enable the scanner to detect intraoral surfaces, a thin layer of titanium dioxide powder (Lava Powder for Chairside Oral Scanner) was applied. The superiorly placed retraction cord was removed, and the abutment teeth were lightly powdered. Phase One of time recording began with the powdering.

The scanning protocol for single crowns involved a quadrant scan capturing the prepared tooth, the opposing quadrant, and the buccal aspect of these quadrants in the intercuspal position. For three-unit FDPs, the scanning protocol consisted of a full-arch scan of the prepared teeth, the opposing quadrants, and the left and right buccal aspects with the teeth in the intercuspal position. After powdering, Phase Two (computer-aided impression of the prepared teeth) and Phase Three (computer-aided impression of the opposing teeth) of time recording were initiated. Phase Four of time recording began at the start of the bite registration procedure.

In total, the beginning sequence occurred 11 times with the computer-aided impression and 14 times with the conventional impression method.
impressions demonstrated significantly better marginal fit than those fabricated from conventional impressions. Additionally, both Zirconia frameworks of single crowns and three unit FDPs fabricated from computer-aided and conventional impressions showed clinically acceptable marginal fit.

They also concluded that computer-aided impressions may be more time efficient for both quadrant scans and full-arch scans when compared with conventional impressions.

**IMPLICATIONS FOR PRACTICE**

The benefits of direct digitisation techniques have been well demonstrated in this trial and should be especially useful for patients who gag easily or suffer from extreme discomfort during the impression taking process. Also direct digitization saves time and eliminates the impression taking and pouring process which is also subject to its own issues in terms of inaccuracies. In essence, as these digital systems become more developed, the argument for continuing with the older methods will make even less sense.

**Reference**


**2. A randomised clinical trial on the use of intermediate bonding on the retention of fissure sealants in children**


The effectiveness of pit and fissure sealants in preventing caries in permanent molars has been proven beyond any doubt in a number of high quality trials and systematic reviews. Resin-based sealant materials are most commonly used and are regarded as the ‘gold standard’ for sealing pits and fissures. Their caries-preventive effect relies on the sealing of pits and fissures through micro-retention, created through tags after acid etching of enamel. However, these are easily destroyed by saliva contamination, reducing micro-retention and consequently, the caries-preventive effect. The preventive benefits and resin-based sealant retention are gained and maintained only as long as the sealants remain completely intact and bonded in place.

Recently, studies have been done wherein bonding agents have been used to try an improve the retention rate of resin based sealants.

McCafferty and O’Connell (2015) reported on a randomised clinical study that sought to compare the retention of fissure sealants on first permanent molar teeth and surfaces to determine whether the addition of an ethanol-based etch-and-rinse primer and adhesive system significantly improved sealant retention after one year. The effect of the participant’s behaviour on the retention of the fissure sealants was also assessed.

**MATERIALS AND METHODS**

Healthy children aged 5–16 years were identified via routine assessment clinics and treatment planned for fissure sealants of first permanent molars. A randomised split-mouth design was used. Paired, fully erupted, maxillary or mandibular molars were selected for fissure sealants as they would be exposed to the same oral environment and similar occlusal forces. One trained operator together with a dental assistant performed treatment for all participants. The matching arch-paired first molar were randomly designated to receive a bonded sealant (study group) or a conventional sealant (control group). Randomisation of the arch, tooth, and bonding was carried out using a coin toss by the nursing assistant on the day of treatment. The type of sealant placed on each tooth was recorded on a data collection sheet. The behaviour of the child was scored and analysed at the end of treatment based on the four-point Frankl Behaviour Rating Scale where 1 was “Completely uncooperative, crying, very difficult to make any progress” and 4 was “Completely cooperative and even enjoys the experience”.

The technique for placing each sealant was standardised. The pit and fissures of the tooth were air-dried for five seconds to remove saliva. Total etch (37% phosphoric acid) was applied to the pit and fissure surface of each tooth for 30 seconds. The etchant was removed using water, air, and high-volume suction until the tooth appeared frosted. Both
the bonding and fissure sealant bottles were agitated for ten seconds before application. Teeth in the study group had a layer of Excite F bond applied to the pit and fissure surface of the tooth with a microbrush and air thinned to allow the adhesive penetrate the fissure anatomy. Helioseal was then immediately placed on the fissures on the tooth using the tip. The light cure tip was placed as close as possible to the tooth surface, and both materials were photopolymerized for 40 seconds simultaneously. In the control group, teeth were etched and the fissure sealant placed and cured in the same way as described above, the only difference being that no bonding adhesive was used. Each sealant was checked for retention using a periodontal probe. No occlusal adjustment was performed. One year after placement, all sealants were reviewed by two blinded examiners.

At the review appointment, each pit and fissure had a visual and tactile assessment of retention of the sealant. The sealants were scored as intact, partially intact, or not intact for each surface (occlusal, palatal, and buccal). Partially intact and missing sealants were grouped together during statistical analysis. The data were analysed using GraphPad InStat 3.0 statistical software. Fisher’s exact test was performed with a significance level of P < 0.05.

RESULTS

A total of 112 patients (56% male and 44% female) with 424 erupted first permanent molars (848 surfaces) participated in this study. The mean age was 8.3 years with a range of 5.1–15.5 years (median age 9 years). Nine patients with 32 fissure sealed first molars were lost to follow-up (four patients had emigrated and five patients failed to attend). The remaining 103 patients with 390 sealed first molars were reviewed at 12 months and included for statistical analysis. Ninety-two patients received fissure sealants on all four-first permanent molars, and 11 patients received two fissure sealants on paired first permanent molars. Excellent intra-examiner and inter-examiner agreement was achieved (Cohens kappa score of 0.81).

The results showed that the higher the participant’s behaviour score (Frankl Behaviour Rating Scale), the greater the number of intact sealants recorded at 12 months (P<0.0001). The majority of children (94%) had a behaviour score of four and were very cooperative. Children with a behaviour score of three had lower sealant retention (67%), and the two participants with a behaviour score of two had only 25% sealants intact after one year.

At 12 months, more bonded sealants (92%) were intact compared with control sealants (79%) when all surfaces are combined (Fisher’s exact test P = 0.0005). No significant difference was noted for sealant retention on occlusal surfaces between the bonded (98%) and control sealants (93%) (P=0.08). Retention of sealants was lower on buccal or palatal surfaces than on occlusal fissures. There was a significant increase in the retention of bonded (92%) compared to conventional sealants (82%) on these surfaces (P = 0.0005).

A difference in sealant retention was also noted between the dental arches. In the maxilla, the retention of the bonded sealants (96%) was significantly greater than the retention of conventional sealants (75%) (P = 0.0001). Sealant retention on the occlusal surface of the maxillary molars was excellent, 100% for the bonded and 93% for the conventional sealants (P = 0.03). The number of intact sealants on the palatal surfaces was significantly higher for the bonded group (95%) compared with the conventional group (75%) (P = 0.0004). There was no significant difference in the retention rate of bonded and conventional sealants in mandibular molars, 89% and 84%, respectively (P = 0.41). Sealant retention was high for mandibular occlusal surfaces for both bonded 97% and 92% conventional sealants. Use of bonding agent had no effect on retention of sealants on the buccal surfaces of the mandibular molars. The variables identified in this study that significantly impacted the retention of resin fissure sealants were the use of the intermediate bonding agent; surface of the tooth and the behaviour of the patient were identified via logistic regression analysis (P = 0.0001).

CONCLUSION

This study has shown that addition of an ethanol-based bonding agent significantly increases the retention of resin sealants on first permanent molars at 12 months on all surfaces (P = 0.0005).

IMPLICATIONS FOR PRACTICE

This study reinforces the knowledge that the patient’s behaviour during the placement of fissure sealants significantly affects the retention of the sealants regardless of the additional bond layer (P = 0.001). Clinicians should advise parents of the reduced preventive effect of sealants where behaviour has been uncooperative for sealant placement. This is one of the very first trials that has been done on this topic but the promising results suggest that resin composites can be more effective when they are placed along with a bonding agent.

Reference

CPD Questionnaire

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

GENERAL

Epithelial cell rests of Malassez: from quiescent remnants to front-runners in periodontal homeostasis and regeneration. A brief review. (p 54)

1. Epithelial cell rests of Malassez represent the sole odontogenic epithelial cells in the periodontium
   a. True
   b. False

2. Epithelial cell rests are remnants of Hertwig’s epithelial root sheath.
   a. True
   b. False

3. Epidermal growth factor enhances osteoclastogenesis in which of the following manner(s):
   a. Inhibition of osteoprotegerin (OPG)
   b. Enhancement of the expression of monocyte chemoattractant protein-1 (MCP-1)
   c. Enhancement of receptor activator of nuclear factor kappa-b ligand (RANKL)
   d. a and b
   e. a and c

Penetration of hydrogen peroxide into the pulp chamber after conventional and laser-assisted bleaching. (p 58)

4. An increased penetration of hydrogen peroxide into the pulp induces oxidative stress, inhibition of pulpal enzymes, inflammatory pulp reaction, and subsequently postoperative dental hypersensitivity.
   a. True
   b. False

5. Hydrogen peroxide penetrates dental tissues as it has a low molecular weight, in addition to the ability to denature proteins and replace ions, which amplifies the depth and amount of penetration.
   a. True
   b. False

6. The concentration of hydrogen peroxide must reach 10,000 µg before there is a negative effect on pulp enzymes.
   a. True
   b. False

Glucocorticosteroids in the treatment of immune mediated oral diseases. (p 62)

7. The production of cortisol is induced by pituitary adrenocorticotropic hormone (ACTH) which in turn is under the positive control of hypothalamic corticotrophin-releasing factor (CRF).
   a. True
   b. False

8. Intermediate acting prednisone remains the systemic drug of choice and in severe acute cases of immune mediated blistering, desquamative, erosive or ulcerative oral diseases, treatment can start with a dosage of prednisone of 1-1.5mg/kg/day:
   a. True
   b. False

9. Generally, very potent topical glucocorticosteroids may safely be used continuously for a period longer than four weeks.
   a. True
   b. False

10. Opportunistic oral infection with candida is an uncommon complication of the use of oral topical glucocorticosteroids.
    a. True
    b. False

Patterns of previous tooth loss in patients presenting at five different types of dental practice. (p 70)

11. When maxillary or mandibular teeth are missing it is most likely that it is the canines which will have been lost.
    a. True
    b. False

12. The 804 patients were together missing 7048 teeth, an average of nearly nine teeth per patient.
    a. True
    b. False

Forensic dentistry case book 6: A self-inflicted bite mark; a case report (p 76)

13. When a bite mark occurs on the lower arm it is important to consider self-infliction as a possibility.
    a. True
    b. False
Maxillo-Facial Radiology Case 138 (p 81)
14. The term Jael’s syndrome was defined by Jael?
   a. True
   b. False

15. Stab wounds of the maxillofacial region are a very uncommon injury?
   a. True
   b. False

Oral medicine case book 72: A rare case of Nodular Fasciitis affecting the mandibular gingiva (p 78)
16. Intraoral Nodular Fasciitis is rarely encountered and the most common intraoral site is the buccal mucosa.
   a. True
   b. False

17. Diagnostic alternatives for Nodular Fasciitis are Pyogenc granuloma, pregnancy epulis, fibrous epulis and peripheral giant cell granuloma.
   a. True
   b. False

Clinical windows (p 86)
18. Both direct and indirect digitization requires the taking of an impression.
   a. True
   b. False

19. The computer-aided impression was more time efficient when compared with a conventional impression.
   a. True
   b. False

20. In the fissure sealant trial, the adhesive and the sealant liquid were light cured separately.
   a. True
   b. False

ETHICAL
Referrals – practitioner, patient & specialist obligations (p 82)
21. General dental practitioners are obliged to seek consultation whenever the welfare of a patient will be protected or benefit by utilising those who have special skills, knowledge, and experience.
   a. True
   b. False

22. “First do no harm” – non maleficence is one of the guiding principles of the healthcare sector.
   a. True
   b. False

23. Referral letters should include:
   a. The patient’s name, age and contact information (address & telephone numbers);
   b. Instructions on the nature, scope and reason of the referral and expectations of the referring dentist;
   c. Relevant treatment and background information.”
   d. Relevant medical history that may necessitate prophylactic antibiotic coverage or any other pre-cautions prior to the consultation.
   e. All of the above

24. One of the dentist’s primary obligations is to keep their knowledge and skills current, know one’s own limitations and when to refer to a specialist or other professional.
   a. True
   b. False

25. After a consultation, a specialist should provide the referred patient with the following information:
   a. diagnosis, recommended treatment and possible prognosis
   b. discussion of risks, benefits, advantages and disadvantages and costs of treatment alternatives
   c. the need for any future treatment, follow-up and maintenance
   d. the expectation that the patient will return to the referring dentist for ongoing dental care.
   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.

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   b. as a record of communication regarding the patient and other health care providers.
   c. to protect the legal interests of all parties involved.
   d. for billing, quality assurance, and other administrative functions.
   e. all of the above.

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E-mail: c.niemann@inovapharma.co.za

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Karel Viviers
Tel: 011 745 6000
E-mail: karel.k.viviers@gsk.com

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Tel: 0800 111 796
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Sharon Fisher
Tel: 011 477 0878
E-mail: sharon.fisher@dentsply.com

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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
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References

1. Phargel® Package Insert Approved February 2012.

Distributed by Pharmaco Distribution (Pty) Ltd. 3 Sandown Valley Crescent, South Tower, 1st Floor, Sandton, 2198. PO Box 786322, Sandton, 2146, South Africa. Tel: +27 11 784 0077.
Website: www.pharmaco.co.za