

*Queen Elizabeth the 1st
of England*



Queen Elizabeth the 1st of England: Elizabeth the 1st is reputed to have suffered terribly from dental problems. Her teeth are described by visiting diplomats as being black and her speech as difficult to understand due to many missing teeth. Historians put the problem down to the arrival of sugar in Tudor England ...to which Elizabeth became addicted.

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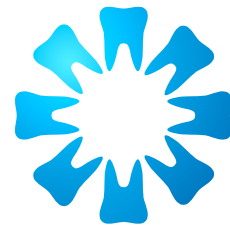
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Our Front Cover for this Issue...

Teeth have on occasion been central to historical, social and humorous events. The Front Cover in 2019 will reflect some of these Famous Teeth.



Queen Elizabeth the 1st of England: Elizabeth the 1st is reputed to have suffered terribly from dental problems. Her teeth are described by visiting diplomats as being black and her speech as difficult to understand due to many missing teeth. Historians put the problem down to the arrival of sugar in Tudor England ... to which Elizabeth became addicted.

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Electronic publications... the ORCID's and the Orchids

SADJ April 2019, Vol. 74 No. 3 p107

WG Evans



The electronic publishing world opens many doors and opportunities - the prospect of more immediate publishing, the possibility of reaching a much wider readership, the reduction in printing and postage costs, the release of constraints imposed by having to accommodate to a strict printing protocol. With an eye to history, and in homage to the famous printing press invented by Johannes Gutenberg in the 15th century, the first foray into electronic printing, named Project Gutenberg, was by Michael S Hart in 1971. He intended to render the printed word more accessible through the Internet. An admittedly slow start saw only ten texts available on computers by 1989... but the indefatigable Hart developed Project Gutenberg and is now Director of the company which in January this year recorded some 58000 books available to computer readers. This pales into insignificance however when it is reported that Google Books now have 25 million books on line from a hundred countries and in 400 languages... achieved in these few years from inception in 2004. It is estimated that there are some 130 million titles worldwide, all of which Google intends to capture online!

An impressive, indeed awesome record. Academia was amongst the first to respect the advantages of being online and the 2009 Report of the International Association of Scientific, Technical and Medical Publishers recorded that 96% of the journals in that stable were indeed available on line. Smaller numbers are produced on Open Access, around 8000 being in that freely available format. If it is realised that the world produces over 25,400 scholarly Journals, the attraction of electronic publishing becomes pragmatic.

There is always a downside, of course. The loss of a hand held publication, one in which the pages offer themselves as windows to be opened to find the treasures within, the actual feel of the paper, the readiness with which the Journal could be stored in a pocket ready to be opened during a train journey or at any other snatched opportunity of time... those losses are deeply felt. A serious loss is the decline in advertisements... rightly or wrongly, the commercial world consider it less likely that readers of an electronic production will spend any time looking at the adverts. Here our Journal at once acknowledges warmly the continued support of many Dental Supply houses and other commercial enterprises. Their contribution to the scientific endeavour is crucial and deeply valued. But importantly, the very attribute that electronics offer, the capacity to store, to process, to recall data... has also resulted in additional requirements to enable maximal handling of publication data.

Every paper has a unique identifier, all papers are subject to categorisation in large data banks, submission to the various platforms involve special formats, with the list of requirements growing over time. One of the more recent dictates is the scheme to have a common register for every author. The advantages are obvious... a unique number will enable researchers to instantly locate publications, to evaluate the publication record, to ensure that plagiarism is avoided. The scheme has an intriguing name: Open Researcher and Contributor ID. The system is described as a non-proprietary alphanumeric code to uniquely identify scientific and other academic authors and contributors. The name attenuates to the acronym ORCID ...and my 16 digit ORCID is 0000 0002 8132-4829. At the time of writing there were 5,987,657 ORCID already issued. This issue of the South African Dental Journal carries at least one ORCID to identify for all time the author.

All authors are to be required to register and all papers must in future carry the ORCID of at least the principal author. Registration is straightforward and quick, with a warm welcome. We are then engulfed in the electronic world... although there may be a strange link with biology, for the pronunciation of the acronym ORCID is precisely that of the botanical word ORCHID. These flowers of mystique, of perfection, of unique beauty, belong to the family Orchidaceae, of which there are 880 genera and some 26000 species worldwide. Each flower has the intrigue of perfection. But wait... whence the name Orchidaceae, given originally by Carl Linnaeus who in 1753 recognised eight varieties? In 1845 John Lindley shortened the term to Orchid, apparently recorded in a book on School Biology. So the etymology? From Greek *Orkis*, from Latin *Orchis*, both meaning "testicle". How so? Examine the roots of an orchid and the resemblance is evident. There are many comments which spring to mind, but the most genteel is that in human terms, both are usually kept hidden.

This issue of the Journal breaks new ground with the inclusion of ORCID's... but retains a firm hold on the essentials... *vide* one of our lead papers which reports on some alarming findings in our routines to control microbial contamination in our laboratories. It is almost paradoxical that with all our meticulous attention to infection control in the surgery, we may lose that basic attention in the laboratory. Moving from the basics to the almost esoteric, consider the exciting opportunities described in a paper discussing applications of cellular biology in endodontics. Whether we are turning the pages by hand or are relying on the computer to do this, there are indeed hidden treasures to be found!

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Communique by CEO

SADJ April 2019, Vol. 74 No. 3 p108

KC Makhubele



Head Office was actively busy in March 2019 in preparation for the 19th Annual General Meeting of the Association. It was an also incredible privilege for me to attend my third Annual General Meeting of our members as Chief Executive Officer. It is important for us to appreciate these opportunities to connect with our membership; after all that's what it is all about for us - successful inclusion of members. In addition to presenting the usual statutory and legal requirement requiring approval by members, including the Audited Financial Statements, voting members were also requested to approve a change in the financial year end of the Association.

The financial year of the Association was changed to coincide with the calendar year and to provide for this, the Association's constitution also required an amendment. Aligning the financial year to the calendar year made sense since it then also aligns with the membership year (1 January to 31 December). The change in financial year end would also greatly assist in operational matters during audit and renewal processes. It would allow the Association to decide on a Congress date without concern about whether budget, income and expenses fall within or outside of the financial year. It also enables Branch plans and budgeting for their annual events and for reporting back to members to be more synchronised.

The SADA's 2017/18 Annual Integrated Report for the period 1 October 2017 to 30 September 2018 was available to members and other stakeholders, presenting a holistic view of SADA's business model, governance, strategy, and performance. It contained reports on operations at the Head Office and Branches countrywide, with the framework of reference being key risks and opportunities that impact on both private and public oral healthcare services. Summarised Audited Financial Reports were also contained in the Annual Report to provide members with an overview of the financial status.

The Annual Meeting was followed by a two day meeting of the National Council where Branch representatives participated in a strategy workshop to provide input into the formulation of the new SADA Strategy for the following three years from 2020 - 2021. The new strategy will guide the business plan of the Association. National Council also considered the report of the Nominations Committee and elected six Dentist Directors for appointment to the SADA Board, in addition to agreeing to retain four directors who were eligible and agreed to serve for a second term of two years. A further two Directors were elected from four candidates recommended by the Nominations Committee. One of the

nominees so recommended withdrew his availability due to his commencing studies overseas. The National Council were also requested to elect the Chairperson and Vice Chairperson of the Board. The Dentist Directors elected by National Council are Dr R Putter (Chairperson), Dr N Osman (Vice Chairperson), Dr S Pieters, Dr FC Meyer, Dr EK Naidoo and Dr S Swanepoel. Congratulations and best wishes!

We also bid a fond farewell to Dr Yvette Solomons, who has served with distinction for the past six years as Chairperson of the Board. I have truly enjoyed getting to know the profession through the guidance of Dr Solomons and we spent many hours working together to improve the professional lives of our members. The past two and half years has seen us begin to lay a foundation upon which the Association will continue to be built in years to come.

The compilation of Relative Value Units (RVUs) for dental codes, initiated in 2018 with consultants, has progressed so well that we were able to secure an abundance of survey responses from general practitioners and specialists. A draft report has been prepared by the consultants and, together with the results of previous RVU surveys, a final draft will be considered by the RVU Steering Committee. We are confident that the final RVU results will be completed in the next quarter. In addition, the Association will be reviewing dental codes, bringing these up to date with the latest technology, procedures and guidelines.

Well underway is the planning and organising of the 2019 Dental & Oral Health Congress and Exhibition which is to be held between 30 August and 1 September at the Albert Luthuli International Conference Centre in Durban.

The theme for this year's congress is "From Start to Finish: Back to Basics". The programme has been partially finalised with the international speakers, with further planning of local speakers, parallel programmes for specialists and allied oral health care professionals. I would like to invite all members to register early and to take advantage of the Early Bird specials. Participate in the premier event in the dental calendar!

Head Office commitment over World Oral Health month



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World Oral Health month - March - and Head Office were out there delivering the message on oral health to many learners... the picture show attentive classes, listening closely to Dr Nosipho Mzobe demonstrating the esoterics of tooth brushing! More than 600 pupils at each of three schools visited by the Head Office team. Well done!



Image 1. Attentive audience.



Image 2. The Head Office team on stage.



Image 3. Dr Mzobe doing her thing for Oral Health.



Image 4. The classes arranged by uniform!

Current and future perspectives for dentin-pulp tissue engineering - an update

SADJ April 2019, Vol. 74 No. 3 p110 - p114

S Srivastava

SUMMARY

The isolation of dental pulp stem cells in 2000 set the scene enabling tissue engineering to generate dental pulp, leading to the possibility of further root development and the reinforcement of dentinal walls by deposition of hard tissues. These developments would be of clinical interest for dentists in endodontics, in which exciting areas of endodontic research are emerging. In roots having thin dentinal walls, there is a risk of fracture when mechanical preparation of the root canal is undertaken. The innovative option of regenerative endodontic procedures could prove to be an effective approach in these cases. This review is an attempt to update on the current trends.

INTRODUCTION

Regenerative endodontics provides the hope of converting the non-vital tooth into the vital state once again, focusing on substituting the traumatized and pathological pulp with functional pulp tissue. The technique has been defined as "a biologically-based procedure designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex".¹

The foundation for regenerative endodontic procedures (REPs) was established by Nygaard-Ostby who observed that the formation of a blood clot was not only desirable, but also sought after as a means of ensuring adequate healing.² Despite some shortcomings, this pioneer study laid the foundation for subsequent investigations in the field of regenerative endodontics. In 2004, Banchs and Trope³ published a case report describing a new treatment procedure in the management of the open apex, called "revascularization". Unlike traditional apexification or the use of apical barriers, revascularization procedures allow for an increase in both the length of the root and the thickness of the root wall. Hargreaves et al. recommended the interplay of stem cells, bioactive molecules and bioactive scaffolds, forming a triad during REP therapies, which aims to reestablish the micro-environments suitable for regeneration of desired tissue.⁴

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ACRONYMS

BMP: Bone Morphogenic Protein
DPSC: Dental Pulp Stem Cells
LIPUS: Low-Intensity Pulsed Ultrasound
MSC: Mesenchymal Stem Cells
NETs: Neutrophil Extracellular Traps
PRF: Platelet-Rich Fibrin
PRP: Platelet-Rich Plasma
REPs: Regenerative Endodontic Procedures
SCAP: Stem Cells of Apical Papilla
VEGF: Vascular Endothelial Growth Factor

A dental stem cell is a self-renewable cell type in the tooth, involved in developing, or in the maintenance of adult dental tissues. Their growth and differentiation are dependent on the release by the dentine niche of growth factors or bioactive molecules. The dentine niche describes an environment conducive to tissue regeneration. The success of vital pulp therapies like pulp capping and pulpotomy are based on the ability of surviving stem cells of the remaining vital dental pulp to help in repair. A dental niche having even small fragments of residual vital pulp tissue will increase the success of regeneration of the damaged tissue.¹⁰

Bioactive molecules are signaling molecules or chemical cues that control a variety of cellular responses through specific binding of transmembrane or intracellular receptors in a target cell.⁵ The bone morphogenic protein (BMP) superfamily of proteins such as BMP-2, BMP-4, BMP-7, and transforming growth factor beta 1 (TGF- β 1) are found to modulate cellular functions.⁶ There exists a rich cocktail of bioactive molecules in dentin and pulp capable of giving the signaling events involved in dentin and pulp regeneration.⁷

Bioactive scaffolds should facilitate cellular infiltration, vascularization, cell differentiation, and also be biodegradable, allowing eventual replacement by the appropriate tissues. The variety of biomaterials include:

1. Tissue extracts such as blood clot, platelet-rich plasma (PRP), platelet-rich fibrin (PRF), pure platelet-rich fibrin, and leukocyte platelet-rich fibrin;
2. Ceramics such as calcium hydroxyapatite, tricalcium phosphate, and mineral trioxide aggregate;
3. Synthetic polymers such as polylactic and polylactic-co-glycolic acids;
4. Biopolymers such as collagen, hyaluronan and chitosan; and self-assembling peptide hydrogel.

Most of the biomaterials that have been proposed lack approval from the Food and Drug Administration (FDA) which makes them not suitable for clinical use.⁸ Chrepa et al. demonstrated *in vitro* an FDA-approved Hyaluronic acid hydrogel -Restylane, an injectable scaffold which promoted the survival, mineralization, and differentiation of stem cells of the apical papilla (SCAP) into an odontoblastic phenotype. As this product, Restylane, is available in injectable form, it may represent a suitable scaffold for immediate clinical use in endodontic regenerative procedures.⁹

A new bioengineering dental triad

The traditional triad of dental stem cells, bioactive signal molecules and bioactive scaffolds as mentioned above fails to generate healthy functional tissue. This is because the regenerated tissue does not completely match the normal healthy functional tissue. These unsatisfactory results suggest that some important factors are still missing in current REPs. Hence, a new dental bioengineering approach has been suggested (Figure 1). The concept involves providing micro-environments favourable to signal molecules and to stem cells.

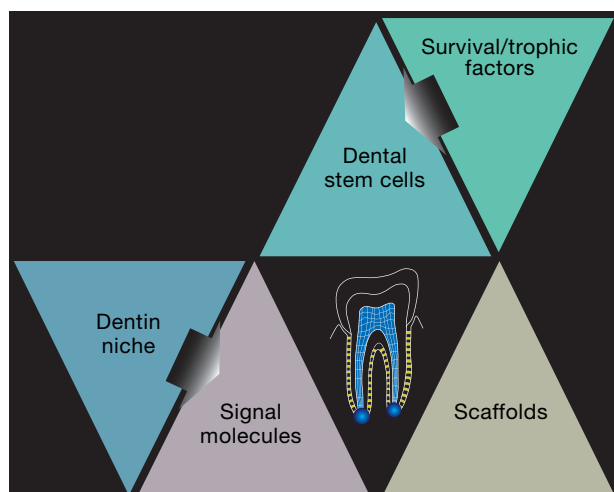


Figure 1. A new dental bioengineering approach with dentin niche and trophic factors.

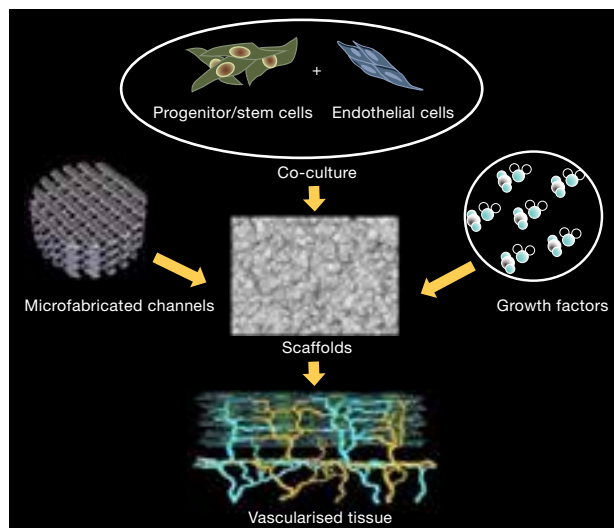


Figure 2. Potential approaches of enhancing vasculature in tissue engineering.

Trophic factors/Survival signals

The dentin matrix contains a reservoir of growth factors and other bioactive molecules sequestered or “fossilized” within the mineralized matrix. These growth factors regulate cell proliferation and differentiation during tooth development and become entrapped in the dentin matrix where they remain functional during life.¹¹

Dentin-entrapped factors are potentially controlled by trophic factors regulating “positional memory” during development. Their exact concentrations could be highly heterogeneous. General REP treatments may be benefited by the release of these entrapped factors from the dentin.

Current developments and challenges in Regenerative Endodontics

Vasculature engineering

Angiogenesis is important not only for nutrient supply during regeneration of the tissue but also, potentially, for stem cell recruitment. During the last decade, there have been major advances in the understanding of the process of neo-angiogenesis which can be categorized into three main approaches.¹²

1. Incorporation of growth factors

Angiogenic factor-incorporated scaffolds incorporating sustained release Vascular Endothelial Growth Factor (VEGF) is a signal protein which is a most potent angiogenic and vasculogenic factor, promoting endothelial cell proliferation, migration, and survival. Yadlapati et al.¹³ found that VEGF-loaded biodegradable fibre may be considered a viable option to stimulate angiogenesis and new tissue formation during endodontic regeneration procedures.

2. Co-culture of progenitor/target cells with endothelial cells

A number of studies have shown that the co-culture of stem/progenitor cells with endothelial/endothelial progenitor cells significantly enhances angiogenesis, acting synergistically.^{14,15} Findings indicate that the co-culture of dental pulp stem cells (DPSCs) and endothelial cells is a promising source for regenerative endodontics.

3. Microfabrication of vasculature or de-cellularized matrices

This approach aims to create a blueprint for micro-circulation in a biodegradable scaffold so that endothelial cells attach to microchannels and proliferate, giving rise to a functional vasculature.^{16,17} Although this method has been investigated in relation to engineering complex tissues such as the liver and brain, it is yet to be attempted in dental tissue engineering.

This approach could overcome one of the most common constraints in pulp regeneration strategies, namely the lack of perfusion at the periphery of newly implanted pulp tissue, which hinders full-length pulp regeneration.

Pulp tissue graft

Minced pulp tissue has been used as a source of mesenchymal stem cells (MSC) for tissue regeneration. The transplanted tissue yields migrating cells that retain

the potential for odontogenic and osteogenic differentiation, allowing for *de novo* pulp-dentin regeneration, and bypassing the need for *in vitro* culture.

This is the basis of the proposed protocol for the “pulp tissue grafting” approach to regenerate the pulp-dentin complex in teeth that require endodontic intervention, without the need for *in vitro* culture of pulpal stem cells.¹⁸

Low-intensity pulsed ultrasound (LIPUS) treatment
MSC from dental tissues may respond to low-intensity pulsed ultrasound treatment (LIPUS), potentially providing a therapeutic approach to promoting dental tissue regeneration.¹⁹

The mechanism has not yet been fully elucidated but is attributed to its non-thermal biomechanical affects. In particular, through acoustic microstreaming and physical radiation, LIPUS may influence the cell membrane and cytoskeleton to trigger downstream signalling processes. Therefore, this relatively easy and inexpensive application may provide an ideal therapy in the dental clinic for the regeneration of dental tissues.^{19,20}

Effect of infection on apical papilla

The apical papilla undergoes liquefaction necrosis along with the dental pulp because they are interconnected. Recent evidence shows that the apical papilla and its rich resident stem cells are capable of surviving prolonged endodontic infections which may have lead to apical periodontitis. The apical papilla represents a rich source of undifferentiated mesenchymal stem cells in REPs.²¹

The survival of the apical papilla and its stem cell population might explain why MSCs such as SCAP can survive during apical periodontitis.

The biological reason for survival may be explained by the relatively low density of blood vessels in the apical papilla in comparison with the adjacent dental pulp.

Disinfection vs regeneration

Most REPs include minimal or no mechanical debridement. Hence, there is heavy reliance on the chemical debridement. The irrigants used should be selected on the basis of their bactericidal/bacteriostatic properties and their ability to promote survival and proliferation of stem cells.²² Thus, an important concept of regenerative endodontics is to achieve disinfection while creating conditions conducive to stem cell survival, proliferation, and differentiation. It has been demonstrated that 6% NaOCl denatures the growth factors embedded in dentin. However, EDTA helps in dissolving these growth factors out of the dentin, thereby increasing their bio-availability.²³ Importantly, the growth factors embedded in the dentin matrix such as TGF- β and dentin sialoprotein (DSP) are known to be potent stimulators of stem cell proliferation and differentiation.²⁴

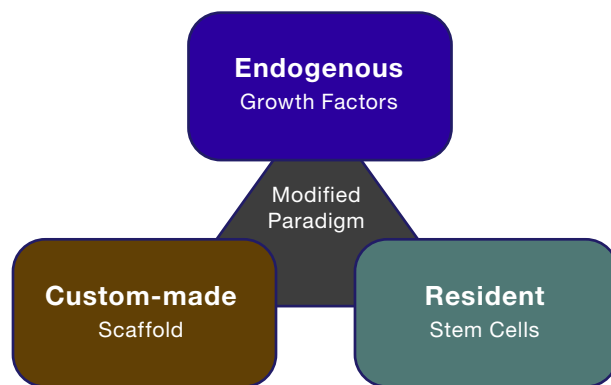


Figure 3. Tissue engineering paradigm modified for cell-homing approaches of pulp regeneration.

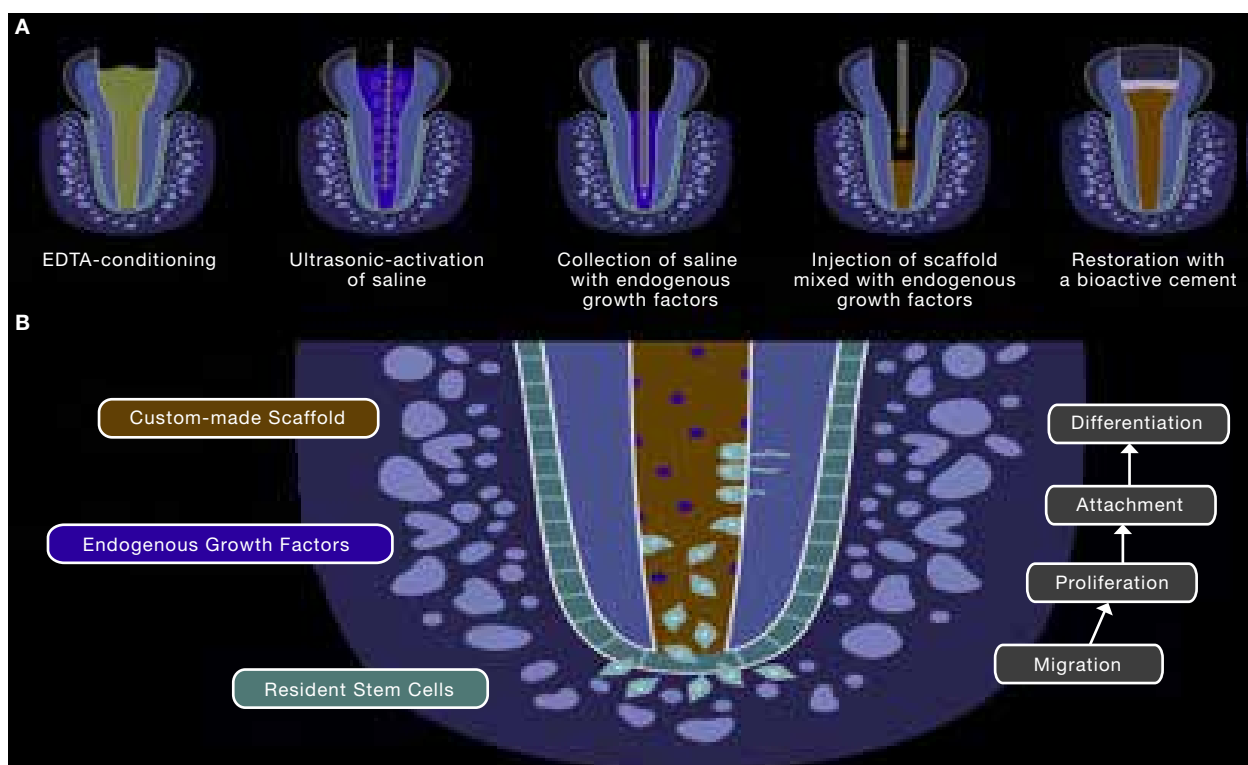


Figure 4. Clinical management of a cell-homing approach to engineer dental pulp.

Potential role of NETs (Neutrophil Extracellular Traps)

Recently, a novel bacterial killing mechanism termed neutrophil extracellular traps (NETs) has been described that uses reactive oxygen species signalling and results in cellular DNA extrusions causing microbial entrapment and death.²⁵

NETs and their components, such as histones, may provide novel prognostic markers for pulp pathologies. The determination of their levels within the infected pulp could be exploited to target the application of novel disease management strategies. They have a potential role in controlling pulpal infections. How these structures may influence the pulp's vitality and regenerative responses is an area of further research.

Cell-homing approach: regenerative endodontics for adult patients

Tremendous effort has been made to revitalize disinfected immature permanent teeth in children and adolescents with diagnoses including pulp necrosis or apical periodontitis. The question remains whether regenerative endodontics can be extended to revitalize mature permanent teeth with diagnoses including irreversible pulpitis and/or pulp necrosis in adults.

The concept of cell homing in dental pulp and dentin regeneration was first proposed in 2010.²⁶ In tissue regeneration, cell homing includes two separate cellular processes: cell recruitment and differentiation.

Recruitment is directional cell migration to the tissue injury or defects. Differentiation indicates the process of transformation of stem/progenitor cells into increasingly mature and matrix synthesis cells. In dental pulp and dentin regeneration, stem/progenitor cells differentiate into odontoblasts, pulp fibroblasts, and other niche cells.²⁷ Cell homing shows a potential for dental pulp regeneration in mature permanent teeth in adults, as shown by He et al.²⁸

The development of biologically-based approaches to regenerate or repair dental pulp has become possible because of recent advances in tissue engineering and biomaterials. However, the several severe problems associated with this approach may render it not feasible for a clinical setting, at least in the near future. Galler et al.²⁴ suggested a modification of the classical tissue engineering paradigm (Figure 3), where resident cells are attracted by endogenous, dentin derived growth factors and induce further cell proliferation and differentiation. A bioactive scaffold material laden with these growth factors would serve as a template for tissue formation (Figure 4).

What the future holds? Immediate versus delayed induction:

Currently, there are no reports of randomized clinical trials on immediate induction for regenerative endodontics, despite the need for investigation in this field. Such as have been conducted, which have compared immediate induction versus delayed induction protocols, show clinical success rates of 71% for delayed induction and 33% for immediate induction.²⁹

The association between success rate and etiology are possible predictor factors. At the time pulp necrosis is diagnosed, the stage of root development might be a relevant factor for periapical and apical healing.

Unfortunately, there is no information on the stage of root development at the time of induction for most studies. Determination of the stage of root formation and etiology are possible critical factors for any therapeutic decision.

DISCUSSION

The field of regenerative endodontics is evolving. Present concepts of the regeneration of dental tissues can revolutionize endodontic procedures. However, there is still considerable debate as to what represents clinical success with such procedures. The source and potency of pulpal mesenchymal stem cells are of paramount importance and could be limiting factors in making this technology available for routine endodontic therapies for patients. Key research questions which still need to be answered are:

- How do we address the challenges involved in the preparation and quality control of clinical grade dental pulp stem cells, which are safe and show efficacy?
- If replacement teeth were available today from a hypothetical tooth tissue bank would it be a practical option for every restorative circumstance?
- Are cell homing protocols feasible for clinical success, especially without the introduction of exogenous signalling molecules?

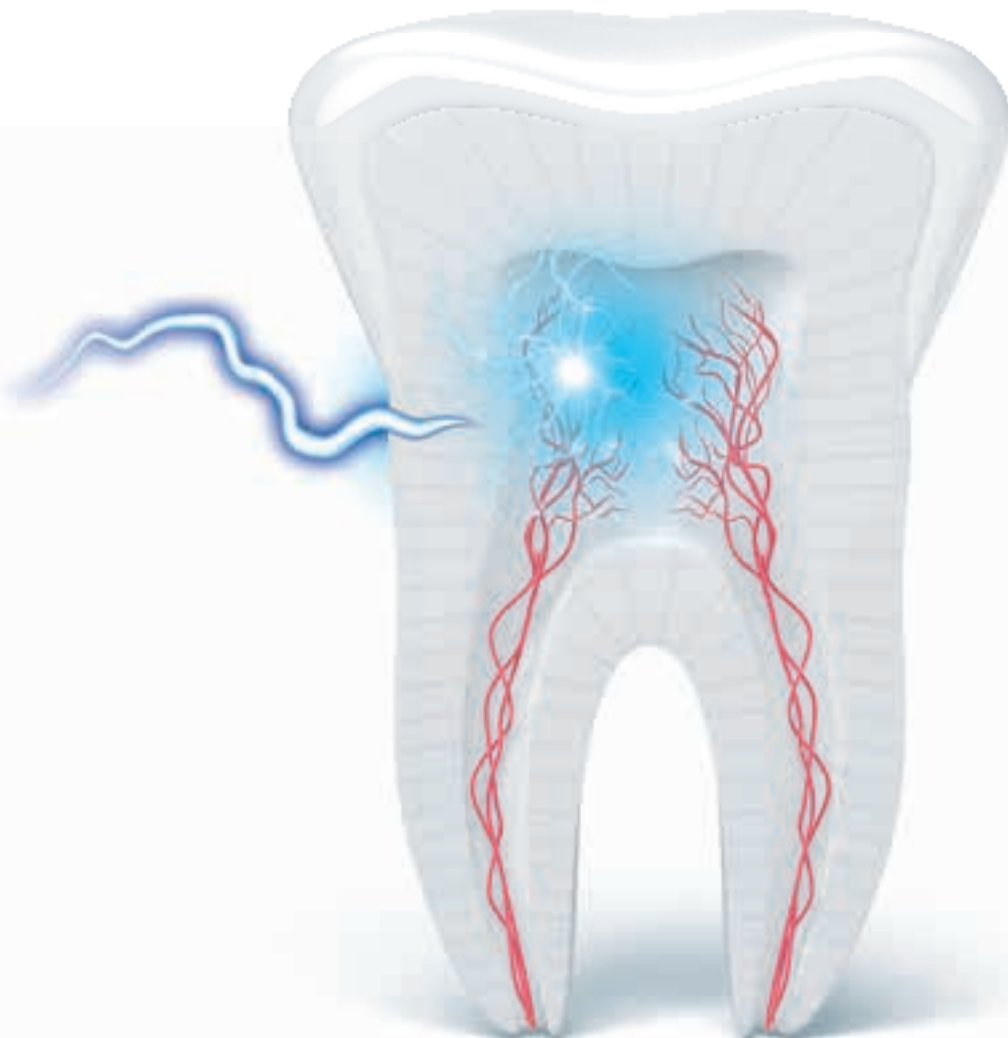
Regenerative procedures could eventually promote tooth longevity in our aging population. Further clinical studies could make significant progress toward achievement of good patient-based, clinician-based and scientist based outcomes.

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Microbial contamination of denture polishing equipment

SADJ April 2019, Vol. 74 No. 3 p116 - p122

LM Sykes¹, M Said², M Ehlers³, SM Mateis⁴, C van Dyk⁵, HD Dullabh⁶

ABSTRACT

Introduction

Lathes and pumice slurry are commonly used without change or disinfection for polishing both new and old, repaired dentures.

Purpose

To identify and quantify any microorganisms harboured in these components in the laboratories of an academic teaching institution where the machines are in constant daily use.

Material and methods

Two machines were identified and labelled in each laboratory, one for exclusive use for new dentures and the other for dentures which had been exposed to any form of patient oral contact. Users were so informed.

Samples were collected twice daily on alternate days over a period of one week and tested for the presence and type of microorganisms, and whether the levels of contamination increased with usage.

Results

Pumice throughout was contaminated with a variety of bacteria, yeasts and moulds, notably *Aspergillus*, which will hover in the abundant aerosol during polishing. Cross-contamination can thus occur between dentures, posing danger to patients. Consultation between the dental staff and the Department of Medical Microbiology established a standardised disinfection protocol for the polishing wheels, machinery and pumice slurry.

Conclusion

Prevention of cross contamination is crucial to avoid inadvertent but nevertheless culpable infection of denture-wearing patients, as well as for personal protection.

INTRODUCTION

Poor infection control is a major problem in dental surgeries as it can result in both infection and possible cross-contamination of patients, dentists and laboratory technicians. As far as possible all materials and equipment used in dental practices and laboratories should be meticulously disinfected and/or sterilised between each patient. However, some procedures may inadvertently be overlooked and could pose a threat of cross contamination. This is a particular concern when clinicians move between chairside and laboratory settings such as while adjusting, polishing and inserting dental prostheses.¹

Many dentists, technicians and students at academic teaching institutions and private dental practices and laboratories use the same denture polishing lathes, pumice slurry and polishing waxes in the laboratory for polishing both new and old dentures, without any of these being disinfected or changed between uses.

This study aimed to investigate whether the pumice and polishing wheels harboured microorganisms, if so to identify and quantify them, and then to develop a disinfection protocol to prevent possible cross-contamination between patients.

LITERATURE REVIEW

Dental pumice consists of a powdered form of first grade volcanic rock, resulting in a fine, light and porous abrasive. It comes in fine, medium and coarse grades, all of which are mixed with water to the desired consistency.²

It is used as a cleaning and polishing aid to finish acrylic resin dentures, and also in toothpastes, polishing compounds and other dental prophylactic oral hygiene pastes. The gritty texture of pumice helps smooth the acrylic resin by removing scratched or pitted areas on denture and tooth surfaces that could harbor plaque and bacteria. It can also be used to polish off surface staining such as those produced by certain foods, drinks and smoking.

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Advantages of pumice are that it is readily available, has a neutral pH, is chemically benign, hard enough to abrade, yet soft enough not to damage the surface, and has a friable property allowing it to be ground down to an ultrafine powder that still retain its abrasive qualities. This makes it ideal for use where the quality and smoothness of the finished surface is of utmost importance.³ Other abrasives used in dentistry include aluminium oxide to deflash crown work, glass beads to aid autoclave sterilization of implements at high temperature, and calcium carbonate as an abrasive in smokers' toothpastes.⁴

Polishing of dentures is accomplished by using a pumice slurry with spiral sewn cotton wheels in a polishing lathe. The plies of cotton cloth are sewn together spirally, making the wheels much harder, which allows more pressure to be exerted on them during the polishing process. This also makes them durable and long lasting so replacement is necessary only after many cycles of use. The cotton plies are also pre-raked to accept the pumice slurry. Final shine is achieved using the same lathe system and cotton wheels, but replacing the pumice with a denture polishing compound. Many studies have been conducted assessing the presence of micro-organisms in dental polishing lathes, pumice, polishing cloths, and in the aerosol created from backscatter during polishing.¹

As far back as 1968, Lorato suggested mixing a chemical disinfectant into the slurry water of the pumice polishing medium.⁶ However, this still did not address the possibility of organisms remaining on the polishing cloths which are seldom changed between patients and in particular those used for the final high polish where wax is used as opposed to pumice.

Kahn et al (1982) found massive microbial growth on new dentures polished after the lathe had been used to re-polish 12 old dentures. This was reduced by 75% when the old dentures were first scrubbed for one minute with 3% hexachlorophene cleanser, and by almost 99% when the new dentures were also scrubbed with hexachlorophene after polishing.¹ This simple experiment illustrated how easily pathogenic organisms could be transferred from patient to patient after simply polishing dentures. It is an unacceptable risk in dentistry as organisms such as *non-haemolytic streptococci*, *lactobacillus*, *Neisseria*, *diphtheroids*, *B haemolytic streptococci*, *Staphylococcus aureus*, *Escherichia coli* and *candida albicans* have all been isolated from this equipment.¹ This poses a possible risk for cross-contamination between dental laboratory staff, clinicians and patients which could result in significant epidemics of communicable diseases depending on the number and types of organisms, patient populations and host resistance.^{1,6}

Cross-contamination can occur through aerosol formation during the pumicing and polishing of dentures and by direct denture and skin contact during handling, especially as many clinicians and most technicians work without gloves in the laboratory areas.⁷ Water and organic matter such as plaque and skin scales can act as nutrients for bacteria and contribute to their growth within the pumice, making this ideal for bacterial growth, and

possibly a conduit for their transfer between patients during the polishing.^{7,8} Setz found used pumice to be contaminated with bacteria from the oral cavity, non-oral bacteria and fungi, and that the contamination was drastically reduced when sterilized pumice and wheels were used.⁶

Williams et al. (1983) tested pumice from two commercial dental laboratories where old pumice was not replaced, but merely added to as needed. They isolated *Acinetobacter*, *Pseudomonas* and *Alcaligenes*, with the *Acinetobacter* being the main contaminant.⁹ This is a concern as this organism has been associated with various infections ranging from mild to life threatening, including pneumonia, septicaemia, meningitis, endocarditis, eye-infections and head and neck infections. It is also resistant to certain chemical disinfectants such as quaternary ammonium compounds.⁹

Verran et al. found that pumice disinfected with chlorhexidine gluconate and used with a rag wheel that had been immersed in chlorhexidine gluconate for one minute, resulted in a significant decrease in contamination. The levels of contamination began to rise again after 24 hours, particularly *Pseudomonas spp*, *Staphylococci*, *Bacillus spp*, and a few fungi.⁷ In a similar study, dentures were immersed in hypochlorite for 10 minutes before pumicing, but it was still found that after three days of lathe use, the levels of microbial contamination were considerable, especially for *Staphylococcus*, *Candida*, *Pseudomonas* and *Micrococcus*. This could be because the hypochlorite reduces the microbial load on the dentures but does not actually destroy them.⁷

Williams et al. identified *Bacillus*, *Acinetobacter*, *Micrococcus*, *Pseudomonas*, *Moraxella* and *Alcaligenes*, as well as *A. calcoaceticus* and *P. maltophilia* in dental pumice. A concern was that the latter two were both resistant to polymyxin B sulphate and penicillin. The most consistently isolated micro-organisms were *aerobic*, Gram negative *bacilli*, which are known opportunistic pathogens that can contaminate dentures and lead to bacterial colonization of the oropharynx. This in turn increases patients' risk for pneumonia, especially if they are also immune-compromised. In addition, *bacilli* can infect a patient by entering open wounds associated with the process of immediate dentures, and increase their risk of developing bacterial endocarditis.⁸ They also found high levels of non-oral micro-organisms which are capable of surviving in pumice for many months. These can be transferred from skin and hands to the pumice and then from the pumice to the denture wearer and vice versa.⁸

Other studies isolated *Gram-positive bacilli*, *Streptococci spp*, *Staphylococcus aureus*, *S epidermis*, *B catarrhalis* and *Neisseria sicca* from dental pumice. The replacement of tap water by *Virkon* yielded significantly lower bacterial counts leading to the conclusion that "bacterial contamination originates from the tap water, the atmosphere, the appliance and the clinician".¹⁰ Fungi have also been isolated in particular *Aspergillus* and *Fusarium spp*. These are opportunistic pathogens and may produce disease in the immune-compromised patient. *Aspergillus flavus* and *Aspergillus niger* are most frequently involved in

human infections. *Aspergillus spp* not only pose a risk for possible infection but can contribute to allergic exposure and toxic manifestations.¹¹ Pumice aerosols are equally dangerous. They may contain *Moraxella* and *Acinetobacter* species which are associated with conjunctivitis.⁸

Recommendations from many sources are to use fresh pumice for each patient, cleanse pumice pans with a disinfectant between patients (or use disposable dishes and discard them after use) and autoclave pumice wheels between patients. The wax may be more difficult to control as it's not possible to use new blocks for each patient, and alternative methods of disinfection must be investigated. Considering that dentists have been aware of possible cross contamination for over 50 years, and that many safety precautions have been documented, it was alarming for the researchers to notice that in the dental laboratories of a large teaching hospital, there was no means of disinfection of this machinery and material. Following this observation, an informal "snapshot" survey of other universities was conducted as well as of random private practices and laboratories. This revealed a diverse range of conditions ranging from excellent to disastrous (Figure 1).



Figure 1. Conventional lathe polishing machines from various teaching institutions and laboratories within South Africa and the United Kingdom.



Figure 2. Rag wheel with pumice slurry where samples were collected.

Given the high incidence of hepatitis, TB, and HIV in South Africa, this situation becomes even more worrying. In 2016, the reported prevalences of HIV in South Africa were: 22.3% in women 15-49 years old; 18.9% in 15-49 year old adults; 5.6% in youth between 15 and 24 years. The estimated prevalence of HIV in the total population is 12.7%, i.e. over 7.03 million people.¹²

AIM AND OBJECTIVES

The aim of this study was to establish whether potentially pathogenic microorganisms could be recovered from denture polishing equipment, and if so, to isolate and identify these organisms from the pumice slurry and on the polishing wheels.

The objectives of this study were to:

- To take samples of the pumice slurry and from the polishing cloths used to polish new and old dentures from a selection of dental laboratories in South Africa. To identify and quantify the selected microorganisms using phenotypic and biochemical methods.
- To investigate current literature and to establish which disinfection protocols are recommended for the different organisms identified.
- To make recommendations and implement a suitable protocol for cleaning and disinfection of the dental equipment investigated in this study.
- To inform and advise dental colleagues and technicians in private practice who may not be aware of the need for a meticulous disinfection protocol for their polishing equipment, as well as other less obvious items and materials.

MATERIALS AND METHODS

The investigation was conducted in collaboration with the Department of Medical Microbiology, using polishing equipment in selected student dental laboratories and technician's production laboratories.

Sample collection

Samples were collected from the rag wheel and pumice slurry from two denture polishing machines in each laboratory area. One machine was used only for new dentures, and the other for dentures that had been in contact with the mouths of patients (Figures 1 and 2).

Culture identification and storage of samples

In brief, the following microbiological aspects of organism isolation, culture and identification were undertaken: The serial dilution method with peptone saline diluent (PSD) at ambient temperature was used for all initial dilutions. Specimens from each dilution were cultured on blood, MacConkey and Sabouraud's dextrose agar plates.

A Gram-stain of each cultured isolate was also performed according to the methods outlined in Brock Biology of Microorganisms (Madigan et al., 2015). The cultured colonies were then quantified and identification and antimicrobial susceptibility of the colonies was performed using the Vitek 2 instrument (bioMérieux, France).

Isolates identified as *E.coli*, *staphylococci*, *Pseudomonas aeruginosa* and *Candida* species then all had their DNA

extracted using the ZR *Fungal/Bacterial* DNA Miniprep™ commercial kit (Zymogen Fermentas, USA) according to the manufacturer's instructions in order to obtain ultra-pure DNA. The species of the specific genes under investigation were identified using multiplex PCR (M-PCR) assays.

Statistical analysis of results

Analysis of the microbiological data was carried out in collaboration with the biostatistician of the Biostatistics unit, Medical Research Council, Pretoria.

The statistical analysis was predominantly summary statistics presenting proportions and associated confidence intervals of the estimates for identified microorganisms. STATA 13 was used for the data analysis.

RESULTS

The results revealed that the pumice and polishing wheels of all the machines were colonized with a large variety and volume of bacteria, yeasts and moulds, with higher colony counts in the pumice than on the wheels (Figure 3).

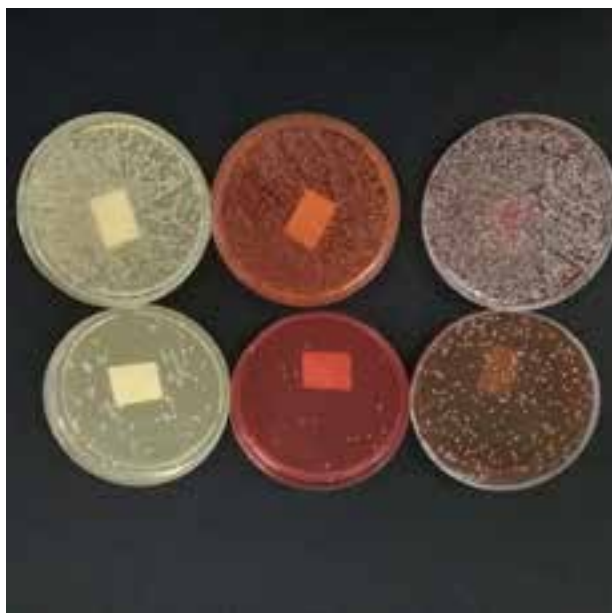


Figure 3. Culture plates from the pumice (top row) and wheels (bottom row).

Bacterial organisms included *Aerococcus viridans*, *Enterobacter cloacae* complex, *leclercia adecarboxylata*, *Moraxella* group, *Pantoea* spp, *Pseudomonas putida*, *Sphingomonas paucimobilis*, *Bacillus* spp, *Micrococcus* spp, *Streptococci*, *Staph. Aureus*, and aerobic gram negative bacteria. Most of the yeast isolates belonged to genus *Rhodotorula glutinitis*, with the most predominant moulds being *Aspergillus niger*.

The *Streptococci* were mostly found on the polishing wheels, while the *Staph. Aureus*, and aerobic gram negative bacteria were isolated from the wet pumice. Most of these organisms are normal oral flora, however, the aerobic gram negative bacteria are gut flora often carried by immunocompromised individuals. There were no *lactobacilli* or *Candida* species present in any of the samples tested.

DISCUSSION

Any instrument or equipment used in the mouth, or that comes into contact with the oral environment is a potential source of cross-infection.¹³ It is impossible to determine the patient's state of infectivity based on their medical and dental records, physical or oral appearance, socio-economic status or verbal questioning. Thus one must assume that all patients are capable of transmitting highly infectious diseases and act accordingly.¹³

This study investigated the microbial contamination of one isolated item of clinical and laboratory equipment, the polishing lathe and pumice. Use of the lathe provides a high risk for the spread of infection as "The rotary action of the wheels, stones, brushes and rags generate aerosols, spatter and projectiles".¹³

The *Aerococcus viridans* are Gram-positive cocci which may cause urinary tract infections, bacteraemia, endocarditis, para-aortic abscess, meningitis, spondylodiscitis and septic arthritis. The risk of infection is increased in persons with granulocytopenia, oral mucositis, prolonged hospital stays, previous antibiotic therapy, invasive procedures and implantation of foreign bodies. As such these are a potential danger to many dental patients especially those who have undergone recent osseointegrated implant placement, and more so if the procedure had involved hospitalisation and follow-up antibiotics.¹⁴

The *Enterobacter cloacae* complex consist of rod shaped Gram-negative bacteria commonly found in terrestrial and aquatic environments (water, sewage, soil and food). They occur as commensals in human and animal intestinal tracts. They may be responsible for nosocomial infections including bacteraemia, lower respiratory tract, urinary tract, and intra-abdominal infections as well as endocarditis, septic arthritis, osteomyelitis and skin and soft tissue infections.¹⁵ Their importance in this study is that the skin and GI tract are the most common sites through which they can be contracted. This makes them dangerous for clinicians or technicians who have skin abrasions or cuts in using contaminated pumice and lathes.¹⁶

Leclercia adecarboxylata is a motile Gram-negative bacillus that was first isolated from drinking water and is distributed widely in the environment especially in food and water, as well as from various clinical specimens including blood, faeces, sputum, urine and wound pus.¹⁷ Infections occur most commonly in immunocompromised patients or those with other infections suggesting its dependence on co-flora to cause disease.¹⁸ It may be a danger to elderly and immunocompromised dental patients, especially those with HIV or undergoing any form of cancer therapy. *Moraxella* is also a Gram-negative rod found in normal oropharyngeal flora. It may cause lower respiratory tract infections, and otitis media. In the latter, it usually forms part of a mixed culture of pathogens along with *Haemophilus influenzae* and *Streptococcus pneumoniae*.¹⁹ *Pantoea* is a genus of Gram negative bacteria of the family *Enterobacteriaceae*. They are rare organisms which may occasionally be isolated from diverse clinical specimens, including blood, sputum, urine, cerebrospinal fluid, joint

fluid, bile, and wounds. As with *Leclercia adecarboxylata*, they are significant in dentistry as they tend to infect compromised hosts or those undergoing invasive procedures or insertion of foreign bodies. Fortunately, they are fairly susceptible to all classes of antimicrobials.²⁰ *Pseudomonas putida* is a rod shaped, flagellated, Gram negative bacterium that is found in most soil and water habitats where there is oxygen, and was thought to be of low pathogenicity. However, over the last three decades, these have increasingly become significant human pathogens particularly in hospital settings. They colonize moist and inanimate hospital surfaces, causing nosocomial infections, especially in immunocompromised patients and those with medical devices or catheters.²¹

Sphingomonas is a rod shaped Gram negative, non-spore forming, chemoheterotrophic, strictly aerobic bacterium that has been associated with a variety of infections in humans, including bacteraemia, pneumonia, catheter related infections, meningitis, peritonitis, osteomyelitis, septic arthritis, postoperative endophthalmitis, lung empyema, splenic abscesses, urinary tract infections, and biliary tract infections. They too are rare but increasingly are being seen in clinical settings.²²

Bacillus is a genus of gram-positive, rod-shaped bacteria and a member of the phylum *Firmicutes*. *Bacillus* species can be obligate aerobes, or facultative anaerobes. They can cause food poisoning, localized infections related to trauma, deep seated soft tissue infections, and systemic infections (meningitis, endocarditis, osteomyelitis, and bacteraemia). Fulminant eye infections are widely recognized complications of non-anthrax *Bacillus* infections, most commonly *B. cereus*. The various species implicated in serious infections include *B. cereus*, *B. subtilis*, *B. sphaericus*, *B. alvei*, *B. laterosporus*, *B. licheniformis*, *B. megaterium* and *B. pumilus*. *Micrococcus* is ubiquitous, being found in water, dust and soil. It is thought to be a commensal organism, though it can be an opportunistic pathogen, particularly in hosts with compromised immune systems, such as HIV patients.²³ It can be difficult to identify *Micrococcus* as the cause of infection since the organism is normally present in skin microflora and the genus is linked to diseases. In rare cases, death of immunocompromised patients has occurred from pulmonary infections caused by *Micrococcus*. Micrococci may be involved in other infections including recurrent bacteraemia, septic shock, septic arthritis, endocarditis, meningitis and cavitating pneumonia, especially in immunocompromised patients.²⁴

Rhodotorula glutinitis was the most predominant yeast isolated. It belongs to a genus of unicellular pigmented yeasts, and is easily identifiable by its distinctive orange/red colonies when grown on Sabouraud's Dextrose Agar (SDA). *Rhodotorula* is a common environmental yeast that is found in air, soil, lakes, ocean water, milk, and fruit juice. This yeast has a strong affinity for plastic, and is often isolated from medical equipment, such as dialysis equipment, fibre-optic bronchoscopes, and other surfaces such as shower curtains, bathtubs, and toothbrushes. It is particularly dangerous in clinical settings as it is an opportunistic pathogen which can readily colonise and infect susceptible patients. The mould *Aspergillus niger* was also isolated. Although

Aspergillus spp are ubiquitous moulds in the environment, they can cause disease, particularly in immunocompromised hosts. The organisms are usually inhaled making their presence in the pumice a concern as this machine is known to produce large volumes of aerosol splatter during use. They may cause respiratory tract infections, mycetomas, orbital and sinus infections, ear infections, and even more invasive disease like infective endocarditis.

To avoid cross-infection from this equipment the following precautionary measures should be implemented whenever they are in use: the front shield should be in place and a ventilating system in operation; the operator should wear a protective face mask and goggles; fresh pumice and clean water should be used for each new patient; a small amount of pumice should be dispensed into either a disposable container that can be discarded after use or a flat dish that can be cleaned and disinfected; used pumice should be disposed of in a suitable hazard bin and not down the drain where it can cause blockages; rag wheels, stones and brushes should be rinsed, disinfected and heat sterilized (boiled in water) after each patient; and all other items wiped down with a suitable surface disinfectant (Fig 4).¹³



Figure 4. The ideal scenario (courtesy Prof Bernitz).

There can be no doubt that there are many more potentially risky areas of cross-contamination that could go unnoticed. Presumably this is due to oblivion and complacency rather than intentional negligence or disregard for protocol. However, all personnel working with patients need to become more sensitised and alert to areas where possible cross-infection could occur. **Awareness** should then be followed by **Action** to rectify the situation, because cross-infection cannot be reversed! The list on p121 is by no means exhaustive, but rather presents examples of latent situations, often overlooked, that could pose a threat of cross-contamination, and suggests some practical solutions for each.

Whenever possible, a third, ungloved person who has had no contact with the patient should handle commonly used items that may be difficult to disinfect or neglected such as cameras, computer keyboards, X-Ray buttons, patient files, and cellular phones. Where not possible, the clinician should remove gloves when handling them. In addition there needs to be effective communication and coordination of disinfection practices between the clinician and the laboratory to help ensure the performance of the appropriate cleaning and disinfection procedures by each, without omissions or unnecessary duplication, and to provide that there is no damage to any of the transferred materials during this process.¹³

All items coming from or going to the oral cavity must be sterilized or disinfected before work starts on them in the laboratory, and again before their next contact with the patient.¹³ Note, clean, disinfected and sterile are not one and the same, and even though items may have been cleaned, they are not necessarily disinfected or sterile and should still be handled with care. Cleaning involves the physical removal of visible debris, blood and bioburden which could isolate and protect micro-organism from sterilizing agents.

Disinfection refers to “the process of removing pathogenic organisms from instruments and equipment by the use of a disinfectant. It may be achieved by using moist heat (washing and rinsing in water at 70°C-90°C will kill most non-sporing micro-organisms), ultraviolet radiation, filtration, gases, and chemical disinfectants.” Sterilisation is “the process by which all types of micro-organisms are destroyed, including spores and vegetative micro-organisms.²⁵ Impressions, appliances and prostheses should ideally be cleaned and disinfected as soon as they are removed from the oral cavity before the blood and biofilm dries out.

The procedure involves rinsing, spraying with, or immersion in an appropriate intermediate-level disinfectant for the recommended contact time, followed by repeat rinsing. Thereafter they may be handled and/or transferred. The same applies to instruments, however, it is often more convenient and easier to clean and sterilize these later.

CONCLUSIONS

Dental clinicians, staff and laboratory personnel need to be more aware of the many potential sources of microbial contamination and potential cross infection when handling materials that have been in contact with the oral environment. The American Dental Association (ADA) has categorized patient care items as critical, semi-critical and non-critical based on their risk of infecting patient during use. They also offer in-depth guidelines for the cleaning, disinfection and sterilization of each.²⁶

All those involved in treating dental patients should re-visit, on a regular basis, these or other similar protocols, such as those issued by the HPCSA,²⁷ the Dental Council of Dublin,²⁸ or the Centre for Disease Control (CDC),²⁹ and update themselves when necessary. They should also implement stringent disinfection and sterilization protocols in their surgeries, and be vigilant that all staff adhere to these.

Ethical consideration and conflict of interest

The protocol gained approval from the Research Committee of the Dental School (RESCOM) as well as the Research Ethics Committee of the Faculty of Health Sciences. Funding was provided by the Department of Medical Microbiology and there was no conflict of interest to declare.

Table 1. Potential sources of cross-contamination and suggested practical solutions.

Item/Situation	Suggested Solutions
Indelible pencil	These are seldom considered sources of cross contamination and are often placed in drawers or other areas for easy access without being disinfected between use (Fig 5). They should either be cleaned with a surface disinfectant and then rinsed and autoclaved between uses, or preferably use disposable sticks such as “Dr Thompson’s sanitary colour transfer applicators” Available in S.A. from pdeville@global.co.za . Expensive but worth it.
Computer keyboard	Cover with a layer of cling-film and wipe down with a surface disinfectant between patients or change the plastic (Fig 6). The mouse is more difficult to protect without making it impossible to manipulate. At least it should be wipe with a surface disinfectant between use.
Gas knobs; X-Ray unit buttons; X-Ray sensors	The first two are often forgotten and should be wiped with a surface disinfectant after use. Plastic disposable covers should always be used on the X-Ray sensors and discarded after use. Other radiographic accessories that have made contact with the mouth, blood or saliva should be disinfected or heat sterilized if possible.
Patient record files	Ideally the dentist should read notes and treatment plans before seeing the patient and putting on gloves, and also only fill in the files after completion of treatment, again ungloved. (In reality, some busy clinicians may only open and consult these during treatment which could contaminate them). Ideally files should be kept in plastic covers which can be wiped clean with a surface disinfectant.
Fox plates, endodontic file rulers	These should all be autoclaved between use
Tooth shade tabs	These cannot be autoclaved but the individual tabs used need to be wiped with a surface disinfectant after use. NB make sure the disinfectant used does not stain or alter their shade.
Cotton wool dispensers, Vaseline, pressure indicating paste etc.	Wipe down the dispensers with a surface disinfectant between every patient, or alternatively use sterile pre-packed rolls and balls. Vaseline should never been taken directly from the tub with gloved or ungloved fingers, but rather use an instrument kept for this purpose. A better situation is to prepare individually dispensed and wrapped portions of Vaseline, pressure indicating paste etc. (Fig 7).
Acrylic laboratory burs	These should be treated in the same manner as burs used intra-orally and not shared between patients. They should be washed, placed in cold sterilizing solution and then autoclaved.
Wax polishing blocks, impression adhesive brushes	Some items are impossible to clean or disinfect, and impractical to discard after single use. In these situations the dentures and special trays themselves should be disinfected after removal from the mouth, rinsed, dried and then polished or painted
Biopsy specimen bottles	These are almost always handled with gloved, often bloodied hands. They should be wiped with a surface disinfectant before sending out to the pathology laboratory
Cameras, telephones, cellular phones	Ideally a third, ungloved person who has no contact with the patient should handle these.



Figure 5. Indelible pencil attached to paper towel dispenser with Pres-tik for “easy access”.



Figure 6. Computer keyboard covered with cling-film.



Figure 7. Individually packaged Vaseline, pressure indicating paste and cotton wool.

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Radiographic assessment of multiple pathoses and dental malocclusion: a case study

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ABSTRACT

Odontomas are rare pathological abnormalities which may occur at any age. It is most unusual to observe an odontoma together with supernumerary teeth, more particularly if this is found in conjunction with an osteoma. This report emphasizes the underlying pathology of a case co-incidentally encountered in a 14 year old patient whose main complaint was of a painful 85 tooth.

An incisional biopsy of the area revealed the presence of mineralized tooth-related tissue resembling a complex odontoma. In conjunction with the radiographic evidence, which confirmed the presence of complex and compound odontomas as well as a number of small osteomas, a provisional diagnosis of Gardner's syndrome was made. The syndrome is a rare autosomal disease that is difficult to treat. If a dentist suspects a patient may present with Gardner's syndrome, the patient should be referred immediately for further medical management.

INTRODUCTION

Benign odontogenic tumours include ameloblastoma, ameloblastic fibroma, ameloblastic fibrodontoma, complex and compound odontomas.¹ Of these, the most commonly encountered in patients less than 20 years of age are the complex and compound odontomas.² These tumours are asymptomatic, slow-growing and may lead to malformation of adjacent developing teeth and malocclusion.

The complexity of odontomas has been studied and analyzed for many years. One example is that of supernumerary teeth developing largely within the maxillary permanent dentition and in conjunction with odontomas.³ These are usually asymptomatic, but may be associated

with pathologic implications. One such manifestation is that of Gardner's Syndrome if the odontoma is also associated with the presence of osteomas.⁴⁻¹⁰ This is a life-threatening condition and it is essential that the presenting signs are not missed.

CASE REPORT

A 14 year-old female patient presented at the Wits Oral Health Centre complaining of a painful primary tooth (85) which appeared to have prevented eruption of the permanent successor, causing a severe malocclusion.

No medical problems were reported. Extra-oral findings revealed no abnormalities. Facial asymmetry was not detected (Fig 1). Intra-oral examination revealed missing premolars together with carious and painful mandibular primary second molars (Figs 1-5). An anterior cross bite involving tooth 42 was noted together with a deep overbite (Fig 2). The gingiva surrounding the painful tooth (85) was swollen with a buccal exudate (Fig 4).



Figure 1. The patient: left, frontal and right views.



Figure 2. The occlusion with the 42 tooth in crossbite position.

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In pursuit of accurate diagnosis and an appropriate treatment plan, further investigations included a panoramic radiograph, a lateral cephalogram and a cone-beam volumetric tomogram (CBCT).



Figure 3. Occlusal views: (A) Mandible and (B) Maxilla.



Figure 4. Panoramic radiograph showing a radicular cyst on tooth 85 and multiple odontomas.

The panoramic radiograph revealed the presence of numerous unerupted and retained deciduous teeth, compound and complex odontomas (bi-mandibular) and a well circumscribed radiolucent lesion resembling a radicular cyst at the apex of the right mandibular deciduous second molar tooth. Several of the unerupted teeth were supernumeraries. The angles of the mandible were deformed by presence number of ectopic teeth and small osteomas (Fig 4). The lateral cephalogram revealed a growth on the inion of the occipital bone (Fig 5).



Figure 5. Cephalometric radiograph showing a growth over the area of the inion.

The patient was classified as having a normal skeletal and dental class 1 profile (Fig 5). However, the bone deformities together with the presence of unerupted supernumeraries, ectopic teeth, osteomas and compound and complex odontomas suggested a diagnosis of Gardner's syndrome, despite the apparent absence of visible epidermoid cysts of the skin.

The CBCT scan confirmed the presence of carious lesions of the teeth, together with multiple radio-opacities on the left angle and ramus of the mandible (Fig 6).

These displayed the appearance of osteomas, thereby confirming the provisional diagnosis of Gardner's syndrome.

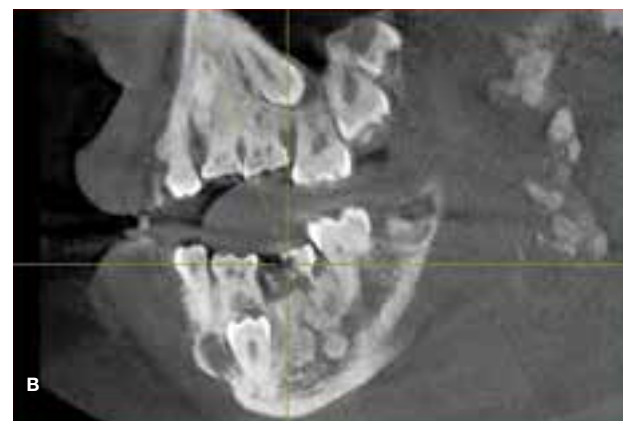


Figure 6. CBCT analysis in tangential view of the right side (A) and (B) left side of the jaw.

An incisional biopsy was done on the right mandible at which the affected tooth and several fragments of bone were removed for microscopic examination. The latter revealed mineralized tissue, trabeculae of woven and lamellar bone together with fragments of enamel.

DISCUSSION AND CONCLUSION

The large number of supernumerary and ectopic teeth together with mixed odontomas and osteomas³⁻¹¹ may be regarded as a rare occurrence.

Based on the clinical, radiological and biopsy findings, a diagnosis of Gardner's syndrome is justified. This is a rare autosomal disease characterised by intestinal polyposis, connective tissue tumours and multiple osteomatosis.^{3,5-9,12} The malignant potential of the intestinal polyps, the presence of which the patient is totally unaware, makes it essential for a dentist to be aware of the signs for early detection of the condition.¹²

Treatment entailed surgical excision of the odontomas and enucleation of the cyst for aesthetic reasons. Thereafter fixed orthodontic appliance treatment would be considered when complete healing occurred.

Referral for colonoscopy was essential for final confirmation of Gardner's Syndrome and the surgical removal of colonic polyps. Recurrence of the odontomas and osteomas is not uncommon and would require possible further surgical intervention. Since there is no cure for Gardner's Syndrome, prevention of cancer is the primary aim in management.¹²

Acknowledgement

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Do the CPD questionnaire on page 153

The Continuous Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

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Chronic Suppurative Osteomyelitis of the Maxilla

- rare case presentation

SADJ April 2019, Vol. 74 No. 3 p126 - p128

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ABSTRACT

Chronic Suppurative Osteomyelitis of the maxilla is a relatively uncommon lesion with scarce information in the medical literature regarding its clinical/pathological status and treatment perspectives.

We report a rare clinical case of a patient presenting with osteomyelitis of the maxilla with pus discharge. The review discusses the pathogenesis, clinical course, investigative procedures and treatment. The diagnosis in this patient was based on data assessed from a specialized imaging technique and from the histopathological findings. Timely medical and surgical therapy reduced the morbidity which may otherwise have occurred due to the significant complications associated with this chronic lesion. This interventional approach can thus be recommended as one of the novel treatments for osteomyelitis of the jaws with the prospect of significant clinical and radiological improvement, as was shown in the present case.

Keywords

Osteomyelitis, chronic suppurative osteomyelitis, maxillary osteomyelitis.

ACRONYM

OPG: Orthopantomogram

INTRODUCTION

Osteomyelitis of the jaws is a lesion with distinct features, but is often challenging in diagnosis and treatment. It is an inflammatory condition involving the medullary portion of the bone, the Haversian system of the cortex and the periosteum,¹ and was originally described by Rees in 1947.² Even though medical and surgical management have advanced, the best prognosis is secured when treatment can be delivered at the initial stage of the disease. The incidence of maxillary osteomyelitis is low as the bone has thin cortical plates associated with a high degree of vascularity. We report a case of an adult patient presenting chronic suppurative osteomyelitis at the uncommon site of the maxilla, having an unusual etio-pathogenesis but with typical manifestation. Treatment was rendered in the classic mode. A review of the current pertinent literature is included.

CASE REPORT

A 52 year old female patient came to the Department of Oral Medicine and Radiology with the main complaint of pain accompanied by a purulent malodorous pus discharge from the posterior area of the maxilla on the right side, extending over the past three months. The patient had experienced a gradual onset of swelling and pain in that area and in the mid-facial region, commencing some six months previously. The medical history included reports of recurrent asthmatic episodes controlled by medication for three years. Two years ago, the patient had undergone extraction of a decayed tooth on the upper left side, following which, three months later, swelling and pus discharge had developed at the extraction site, necessitating surgical management. Personal and family histories were non-contributory.

On extra-oral examination, facial asymmetry was observed with diffuse swelling evident on the right side of the mid-facial region, obliterating the nasolabial fold. On palpation, the swelling was tender, soft in consistency and fluctuant. There was no evidence of paresthesia. A single submandibular lymph-node could be felt on the right side, being tender, soft and freely mobile, and measuring about 1 cm in size.

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3. **Ganapathy Sivas:** 25%
4. **Sivan Sathish:** 20%
5. **VN Kalaivani:** 15%
6. **Songa Sushmita Naidu:** 10%



Figure 1. Intra-oral picture showing swelling with pus discharge and bony sequestra in relation to the right maxillary edentulous posterior region and a left sided side oro-antral fistula.

On intra-oral examination, a single localized swelling, with discharging pus, was evident. It extended from the edentulous region of right maxillary permanent canine to the second molar region (Figure 1). The swelling had obliterated the adjacent labial and buccal sulci, was soft in consistency and fluctuant on palpation, with a contained bony sequestrum.

On the left side, an oro-antral fistula was discovered.

An orthopantomogram (OPG) revealed an extensively destructive lesion with bony sequestra of the right maxilla and an oro-antral communication on the left maxilla.

The radiograph also confirmed multiple missing maxillary and posterior mandibular teeth (Figure 2a). An intraoral

periapical radiograph of the right sided lesion revealed scattered areas of lytic changes with bony islands, along with sequestra. A provisional diagnosis of right maxillary osteomyelitis was made.

Subsequently, the wound was treated by surgical curettage, debridement and bone sequestrectomy. Intraoral suturing was performed after excision of the sinus tract.

Antibiotics were prescribed for the patient, taking into account her physical and medical health status.

The surgical specimen was placed in 10% neutral formalin and sent for routine histopathological examination, which revealed a basophilic necrotized bone tissue with foci of calcified material surrounded by inflammatory cells and haemorrhage (Figure 2b).

The history, clinical picture and investigations confirmed a final diagnosis of chronic suppurative osteomyelitis of the right maxilla. The patient was followed up regularly fortnightly for next three months and has been in a disease free state over the past two years. (Figures 3a and 3b)

DISCUSSION

Osteomyelitis refers to inflammation of bone and its marrow contents. In Greek mythology, “osteon” means bone and “muelinos” means the medullary portion of bone. This lesion is of utmost importance as neglect can lead to various serious conditions like cavernous sinus thrombosis, meningitis, cerebral abscess and septicaemia.³

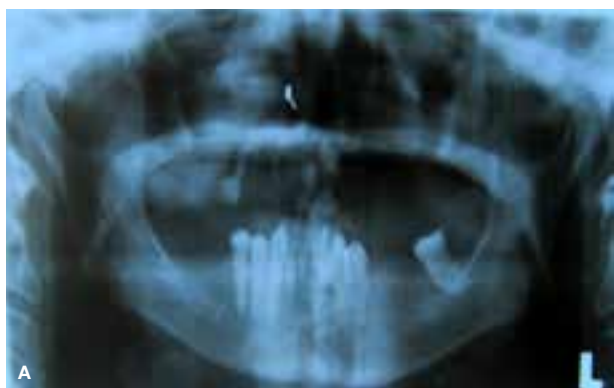
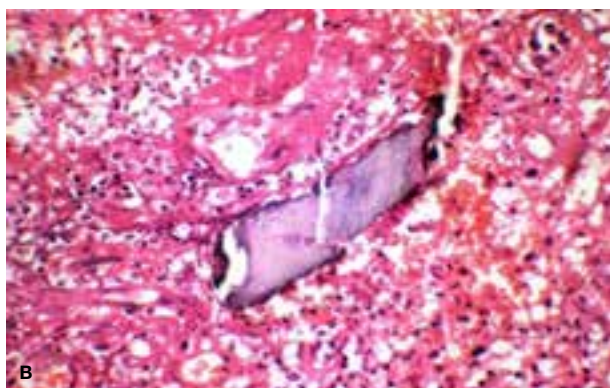


Figure 2a and 2b. Orthopantomogram showing extensive destructive lesion of right maxilla with bony sequestra and an oro-antral communication in the left maxilla with multiple missing maxillary and mandibular teeth.



Histopathological picture (40x magnification) exhibiting necrotized bone associated with surrounding inflammation and haemorrhage.



Figure 3a and 3b. Post-operative photograph showing the sutured right maxillary posterior region and a post-operative radiograph showing no evidence of dead bone, with healing in the right maxillary right posterior region following the surgical procedure.

Waldegrel and Lew classified osteomyelitis of jaw bones broadly as "Suppurative or Non-suppurative". Clinically, it is further divided as:

- A. Acute suppurative
- B. Subacute
- C. Primary chronic (no acute phase)
- D. Non-suppurative

The occurrence of osteomyelitis in the jaws is rare and multi-factorial. Mandibular osteomyelitis occurs 3%-19% more frequently than does maxillary osteomyelitis.

The following factors may contribute to the occurrence of maxillary osteomyelitis:

- A. Traumatic (teeth/lacrimal apparatus/antrum injuries/compound fracture/gingival ulceration - furuncle/periodontitis)
- B. Odontogenic (decayed tooth/primary tooth germ)
- C. Surgical site/open soft tissue wound
- D. Polymicrobial infection - diabetes, malignancy, malnutrition, bone metabolic diseases and immunosuppression altering host response
- E. Osteoradionecrosis involving chronic infections (radiation therapy).

Although the most common site of chronic suppurative osteomyelitis is antral or in the odontogenic apparatus, our case could be attributed either to idiopathic/generalized immunosuppression or to pre-existing bacteria present in the dental biofilm of gingivitis and periodontitis, which may be the source of infection if other etiologies are excluded.

The prognosis of patients with osteomyelitis depends on several factors such as the characteristics and virulence of the microbial agents (*staphylococcus aureus* and *staphylococcus epidermidis*),⁴ host immune response, source of infection and local tissue perfusion.⁵ The pathophysiology involves the accumulation of inflammatory exudates due to microbial infection in the bony cavities resulting in compression of the central and peripheral blood supply to bone. Reduction in oxygen supply and nutrients occur due to a compromised blood supply.⁶

Osteomyelitis occurs more commonly in males between fifty to sixty years of age.⁷ This lesion is usually seen in the posterior region of mandible where the cortical plates are thick and there is limited blood supply. Patients exhibit swelling, pain, pus discharge, paresthesia, trismus and regional lymphadenopathy. Pathological fractures and paresthesia are common complications of osteomyelitis. Progressive bone destruction and the presence of sequestra are traits of osteomyelitis.⁸

The present case occurred in a female patient in the relatively rare site of the posterior maxilla, but with typical symptoms. This lesion presented as extensively destructive, involving a diffuse radiolucency mixed with radiopaque calcification suggestive of a 'Moth eaten' appearance. Histopathologically, the tissue exhibited foci of calcification and necrosis of bone tissue with sequestra surrounded by mixed inflammatory cells (PMNs, lymphocytes and plasma cells). Osteoblasts were absent in the tissue specimen, suggesting a deficiency of new bone formation.⁹

Medications in the case included steroids, antibiotics and bisphosphonate therapy. Surgical management options included saucerisation, sequestrectomy, debridement, de-cortications, jaw resection with reconstruction, and hyperbaric oxygen. The case under report was surgically debrided, curettaged and sequestered.¹⁰

Correct diagnosis of the rarely seen chronic suppurative osteomyelitis of maxilla, with early intervention including a less invasive procedure, saved this patient from significant morbidity.

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Conflict of interest

None.

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Glide path preparation in Endodontics: case report and a literature review of available materials and techniques

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ABSTRACT

Maintaining a smooth, reproducible, glide path when successive files are used is an important characteristic of proper root canal preparation. Glide path enlargement allows for safer, more effective canal shaping with increased prospects of successful treatment outcomes.

Many authors have proposed that rotary nickel titanium (NiTi) instruments should not be used for canal preparation without prior glide path preparation. In this paper the authors discuss a review of the literature on some of these glide path techniques and illustrate the correct clinical application of some of these preparation techniques through clinical case studies.

INTRODUCTION

The endodontic glide path is defined as a smooth, patent passage from the coronal orifice of the canal to the radiographic terminus or electronically determined portal of exit.¹ A successful glide path is an uninterrupted passage that can be reproduced when small-size files are used in sequence in the canal.² Apical pre-enlargement tends to minimise biomechanical preparation failures such as canal transportation and ledge formation at different levels and also reduces the number of pecking motions required to achieve the working length.^{3,4}

The glide path can be achieved with both hand- and rotary instruments.⁵ The use of hand files, however, has been shown to be more time consuming, particularly in teeth with constricted and/or severely curved canals.⁶ Over the last few years, research has repeatedly shown that NiTi glide path rotary instruments are capable of achieving a safe and predictable glide path in comparison with hand files.⁵⁻⁸

Mechanical (NiTi) glide path systems have been shown to improve the glide path prior to the use of NiTi shaping instruments.^{9,10} Systems like the ProGlider (Dentsply Sirona, Ballaigues, Switzerland), and G-Files (Micro-Mega, Besançon, France) are said to preserve the original canal anatomy and cause fewer aberrations and modifications of canal curvature.

Predictable radicular cleaning and shaping is more likely after an established glide path has been formed that is smooth and centred from the root canal orifice to the physiologic terminus. Glide path enlargement allows for more effective and safer rotary shaping because it guarantees that the root canal diameter is sufficiently large to receive the first shaping instrument.¹¹⁻¹³

A number of studies have illustrated the many benefits of glide path formation, which include decreased canal aberrations and decreased risk of shaping file fracture.^{11,12,14,15} According to West, a successful glide path will most likely be maintained by larger shaping instruments, and must then be the starting point of all root canal treatment.¹⁶ The converse, therefore, follows: procedural errors initiated during glide path enlargement are more likely to be exacerbated during shaping by larger NiTi rotary files, in this way affecting the clinical outcome. Any instrumentation that removes excessive dentine and changes the canal anatomy significantly will cause iatrogenic preparation errors and may adversely affect the strength of the tooth.^{17,18}

1. Stainless steel K-Files Manual

According to West, a glide path is present when a size 10 stainless- steel K-File fits loosely in the canal.¹⁶ Stainless steel K-Files (Fig. 1) have a constant taper of 2%. West advocates using these files in a vertical in-and-out motion with initial amplitudes of 1 mm, gradually increasing as the dentine wall wears away and the file advances apically. West stresses that the file must not be forced apically through any obstructions and suggests oscillating the file back and forth in 30° to 60° increments to simulate a “watch-winding” motion to remove restrictive dentine in narrow canals.

Van der Vyver recommends that the file be withdrawn in 1 mm increments from 1 mm to 5 mm, while ensuring that the file may continue to slide to working length, confirming the glide path after each increment.¹⁹

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Figure 1. Stainless steel K-Files sizes 10 (purple), 15 (white) and 20 (yellow).

Schilder recommended pre-curving instruments for use in curved canals. This technique allows the “watch-winding” motion in order to create space for larger curved files to follow by advancing the file just short of maximum resistance.²⁰ Then the file is removed while simultaneously being rotated in a clockwise direction. The many advantages of using stainless steel K-Files over NiTi files for glide path enlargement include improved tactile sensation with a heightened appreciation of anatomical curvatures; decreased risk of file fracture and decreased cost; and the elimination of the use of a hand piece.^{11,21–23} Canal obstructions can be bypassed and an appreciation of the anatomy of curved canals gained by using stiff stainless steel K-Files.^{11,21,24} The disadvantages include operator fatigue and hand fatigue, a longer operational time;²⁵ the risk of canal irregularities with the use of larger file sizes;¹⁶ and increased apical extrusion of debris.²⁶

2. Stainless Steel K-Files Reciprocation

The M4 safety hand piece (SybronEndo, Glendora, CA, USA) was developed so that stainless steel K-Files could be used in a reciprocating motion for glide path enlargement (Fig. 2). The hand piece features a 4:1 gear reduction, oscillates 30° in both clockwise and counter-clockwise directions, in this manner replicating manual wrist watch winding. According to the manufacturer, this watch-winding motion keeps the file loose inside the canal, reduces torsional stress and metal fatigue, and permits safe negotiation while the operator controls the apical pressure. The NSK Ti-Max Ti35L 10:1 (Nakanishi Inc, Tokyo, Japan), Endo-Gripper (Moyco/Union Broach; Montgomeryville, USA) and the NSK TEP-E10 R (Nakanishi Inc.) are similar to the M4 hand piece but with 45° and 90° horizontal rotational motions, respectively.



Figure 2. M4 Safety Reciprocating Hand Piece (SybronEndo) with a size 08 stainless steel K-File attached.

A study by Gambarini et al. compared the cyclic fatigue resistance between stainless steel K-Files used in a reciprocating motion and NiTi PathFile rotary instruments in artificial curved canals.²⁷ The aim of their study was to evaluate whether stainless steel instruments could benefit from a reciprocating motion during their enlargement of

the glide path, given that that reciprocation can improve fatigue resistance of NiTi instruments. The stainless steel K-Files used with the M4 hand piece showed a significantly greater resistance to cyclic fatigue in comparison with the NiTi rotary PathFiles.

Clinically, reciprocation is used after the canal has been negotiated to the working length by hand and with the use of a small-size K-File. Reciprocation proceeds with the first file that binds at working length. Reciprocation is useful for the early enlargement of calcified canals and the elimination of iatrogenic ledges.²⁸ Once the stainless steel K-File can negotiate around the ledge, it is left in place and reciprocated, as suggested by Mounce.²⁸

The advantages of using a stainless steel K-File in a reciprocating hand piece for glide path enlargement include a reduction in preparation time; reduced operator and hand fatigue; and reduced risk of instrument separation compared with rotary NiTi methods.²⁹ The disadvantages include the need for a dedicated hand piece; the risk of apical transportation with files larger than a 15 K-File;¹⁹ the risk of excess dentine removal as a result of the clinician instrumenting the canal for longer than necessary;³⁰ the risk of apical extrusion of debris if the hand piece is forced apically;²⁹ and decreased tactile sensation.

3. Rotary Glide Path Instruments

3.1. PathFiles (Dentsply Sirona)

In 2009, Dentsply Sirona introduced a three-file rotary NiTi system specifically for glide path enlargement. Each file has a taper of 2% and exhibits a square cross-section. These features, according to the manufacturer, ensure flexibility, improved cutting efficiency, and render these files more resistant to cyclic fatigue. The tip of each file is non-cutting, which reduces the risk of ledge formation. PathFile no.1 (purple) has an ISO 13 tip size, PathFile no.2 (white) ISO 16 tip size and PathFile no.3 (yellow) has an ISO 19 tip size (Fig. 3). The gradual increase in tip size facilitates progression of the files. The manufacturer suggests using PathFile no.1 only after a size 10 stainless steel K-File has been used to explore the root canal to working length.²⁵



Figure 3. PathFile no.1 (purple), PathFile no.2 (white) and PathFile no.3 (yellow) (Dentsply Sirona).

There are numerous studies on the efficacy of PathFiles. Berutti et al. have shown that PathFiles maintain the original canal anatomy with less modification of canal curvature and fewer canal aberrations than does manual glide path enlargement performed with stainless steel K-Files.²⁵ Pasqualini et al. used micro-computed tomography (micro-CT) to examine curved root canals where glide paths were prepared to full working length with the use of PathFiles and stainless steel K-Files.³¹

These researchers concluded that PathFiles have a higher root canal centering ability, cause fewer modifications of the canal curvature and fewer canal aberrations and, therefore, maintain the original canal shape considerably better than do stainless steel K-Files. In 2014 Nakagawa et al. studied the flexibility and torsional resistances of rotary NiTi PathFile, RaCe ISO 10 (FKG Dentaire, La Chaux-de-Fonds, Switzerland), ScoutRaCe (FKG Dentaire) and stainless steel hand K-Files.³²

The results of this study demonstrated that the NiTi rotary glide path enlargement files were more effective at enlarging the glide path with fewer aberrant modifications to canal anatomy. PathFiles were shown to be the most flexible and the least torque resistant compared with ScoutRaCe and RaCe ISO 10 instruments. A study examining the influence of a glide path on canal curvature and axis modification after instrumentation with WaveOne Primary reciprocating files (Dentsply Sirona) showed significantly fewer canal modifications when WaveOne was used after glide path enlargement.³³

3.2. RaCe ISO 10 (FKG Dentaire)

RaCe ISO 10 (FKG Dentaire) (Fig. 4) is a three-file system with progressively increasing tapers: 2% (yellow ring), 4% (red ring) and 6% (blue ring). All have the same apical diameter of 0.1mm. These files have been indicated for constricted obliterated canals and for abrupt coronal curvatures.³⁴



Figure 4. RaCe ISO 10 (FKG Dentaire) 2% (yellow), 4% (red) and 6% (blue) tapered files.

3.3. ScoutRaCe (FKG Dentaire)

ScoutRaCe (FKG Dentaire) (Fig. 5) is a two-file system with each file exhibiting a 2% taper, a triangular cross section, alternating cutting edges and a non-cutting tip. They are available in ISO tip size 10 (purple), 15 (white) and 20 (yellow) and are used in sequence following initial canal exploration with a size 06 or 08 K-File to working length.³⁵

Ajuz et al. examined changes in canal curvature and incidence of canal irregularities after glide path enlargement with stainless steel K-Files, PathFiles and ScoutRaCe files.³⁶ PathFile instruments generated less modification of curvature and fewer canal aberrations. ScoutRaCe, however, showed significantly better performance in shaping double-curved canals. A study by Lopes et al. compared the mechanical properties of C-Pilot (VDW), PathFile (Dentsply Sirona), and ScoutRaCe.³⁷

PathFile instruments showed the highest resistance to cyclic fatigue, and ScoutRaCe files exhibited the highest angular deflection to fracture.



Figure 5. ScoutRaCe files (FKG Dentaire) ISO size 10 (purple), ISO size 15 (white) and ISO size 20 (yellow).

3.4. G-Files (Micro-Mega, Besançon, France)

The G-File system (Micro-Mega) consists of two files: the G1 file (red ring) with an ISO 12 tip size; and the G2 file (white ring) with an ISO 17 tip size (Fig. 6). The files have a 3% taper along the length, an evolving cross section that varies along the instrument, and non-cutting asymmetrical tips to aid in the progression of the file. The cross section has blades on three different radii to aid in the removal of debris and to reduce torsion. The manufacturer recommends their use after a size 10 hand file has been used to explore the canal to working length.



Figure 6. G-Files (Micro-Mega) G1 (red ring) and G2 (white ring).

3.5. ProGlider (Dentsply Sirona)

The ProGlider (Dentsply Sirona) (Fig. 7) is single mechanical glide path file manufactured using Memory nickel-titanium wire (M-Wire). M-Wire is constructed by thermos-mechanically treating NiTi to increase flexibility and resistance to cyclic fatigue. According to Johnson et al. this process makes M-Wire files almost 400% more resistant to cyclic fatigue than conventional NiTi files and, in this way, decreases the risk of file fracture.³⁸



Figure 7. ProGlider file (Dentsply Sirona).

The ProGlider file has a square cross section with a diameter of 0.16mm at D0 and 0.82mm at D16 and is progressively tapered from 2% to 8% over its length. According to its manufacturers, the file ensures a controlled, smooth, inward-cutting action that produces a smoother glide path. A small-size stainless steel K-File is initially used to scout, expand, and refine the internal walls of the canal. Once the canal can be manually reproduced, the single ProGlider file may be used to expand the working width in preparation for shaping procedures.³⁹

A study by Van der Vyver, Paleker and Jonker compared the preparation times of glide path enlargement in plastic blocks, using stainless steel K-files, PathFiles (Dentsply Sirona), X-Plorer files (Clinician's Choice Dental Products Inc., New Milford, USA) and the single ProGlider file.⁴⁰ The ProGlider file demonstrated significantly shorter glide path enlargement times with a mean preparation time of 11.3 seconds.

A more recent study compared the preparation times of glide path enlargement using stainless steel K-Files, G-Files (Micro-Mega, Besançon, France) and the single ProGlider file in curved mesial canals of mandibular molars.⁴¹ The ProGlider file and G-Files demonstrated significantly shorter glide path enlargement times with a mean preparation time of 27.95 and 41.87 seconds respectively. K-Files recorded a mean preparation time of 74.92 seconds. In this study by Paleker and Van der Vyver, micro-CT was used to compare the centering ability and apical canal transportation of these three file groups. Both the NiTi rotary glide path enlargement systems used here exhibited significantly less apical canal transportation than did the stainless steel K-files. The ProGlider file, however, exhibited a superior centering ability to that of both stainless steel K-Files and NiTi G-Files at the point of maximum curvature.

In 2014, Elnaghy and Elsaka used Cone Beam Computed Tomography (CBCT) imaging to compare the volume of removed dentine, transportation, and the centering ability of the ProTaper NEXT (Dentsply Sirona) system with and without glide path enlargement.³ The authors examined transportation values at 3-, 5-, and 7 mm levels. Their results showed significantly reduced mean transportation values at the 3mm- and 5mm level in the ProGlider-ProTaper NEXT group. The conclusion was reached that using this method resulted in better performance with fewer canal aberrations than instrumentation performed with PathFile-ProTaper NEXT or ProTaper Next only.

3.6. One G (Micro-Mega)

The One G instrument (Micro-Mega) was launched in 2015 as a single file system for glide path enlargement. This NiTi rotary glide path file has a 3% taper with three cutting edges situated on three different radii relative to the canal axis, which, according to the manufacturers, enhances the cutting action and allows for more space for debris elimination. The One G instrument has an ISO size 14 non-cutting tip that reduces the risk of ledge formation (Fig. 8) and a variable pitch between the cutting edges that is said to limit the screwing effect.



Figure 8. One G file (Micro-Mega).

Ha et al. compared the One G prototype with the G2 file (Micro-Mega) and found that One G had a higher cyclic fatigue resistance.⁴² These authors concluded that the increased fatigue resistance and flexibility might enable maintenance of the original canal anatomy during glide path enlargement, as well as a reduced risk of ledge formation or transportation.

The minimised contact area from the shaft of 3% taper was reported as possibly reducing the torque during instrumentation.

3.7. X-Plorer Canal Navigation NiTi Files (Clinician's Choice Dental Products Inc., New Milford, USA)

The X-Plorer Canal Navigation NiTi Files (Clinician's Choice Dental Products Inc.) (Fig. 9) consists of four instruments, available with distinctive cutting surfaces, tapers and cross-sections. The cutting surface of each file is limited to the apical 10mm of the file. This feature decreases torsion and contact with the surrounding surface and, perhaps conversely, increases tactile feedback.



Figure 9. X-Plorer Canal Navigation NiTi Files (Clinician's Choice Dental Products Inc.) ISO 15 tip (white ring, marked 01), ISO 20 tip (yellow ring, marked 01), ISO 20 tip (yellow ring, marked 02), and ISO 25 tip (red ring, marked 02).

The manufacturer recommends using the X-Plorer series after a size 08 or size 10 stainless steel K-File has been used to penetrate the canal to working length. The first X-Plorer file has an ISO 15 tip size and a 1% taper with a triangular cross section. The second has an ISO 20 tip size with a 1% taper and square cross section. The third has an ISO 20 tip size with a 2% taper and square cross section. The fourth has an ISO 25 tip size and a 2% taper with, again, a square cross section. The reduced taper increases flexibility and facilitates apical progression of the files. The X-Plorer files are available as rotary and hand files and have non-cutting tips each with a tip angle of 75°. Recently, a fourth file was introduced specifically for both clinicians who prefer to establish a working length up to a size 25 and those who want to have a larger diameter at working length before using rotary shaping files in tiny canals.

4. Reciprocating Glide Path Instruments

4.1. WaveOne Gold Glider (Dentsply Sirona)

The WaveOne Gold Glider (Dentsply Sirona) (Fig. 10) was launched in 2017. The file is a reciprocating NiTi file designed for glide path enlargement prior to shaping canals with a Primary WaveOne Gold instruments.

The WaveOne Gold Glider is a single-use sterile instrument and re-use is not allowed. The file has an ISO size 15 tip size with a variable taper of between 2% (D0) and 6% (D16) and a parallelogram shaped cross sectional design. The tip of the file is semi-active and the active cutting flute length is 16mm.



Figure 10. WaveOne Gold Glider (Dentsply Sirona).

The manufacture of the WaveOne Gold Glider entails the use of NiTi wire subjected to a post-manufacturing thermal process. During this process, a new phase-transition point between martensite and austenite is identified in order to produce a file with super-elastic NiTi metal properties. This process gives the file a gold finish and renders it more flexible and more resistant to cyclic fatigue compared with conventional NiTi and M-Wire alloys.⁴³

4.2. R-Pilot (VDW, Munich, Germany)

The R-Pilot instrument (VDW) (Fig. 11) is a glide path instrument manufactured from M-Wire and is used in reciprocating motion to prepare the root canal system before the shaping with a rotary or a reciprocating instrument. The R-Pilot instrument has a constant taper of 4%, an ISO tip size of 12.5 and an s-shaped cross section. It is a single-use instrument designed for use in no more than one molar.

The R-Pilot instrument can be used only in a reciprocating motion with a designated drive system that uses the original Reciproc (VDW) settings. Failure to do so, according to the manufacturers, can lead to instrument fracture and misuse. The instrument is not recommended for use in canals with abrupt apical curvatures in the apical region.



Figure 11. R-Pilot (VDW).

CASE REPORT

A patient, a 70-year-old male, reported with irreversible pulpitis affecting his maxillary first left molar. The tooth provided an abutment for a three-unit zirconia bridge.

A periapical radiograph revealed possible curvatures in the mesiobuccal and distobuccal root canals (Figure 12). It was decided with the consent of the patient to take a limited field of view CBCT scan to explore the anatomy of this tooth. The scan revealed in the axial plane three root canal systems, and in the sagittal plane it was evident that there were indeed severe root curvatures present in the mesiobuccal and distobuccal root canal systems. It was decided to undertake a more in-depth investigation regarding this complex anatomy, using the 3D Endo Software (Dentsply Sirona).

The data of the limited field of view CBCT scan was exported as a DICOM files and imported into the 3D Endo Software. The 3D Endo software confirmed severe curvatures in the two mesiobuccal root canals and an apical curvature in the distobuccal root canal. The software projects the proposed root canal instruments into the canals (Figure 13), allowing the operator to visualize the internal anatomy of the root canals. The image may be rotated in 3D to alert the operator to the angles and directions of curvatures in the root canal systems. Note the severe midroot curvatures in the two mesiobuccal root canals and in the apical part of the distobuccal root canal.



Figure 12. Preoperative periapical radiograph.



Figure 13. The 3D Endo Software projects the proposed root canal instruments into the canals. Note the severe midroot curvatures in the two mesiobuccal root canals and apical part of the distobuccal root canal.

At a following visit the tooth was anaesthetized, a rubber dam placed, and an access cavity was prepared. The canals were located under magnification.

Canal negotiation and glide path preparation

The pulp chamber was filled with Glyde Root Canal Conditioner (Dentsply Sirona) and canal negotiation was initiated with a pre-curved size 08 K-File. It was possible to negotiate the palatal and distobuccal canals to patency.

It was only possible to negotiate the mesiobuccal canal to approximately two thirds down the length of the mesiobuccal root canals before resistance was met (Figure 14a). It was decided to flare the coronal aspect of the canal with a WaveOne Gold Glider (Figure 14b). The larger coronal flare of the canals allowed a size 08 K-File to progress to patency (Figure 14c). Working length measurements were obtained from an electronic apex locator and confirmed radiographically (Figure 15).

The size 08 K-File fitted very tightly into the root canals and it was decided to prepare a reproducible glide path for each root canal system with the size 08 K-File in a M4 Reciprocating hand piece (Sybron Endo) (Figure 16a), followed by repetitive instrumentation to make a size 10 K-File super loose" (Figure 16b). Thereafter, a WaveOne Gold Glider (Dentsply Sirona) was used in reciprocating motion to expand the glide path up to full working length (Figure 16c).

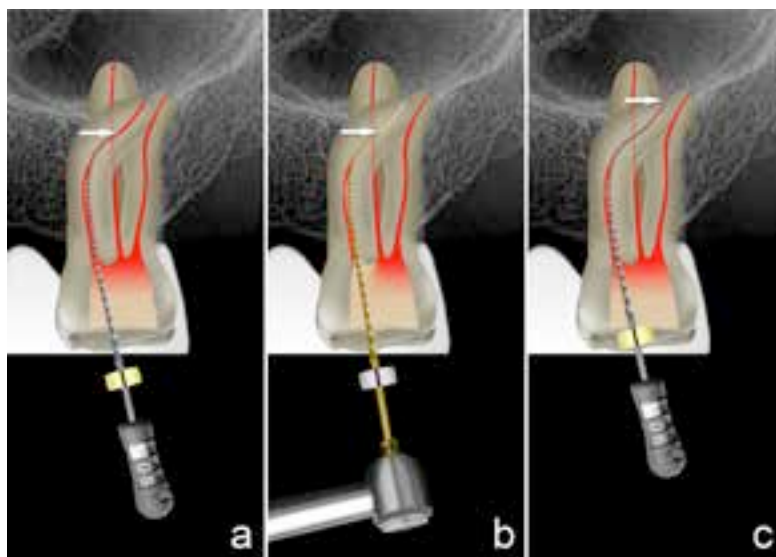


Figure 14. (a) It was only possible to negotiate the mesiobuccal canals to approximately two thirds of the full length with a size 08 K-File before resistance was met; (b) coronal aspects of the mesiobuccal canals were flared with a WaveOne Gold Glider; (c) Increased coronal flare of the canals allowed a size 08 K-File to progress to full length and patency.

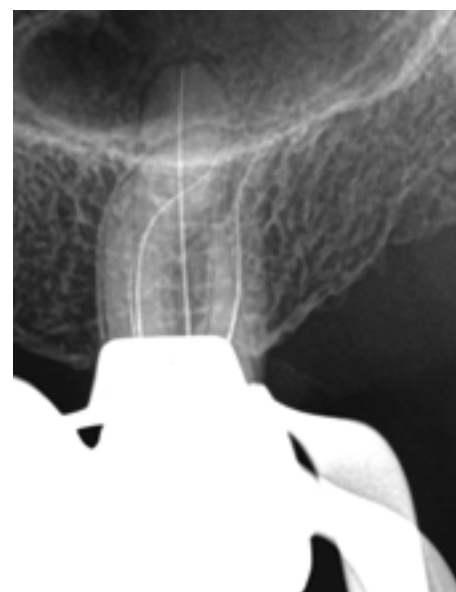


Figure 15. Length determination radiograph.

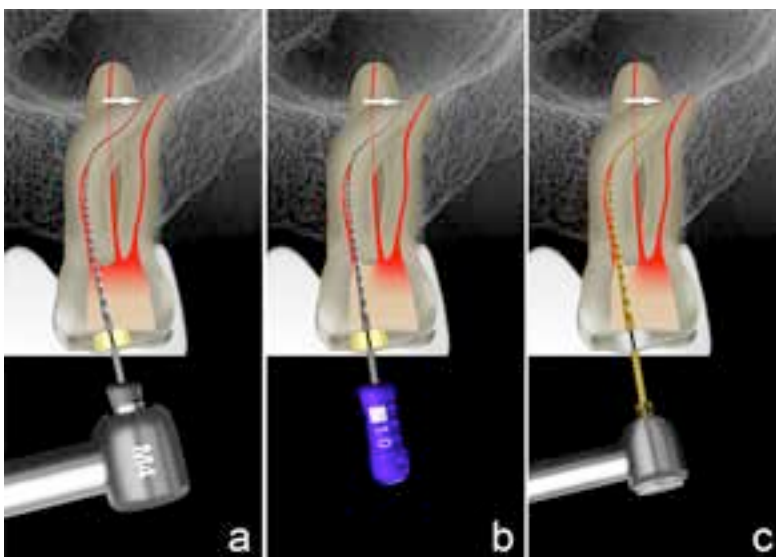
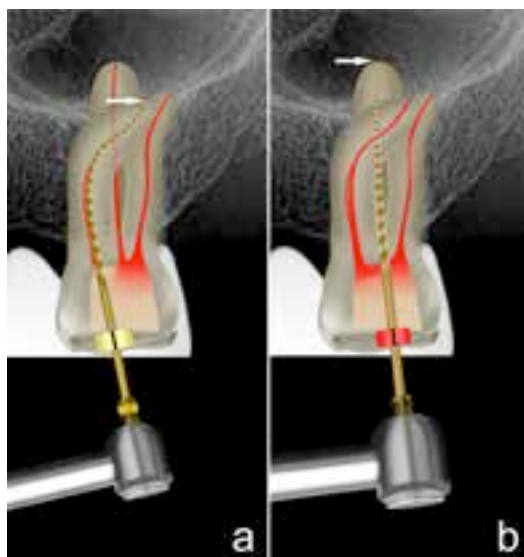


Figure 16. (a) Size 08 K-File in the M4 Reciprocating hand piece was used to initiate the preparation of a reproducible micro glide path; (b) size 10 K-File was made "super loose" to complete the preparation of the reproducible micro glide path; (c) Wave One Gold Glider was used in a reciprocating motion to further the glide paths in all the root canals.



Figure 18. Periapical radiograph showing the final result after obturation. Note the severe curvature of the two mesiobuccal root canal systems.



Root Canal Preparation, Irrigation and Obturation

The two mesiobuccal and the distobuccal root canal systems were prepared with the Small Wave One Gold instrument (figure 17a) and the palatal canal was prepared with the Primary Wave One Gold instrument (Figure 17b).

After canal preparation, the canals were flooded with 17% EDTA solution (Ultradent) and the solution activated for 1 minute with EDDY Endo Irrigation Tip (VDW) driven by an air scaler (Soniflex LUX 2000L, KAVO). Thereafter, final disinfection was achieved by activating 3.5% heated sodium hypochlorite for 3 minutes, again activated with the EDDY Endo Irrigation Tip.

Figure 17. Root canal preparation was done with the (a) Small WaveOne Gold instrument in the two mesiobuccal and distobuccal root canal systems (b) Primary WaveOne Gold instrument for the palatal root canal system.

The canals were dried with paper points and obturated using matching gutta-percha points, Pulp Canal Sealer (Kerr) and the Calamus Dual Obturation Unit (Dentsply Sirona). Figure 18 shows the final result after obturation.

CONCLUSION

With the introduction of newer glide path systems (for example single file and reciprocating glide path systems) and the advancement in the metallurgic properties of these glide path instrumentation systems, the clinician is presented with the opportunity to enlarge and shape root canal systems more predictably, with a reduction in preparation time as well as a decrease in procedural aberrations.

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South African toothpaste pot lids

SADJ April 2019, Vol. 74 No. 3 p137 - p140

BR Pynn¹, E Lastovica², L Evans³, HF Hagen⁴

As towns and cities rapidly expanded in the 1800s, manufacturers and retailers had to develop new methods for packaging and transporting the large number of household commodities required for domestic use or consumption.

These newly developed ceramic containers soon became the standard of the day, housing numerous products that came in a paste form, such as bear's grease, cold cream, salves and ointments to edible pastes, shaving cream and... toothpaste. Most manufacturers and retailers went one step further, taking the opportunity to print advertising on the lids of the small pottery containers. As competition became fierce, manufacturers and retailers made wild and often false claims about the benefits of their product to out-manoeuvre the opposition.

Just as happens with the containers of today, most of these jars were considered dispensable and were consigned to the dustbin and eventually ended up in the local trash dumps of the time. There they remained for many generations before eager collectors excavated these long forgotten sites (often called tips), searching for rare and attractive examples of yesteryear.

The earliest proprietary tooth powders were packaged in labelled paper bags, wooden containers with revenue stamps, and small ceramic pots covered with parchment or paper which was secured with string. Prior to the invention of the transfer printing process, the brand names of manufactured goods were hand lettered onto the side of the pot or described by means of a paper label pasted on the lid.

The invention of the transfer printing technique allowed a much more durable method of promoting the contents, and the lids were frequently decorated using this method. Although still laborious by today's standards, this also allowed for a greater degree of artistic expression, effected with the aim of enticing buyers through the aesthetic appeal of the package.

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The process was distinctively English, originating in Liverpool in the second half of the 18th century. However, the main centre of production in the UK was the Staffordshire potteries. They would receive orders from throughout the world including the USA, Australia, New Zealand, Germany, and Canada. Pot lids would remain in popularity until the end of the first world war when more modern and now familiar forms of packaging became established.

The method of printing on a pot lid was multi-staged and time-consuming. The transfer was lifted on tissue-thin paper from an engraved copper plate that had been previously inked or coloured. It was then transferred to the lid after the first baking (the bisque stage) and rubbed until the print firmly adhered to the pottery. In most cases, the paper was then carefully removed, usually by washing or floating it off in water. Finally, the lid was glazed and fired to fix the design as an integral part of the pottery.

As a result of the high production cost of multi-coloured advertising pot lids, single coloured or monochrome lids dominated the market. Most dentists or chemists of this era packaged toothpaste or pharmaceutical products such as cold cream and hair restorer in pots with monochrome lids. Gold bands and serrated edges were sometimes added around the border of the container to give the product a high-class appearance.

The shapes of the pot and lid also evolved after their inception. For the first 30 years of their use, all printed pots were round in shape with flat or domed lids. From the late 1870s and 1880s, rectangular and square lids became popular. Oval-shaped pots and lids were also manufactured, with far less acceptance, because these were difficult to pack and store. The toothpaste pots came in various sizes from a small sample size of less than an inch in diameter to five inches for economy size. Occasionally dentists produced specialty toothpaste containers (Figure 1).

Victorian advertising yields fascinating insights into the early days of mass marketing. Many of the lids were printed with elaborate designs and bright colours, which made them stand out amongst other lids, the majority of which were monochromatic.

Several themes dominated the pictorials on these lids. A popular theme was the inclusion of images of attractive girls and aristocratic gentlemen, conveying the message that "you too could look this good". Farmland scenes, beehives, horse & carts presented a message of natural, wholesome products; famous architectural structures sent a message of solidity, dependability and longevity; and unusual locations and exotic animals, such as palm trees, temples and camels, attempted to allure the consumer with rare, expensive and mysterious ingredients.

While all these themes had a following, the most successful was that eliciting a connection through the use of Royalty crests or actual images - it seemed that many of the dentists or perfumers were appointed by the Royal family - sending a message that if it was good for the rich and famous, it was certainly good for the commoner. Princess Alexandra of Denmark, later Queen consort to Edward VII, was the most popular Royal, appearing on 15 known varieties issued by five different toothpaste manufacturers.

Dental images such as toothbrushes and teeth appeared on a few of the dental related toothpaste pot lids but were in fact quite rare (Figure 2); the majority of pictorial images commissioned by chemists or dentists were cherries or mosque/palm trees. The two most popular types of toothpaste flavours were areca nut and/or cherry. Cherry toothpaste was cherry-coloured by the addition of carmine or Armenian bole. Nothing was added to give the paste a cherry flavour, the description "cherry" being applied merely due to its colour.



Figure 1. Miscellaneous international lids.



Figure 3. RSA pot lids.



Figure 2. Dental images and toothbrushes.



Figure 4. RSA pot lids.

The addition of cherry colouring and Indian areca, or betel nut as it is also known, inspired attractive pictorial adornments for the lids. Areca nuts were normally chewed with betel leaves for their effects as a mild stimulant... but they also have anthelmintic properties, although it is unlikely that many consumers realized they were being mildly deformed when they cleaned their teeth!

Whilst the total number of English pot lids is believed to be around ten thousand, there are fewer than 300 designs of American pot lids. These can be found throughout the United States of America, but are concentrated around the coastal areas such as New York, Philadelphia and San Francisco. Jules Huel, Xavier Bazin and H.P. & W.C. Taylor, all of Philadelphia, exhibited their pot lid products at the Great World Fair of 1851, which in turn popularized their usage over the next 50 years.

Canadian pot lids are even rarer with less than 25 known examples. These lids have been found in four provinces, Ontario, Quebec, Nova Scotia and New Brunswick.

Forty-seven South African pot lids have been officially recorded, but it is estimated that since then, at least another ten have been recognised. Of the 47 lids recorded to date, 36 are toothpaste lids (34 ceramic lids and 2 metal containers); 6 are cold cream and 11, ointments (including Oog Zalf/Salf/Salve).

Thirteen towns or cities are found on the South African lids, especially, Cape Town, Johannesburg, Boksburg, Pretoria, Kimberley, Port Elizabeth, East London and Pietermaritzburg (Figure 3).

The Floral Tooth Paste lid used by B.G. Lennon & Co. is striking with the crest of the Cape Colony almost filling the design. The company was founded in Port Elizabeth in 1850 by Berry Grey Lennon, grandson of Sir George Grey, Governor of the Cape Colony (renamed Cape Province in 1910). This lid dates from before 1891. Lennon were successful wholesale chemists, druggists and druggists' sundrymen. Their pharmaceutical products are still sold in the 21st century.

Three Heynes' tooth paste lids are of interest because they can be dated from the 1860's until 1872. These lids state that Heynes' tooth paste was patronised by H.R.H. the Duke of Edinburgh, Queen Victoria's second son, Prince Alfred. He visited Cape Town three times. In 1866, as a sixteen-year old, he undertook a 1200 mile journey around the country by horse and wagon. The merchants of the town vied for his patronage, and Heynes, a chemist, was appointed to deal with the prince's pharmaceutical needs, including tooth paste. The Duke of Edinburgh visited the Cape again in 1867 as Captain of HMS Galatea, and returned for his last visit in 1872 (Figures 4 and 5).

The most beautiful, partially coloured, South African lid was used by J.H. Cooper who were chemists in central Cape Town and Sea Point from 1883 to 1925. Their Cherry Tooth Paste lid features brightly coloured cherries and leaves, surrounded by black and white text. The colour was possibly painted over- the-glaze at the time of production (Figure 6).

36 ADVERTISEMENTS.

JOHN HEYNES,
PHARMACEUTICAL CHEMIST,
 Wholesale & Retail Druggist,
BRITISH DISPENSARY,
 CAPE TOWN.

PURE PHOTOGRAPHIC CHEMICALS
 (GUARANTEED),
 TOILET BOTTLES, SCENTS, SCENTED SOAPS,
 HAIR, NAIL, AND TOOTH BRUSHES,
 OF SUPERIOR QUALITY, FROM BEST MAKERS.



Patronised by H. R. H. the Duke of Edinburgh.

HEYNES' TOOTH PASTE.
 A fragrant and useful Toilet Requisite, possessing singular virtues. It cleans, preserves, and beautifies the Teeth, giving to the Gums a healthy firmness, to the Breath a pleasant sweetness, and is a certain remedy for Toothache.
 British Dispensary, Adderley-street.

HEYNES' TONIC WINE.
 This Preparation is one of the pleasantest and most effectual Tonics ever offered to the Public, its basis being pure Quinine. It can be recommended as the best preventive against Fever, Debility, Loss of Appetite, &c., &c.
 PRICE, 2s. 6d. per Bottle.

GENUINE PATENT MEDICINES.

Figure 5. Heynes advert.



Figure 6. Cooper Cherry tooth paste.

Lidded tins post-dated the ceramic pot lids as a form of container for paste products, although there would have been some overlapping in the two forms of containers. Included here are two interesting South African examples of early 20th Century tin containers (Figures 7A and B).

Although reproductions are uncommon, several varieties have surfaced over the past few years. Fakes are also known and a common method to deceive is to glue a photocopy of a rare transfer to an original plain lid and to seal it with a varnish or lacquer.

More sophisticated fakes are glazed and fired at a low temperature and the kiln is opened early whilst still hot to produce artificial age crazing. Generally, forgers often use lids which are usually the wrong size and weight compared with the original lid.

Unfortunately, they can be difficult to distinguish from an authentic example so it's always worth checking with an expert if there are any doubts.

Books on the topic

1. R Dale. *The Price Guide to Black & White Pot Lids*. Antique Collectors' Club Suffolk UK; 1977 (480 pages).
2. R Keil. *Collecting Australian Pot Lids*, Self Published; 1981 (220 pages).
3. S Jackson, B Jackson. *American Pot Lids*, Self Published; 1987 (91 pages).
4. B Houghton et al. *Historical Guide to Advertising Pot Lids*, Self Published: 2018 (713 pages).



Figure 7A. Colgate Tooth Paste - War Time Pack tin.



Figure 7B. Heynes Saponaceous Dentifrice tin.

Introducing the Alveolar Moulding Obturator (AMO): an appliance for the early management of Cleft Palate Neonates

SADJ April 2019, Vol. 74 No. 3 p141 - p143

SM Dawjee¹, MM Dawjee²

Keywords

Cleft palate, alveolar moulding, cleft obturator, feeding plate.

Clefting of the lip and palate is one of the most common congenital malformations encountered worldwide. It affects about 1 to 1.6 per 1000 live births and is more common in males than in female,¹⁻³ occurring more frequently on the left side than it does on the right side of the face.^{1,4} The condition can come as a severe emotional shock to parents, particularly in third world countries where prenatal detection is not affordable and parents cannot be sensitised before the birth of their child. Such emotional trauma can lead to a sense of blame, guilt and strained social relations at a time when family support is most needed.⁵

Early intervention into cleft management provides some emotional comfort and is helpful as the maxilla undergoes its greatest postnatal growth change during infancy and early childhood.⁶

Maxillary growth was found to be favourable in patients who waited the recommended period as compared with those who had early surgery. In addition, palatal dimensions were more nearly normal in the late group than in the early group.⁷

The 'rule of ten' (10g haemoglobin, 10 weeks of age and 10 pounds of body weight) is usually applied to determine the timing of the surgical intervention in cases of congenital clefts.^{3,8} Adequate feeding and nutrition is therefore vital to meet this requirement.

While the six months waiting period prior to surgery is a medical recommendation, the delay may be psychologically challenging and stressful for the parents and family.

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ACRONYMS

AMO: Alveolar Moulding Obturators

CAD: Computer Aided Design

Lip taping of the cleft lip and the use of intra-oral obturators/feeding plates promote neonatal nursing and can have a reassuring and comforting outcome on the parents and family.⁹

Patients treated by presurgical orthopaedics such as obturators or feeding plates have been shown to have a higher probability of achieving favourable occlusal relationships than in those treated by surgical intervention only.¹⁰

An obturator or feeding plate is an appliance fabricated from acrylic that seals the cleft, separates the oral and nasal cavities and permits effective deglutition without regurgitation or spillage of fluids through the nose. This appliance was designed by Hotz and has been modified considerably since its introduction.¹¹

Acrylic obturators have generally been the appliance of choice for neonates presenting with a cleft palate.

Although claims have been made that these appliances can result in favourably reducing the cleft, there is no documented evidence to support this. Acrylic obturators are bulky in the confines of a neonate mouth and require periodic relining, rebasing and even replacement to conform to changes in growth. Acrylic carries the inherent risks in that it may irritate the mucosa and can compromise oral health by virtue of its porosity. The relining material has the potential to tear or fracture and the additional mass it introduces can negatively influence the retention of the appliance in the confines of a neonate mouth.

According to Bütow (1984), the infant tolerates the feeding plate well, and usually gives voice to displeasure at its removal for cleaning purposes. It is important that initially such a plate should be placed in the first two weeks of life, preferably in the first couple of hours after birth.⁸

Infants should not wear the obturator during the week prior to surgery so that the mucosa may be lesion-free and so resist any hyperplastic reaction. To limit the risk of complications the mucosa has to be as healthy as possible for the surgical reconstructive procedure.⁸

The adoption of computer technology and computer aided design (CAD) in particular, offers the potential to design obturators that may alter and direct tissue growth favourably in and around the cleft to facilitate surgical closure.

Invisalign® and Clearpath® are orthodontic treatment modalities aimed at aligning teeth through the application of a series of modified thermoplastic occlusal guards (gum-guards). The appliances progressively effect selective and incremental changes in tooth position until the desired result is achieved. The appliances are made from a thermoplastic, viscoelastic material 1-3mm thick that is heated and tightly suctioned over a study cast of the patient's mouth. The appliances are translucent, smooth, light weight and have an inherent elasticity which makes them self-retentive, eliminating the need for wire clasps or relines.

While successful in achieving tooth movement, the Invisalign® and Clearpath® techniques have not been applied to the management of neonates with a cleft palate. This treatment modality may have significant value in the early stages of cleft palate management. It is therefore pertinent that the application of this treatment modality to cleft palate babies be explored.

From successive CAD modified images of the cleft palate (Figures 1 and 2), models can be printed and thermoplastic, viscoelastic Alveolar Moulding Obturators (AMO) may be constructed on the models.

A total of five AMOs fabricated from five progressively modified printed models are shown in Figure 3.

These should be supplied to the patient individually on a monthly basis and it is expected that the use of progressively modified obturators will approximate the alveolar arches and palatal cleft favourably in preparation for surgical repair. The AMO approach will provide that essential emotional comfort to patient and to parents, will minimise regurgitation and spillage, and should result in reduced surgical commitment.

The appliances are destined for clinical trial.

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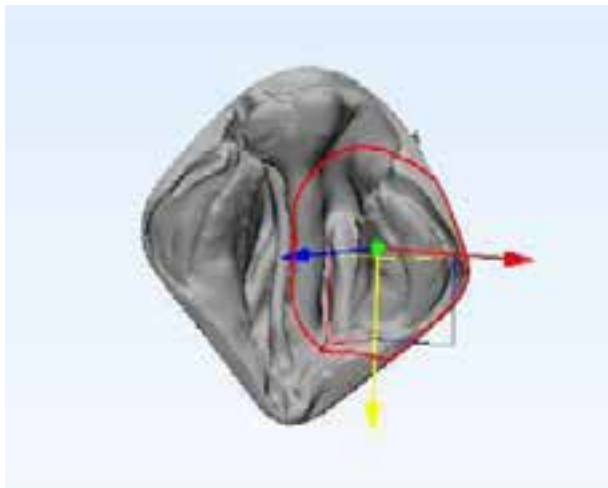


Figure 1. A digital representation of a study cast with arrows indicating the intended growth modification of the alveolar arches in a bucco-lingual and posterior direction to reduce the cleft size and align the prolabium.

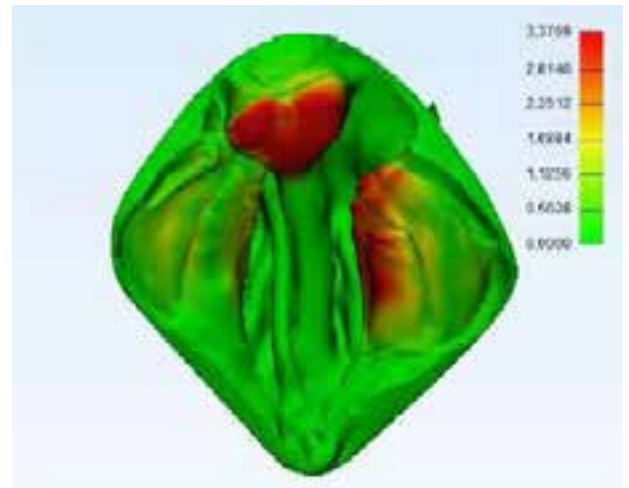


Figure 2. Computer aided design (CAD) analysis of a digital study cast for the production of progressively modified AMOs.



Figure 3. A series of AMOs made from digitally modified printed models. Note the progressive alignment of the segments.

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What's new for the clinician: excerpts from and summaries of recently published papers

SADJ April 2019, Vol. 74 No. 3 p144 - p147

Compiled and edited by Prof V Yengopal

1. Does oral health influence school performance and school attendance? A systematic review and meta-analysis

MAB Rebelo, JM Rebelo Vieira, JV Pereira, LN Quadros, MV Vettore
Int J Paediatric Dent. 2019; 29:138–48.

Several chronic diseases are known to affect children, requiring significant adjustments in life management and leading to decreased quality of life. Among the most prevalent diseases of childhood are dental caries, asthma, diabetes, and obesity, with dental caries being the most common, occurring 5 to 8 times more frequently than asthma, the second-most common condition.

Chronic illness can interfere with a child's ability to succeed in school. Evidence shows that increases in missed school time caused by chronic illnesses can lead to declines in school performance.

Rebelo and colleagues (2019)¹ undertook a systematic review with meta-analysis to assess the evidence on the possible influence of oral health on school performance and school attendance in children and adolescents.

METHODS

The protocol of this systematic review was registered on PROSPERO and presented according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA Statement) checklist.

Studies involving participants aged 18 years or under that assessed oral health measures concomitantly with information regarding participants' school performance and/or school attendance were considered for selection.

Clinical trials and observational (cohort, case-control and cross-sectional) studies published in any language were eligible. Editorials, letters to editors, review papers, descriptive studies (case reports and case studies), and duplicated studies were excluded.

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ACRONYM

NOS: Newcastle-Ottawa Scale

A search strategy was developed and five electronic databases were searched without publication period restrictions to May 2018. No search of the grey literature was undertaken.

All the retrieved studies were screened for inclusion by three reviewers independently. Disagreements between the three reviewers were resolved by discussion with a fourth reviewer. Potentially eligible studies were then assessed in full for eligibility according to the selection criteria. Manual searches were conducted in the reference lists of the identified papers for discovery of additional relevant studies. Finally, the selected studies were assessed for inclusion in the meta-analyses.

Data extraction was carried out independently by the three reviewers in a method similar to that used for assessment of studies for inclusion. Data extraction forms were used to record the following information: **(a)** authors and year of publication; **(b)** study design; **(c)** country and study setting; **(d)** age group and sex; **(e)** sample size; **(f)** oral health condition and measurement; **(g)** outcomes: school attendance and/or school performance; **(h)** number of confounders assessed; and **(i)** summary of the main findings.

The methodological quality assessment was performed by the same three researchers using the Newcastle-Ottawa Scale (NOS) for cohort studies and case-control, and the modified Newcastle-Ottawa Scale for cross-sectional studies. NOS for cohort, case-control studies and cross-sectional studies is made up of 8, 8, and 6 items, respectively. Each item may receive one point (one star) except from the item "Comparability" in which the score ranges from 0 to 2 stars. Low risk of bias studies could receive a maximum score of nine stars

for cohort and case-control studies, and seven stars for cross-sectional studies. Cohort and case-control studies from 6 to 8 stars were classified as moderate quality, and those with five stars or less were considered to have low quality. Cross-sectional studies rating between 4 and 6 stars were evaluated as moderate quality, and those with three stars or less were considered to have low quality.

Meta-analysis was considered for included papers where the effect size (odds ratios) and 95% of CIs were reported or could be extracted. Continuous effect size measures (e.g.: mean differences) were translated into odds ratio standardized effect size using information from the comparison groups, including sample size, mean, and standard deviation. Since only observational studies were included in the meta-analysis, the random effect method was used to obtain pooled estimates, according to the outcome (school performance and school attendance) and the different oral health exposures.

Heterogeneity among studies was tested by Cochran's *Q* test. The proportion of the variance between studies due to heterogeneity was assessed using *I*². Meta-analyses reporting *I*² ≥ 75% were rated of high heterogeneity. Potential publication bias was not tested since the meta-analyses included less than ten studies.

RESULTS

The initial search identified 9308 potential papers. Of these, 3706 studies remained after excluding duplicated documents. All titles and abstracts were then reviewed, and 3638 documents were considered irrelevant and were also excluded. The full texts of the remaining 68 papers were analysed for inclusion. Of these, 50 were thereafter excluded according to the inclusion criteria. In the end, a total of 18 studies were included in this systematic review. No additional paper was identified through manual search of the reference lists of the selected papers. Meta-analyses were carried out using data from 15 studies.

Of the 18 included studies, one cohort, one case-control, and 11 cross-sectional studies assessed the relationship between different oral health measures and school performance. Of these, five cross-sectional studies also evaluated the association between oral health and school attendance. In addition, a further five studies tested the relationship between oral health and school attendance.

Most studies were conducted in schools, and the sample sizes varied between 312 and 65,680 participants. Dental caries was the most investigated dental exposure. Other measures which were investigated included gingivitis, dental trauma, malocclusion, parent's perception of child's oral health, self-perceived oral health and toothache, school performance and school attendance.

The risk of bias assessment ranged from low to moderate quality for the included studies.

The pooled effect size of the association between dental caries and school performance was obtained using data from 3205 children from five studies. Children with one or more decayed teeth had 44% higher probability of poor school performance than caries-free children

(OR: 1.44 95% CI: 1.24-1.64) (Figure 2). Data from 30 995 children from five studies were used to obtain the pooled effect size between parent's perception of child's oral health and school performance. Poor school performance was significantly associated with poor paternal perception of children's oral health (OR: 1.36 95% CI: 1.16-1.57).

No heterogeneity was observed in either analysis (dental caries: *Q*: 0.94, *P*=0.918; parent's perception of child's oral health: *Q*: 8.88, *P*=0.064). Meta-analysis of the estimates of the association of gingivitis (*Q*: 4.14, *P*=0.042, *I*²: 75.9%) and toothache (*Q*: 24.42, *P*<0.001, *I*²: 91.8%) with school performance revealed high heterogeneity.

Children with decayed teeth had significantly higher odds of having poor school attendance than those without dental caries (OR: 1.57 95% CI: 1.08-2.05). The pooled effect size was obtained from five studies using data from 4416 children. Parents of children with poor school attendance were 1.35 times more likely to report poor oral health of their child when data from 108 214 children from three studies were combined (95% CI: 1.22-1.42).

There was no statistical association of dental trauma and toothache with school attendance. Heterogeneity tests on the meta-analyses for school attendance were not statistically significant (dental caries: *Q*: 2.24, *P*=0.816; dental trauma: *Q*: 0.53; *P*=0.467; parent's perception of child's oral health: *Q*: 4.37; *P*=0.113; toothache: *Q*: 0.31; *P*=0.580).

CONCLUSIONS

Children and adolescents with dental caries and those reporting worse oral health experience poor school performance and poor school attendance.

Implications for practice:

Clinicians should note that the strength of the evidence used to assess the research question for this study ranged from low to moderate. The researchers acknowledged the need for more longitudinal high quality studies to add to the evidence pool for this topic. However, there is no doubt that school performance and attendance among school going children is negatively affected by poor oral health!

Reference

1. Rebelo MAB, Rebelo Vieira JM, Pereira JV, Quadros LN, Vettore MV. Does oral health influence school performance and school attendance? A systematic review and meta-analysis. *Int J Paediatric Dent* 2019; 29:138–148.

2. Changes in masticatory performance of edentulous patients treated with single-implant mandibular overdentures and conventional complete dentures

TE Nogueira, M Schimmel, CRJ Leles
Oral Rehabil. 2019; 46:268–27.

Patient satisfaction with a mandibular complete denture (CD) is frequently low due to its limited retention and stability, which negatively affects oral function and comfort. The use of a single implant in the mandibular midline to retain an overdenture has been considered an alternative for improvement of the oral function and comfort of conventional denture wearers and a less invasive and less costly option compared with the two-implant overdenture.¹

However, although studies suggest significant improvement in patient-reported outcomes following treatment with the single-implant mandibular overdenture (SIMO), there is scarce information about functional changes, including the effect on masticatory function.

Nogueira and colleagues (2019)¹ reported on a clinical trial that sought to assess the changes in masticatory performance in edentulous patients rehabilitated with conventional maxillary dentures opposed to a CD or a SIMO, using a parallel-group randomised controlled trial comparing the two treatments options.

The colour-mixing ability of a two-coloured chewing gum was used for measurement of the patients' masticatory performance. The null hypothesis was that edentulous patients with conventional CDs do not benefit, in terms of masticatory performance, from stabilisation of the mandibular denture by means of a single implant.

MATERIALS AND METHODS

This study reported the findings regarding masticatory performance from a randomised clinical trial that compared two treatment alternatives for edentulous subjects: conventional maxillary denture opposed to either a conventional mandibular complete denture or a single-implant mandibular overdenture.

Edentulous subjects were recruited and randomly assigned to the two study groups. All participants received a new set of conventional CDs and, additionally, participants assigned to the SIMO group received a Straumann® Standard Plus SLActive® regular neck implant in the symphyseal region of the mandible. After a three-week healing period, a retentive titanium anchor abutment (3.4 mm height, 2.25 mm ball; Straumann) was connected to the implant and the corresponding elliptical matrix was used for denture retention, which consists of a titanium housing into which a gold lamella retention insert is screwed.

Masticatory performance was measured by assessing the mixing ability of a two-colour chewing gum. For each participant, two masticatory tests were performed with 20 and 50 chewing cycles. The variance of the hue (VOH) was

ACRONYM

CD: Conventional Mandibular Complete Denture

SIMO: Single-Implant Mandibular Overdenture

VOH: Variance of the Hue

considered as the measure of mixing: the smaller the VOH value, the greater was the mixing of the two-coloured layers of the chewed gum, which in turn meant better masticatory performance.

Tests were performed for all participants after CD insertion (baseline) and at the six- and 12-month follow-ups. Only patients with baseline data and at least one longitudinal assessment were included in the final sample.

Mean (standard deviation) and 95% confidence intervals were used to summarise VOH data. Chi-square and independent *t*-test were used for comparison of the participants' baseline characteristics between treatment groups. For analysis of the factors affecting masticatory performance, considering the hierarchical structure of data, a multilevel linear regression was used to model the changes in masticatory performance, in which the outcome measure was clustered within the time points and the number of chewing cycles, and the two treatment options added as a fixed effect to the model.

The participant-level variable was used as the covariate that defined the subject grouping for the random effects model.

RESULTS

The final sample size was 15 for the single-implant mandibular overdenture (SIMO) group and 19 for the complete denture (CD) group. The overall mean age was 63.9 (SD=9.0) years, 67.6% were women.

The between-group comparison of baseline characteristics showed no significant differences regarding sex ($P=0.397$) and age ($P=0.143$). Time period between the new denture insertion and baseline measurements was similar in both groups: 5.0 ± 2.6 weeks for CD and 4.8 ± 2.3 weeks for SIMO group ($P=0.746$).

The mean overall masticatory performance was similar between groups at baseline for the CD (VOH=0.639 ± 0.098) and SIMO (VOH=0.641 ± 0.097) ($P=0.924$).

However, there was a significant difference in overall measures between 20 (VOH=0.602 ± 0.130) and 50 (VOH=0.473 ± 0.142) chewing cycles ($P<0.001$). A significant linear effect was observed for the different time points ($P<0.001$).

Overall improvement in mixing ability, measured by the differences in VOH scores from baseline to 12 months, was $-0.21 (\pm 0.11)$ for 20 cycles and $-0.23 (\pm 0.10)$ for 50 cycles, ranging from $+0.09$ to -0.45 points for the whole sample. No differences between treatment groups regarding the overall improvement in masticatory performance were observed for 20 cycles ($CD = -0.24 \pm 0.11$; $SIMO = -0.19 \pm 0.11/P = 0.232$) and 50 cycles ($CD = -0.25 \pm 0.08$; $SIMO = -0.22 \pm 0.13/P = 0.428$). However, the improvement in masticatory performance as assessed at 20 cycles was higher in the SIMO (0.13 ± 0.10) than in the CD (-0.04 ± 0.12) group ($P = 0.024$), suggesting that the implant stabilisation of the mandibular denture promotes an earlier functional improvement compared with the CD.

For the regression analysis, the number of cycles and time points were inversely associated with VOH values (negative regression coefficients), which means that the higher number of cycles (from 20 to 50 chewing cycles) and longer follow-up (compared to baseline), the lower were the VOH values (and greater the mixing ability).

SIMO treatment did not improve the mixing ability compared to CD treatment ($P = 0.935$). However, the differential association across treatments were significant in the interaction terms for the time point factor at the six-month follow-up ($P = 0.048$), suggesting that SIMO treatment may perform better than CD in the shorter follow-up period.

CONCLUSIONS

The masticatory performance of edentulous patients rehabilitated with mandibular CD improved significantly after a 12-month follow-up period, irrespective of the stabilisation of the mandibular denture with a single implant or not. However, the greater improvement in the mixing ability of the SIMO group after six months suggests that the use of an implant to retain the mandibular denture may result in a different pattern of changes in masticatory performance compared with patients rehabilitated with a CD.

Implications for practice

For the outcome of masticatory performance, both treatments offered significant improvements for the patients.

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1. Nogueira TE, Schimmel M, Leles CR. Changes in masticatory performance of edentulous patients treated with single-implant mandibular overdentures and conventional complete dentures. *J Oral Rehabil.* 2019; 46:268–27.

Maxillofacial Radiology 169

SADJ April 2019, Vol. 74 No. 3 p148

CJ Nortjé

A sixty five year old female patient (Figure 1 & 2) presented at the Oral Health Centre with the main complaint of pain, swelling and stiffness of the right and left temporomandibular joints. Clinical examination revealed an anterior open bite and attrition of the posterior teeth. List your observations and give a differential diagnosis.



INTERPRETATION

The most important radiological observations are resorption of the articulating surfaces of the head of the condyle and articular eminence; sclerosis of the osseous components and a decrease in the size of the "joint space", an anterior open bite if one takes note that the posterior teeth are in close contact with each other and show signs of attrition. A provisional radiological diagnosis of Rheumatoid arthritis was made. Rheumatoid arthritis and related joint diseases consist of a number of inflammatory disorders that are characterized by prominent inflammation of the synovial membrane. It is a systemic disease with unknown aetiology and usually occurs within the 20-50 years age group but may occur at other ages. When it starts before the age of fifteen it is called the juvenile type of rheumatoid arthritis. Women are affected two to three times more often than men. In earlier reports the percentage figures of involvement of the temporomandibular joint were rather low, but later studies utilizing improved radiographic techniques have found involvement of the joint in from 40 to 80 per cent of cases.

Clinically, the symptoms are usually pain and tenderness of the affected joint and stiffness or reduced mobility of the mandible. In the juvenile type, especially when the disease starts very early in life, marked growth changes may take place due to alterations in the condylar growth area. This results in the reduction of the forward and downward movement of the mandible, disto-occlusion and an anterior open bite (Figure 3). The classical clinical appearance of a bird-face may be the result of the growth changes. Radiographically, the condylar head may reveal flattening (Figure 2) or may be absent. The generalized osteoporosis may also involve the condyle, and subcondylar cysts may be formed (Figure 4 (green arrow)). The radiological joint changes are significantly related to the duration of the disease. Rheumatoid arthritis can affect any joint in the body, including those in the hands and fingers causing destruction of the joints (Figure 5 (red arrows)). The patient may experience hand pain, finger pain, swelling, and stiffness.

Reference

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Overview of the moral theories of Justice: part one

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PD Motloba¹, NL Makwakwa², LM Machete³

INTRODUCTION

Justice is regarded as the greatest and most fundamental moral virtue, overarching and taking precedence over all others. Equally, however, Justice remains the most contentious moral, ethical, political and social issue of our time. Hence any attempts to define and describe Justice accurately, scientifically and exhaustively, will have limitations, which supports the multidimensionality of the nature and meaning of the concept.

Justice is derived from a Latin word “jus” meaning right or law. It therefore follows that a just person obeys the law (lawful) and does what is right (morally, ethically). Synonymously, Justice means fairness, that is giving to persons what is due to them.¹ Philosophical enquiries on the concept of Justice as described below interrogate the nature and or character of Justice, and its application specifically in a political society. This elucidation of Justice will provide the basis for application of this complex concept to health care and oral health in particular. To capture this concept fully, this paper, which is a prelude (part one), will explore and define the construct of Justice. The second paper will provide application of the concept to oral health care.

FOUNDATIONAL DEFINITION OF JUSTICE

Ancient and Medieval philosophers

a). Plato and Aristotle (Ancient Greek)

Plato and Aristotle are undoubtedly the most celebrated and influential early philosophers, credited for shaping much of the Western moral thought. These scholars conceptualised Justice and brought to the fore its essential form. They jointly defined Justice in terms of its characteristics or quality that makes all things that are just, just. Plato and Aristotle defined Justice as a component of general virtue, that is the particular excellence of a thing, or something possessed by a thing or some quality of a thing that enable the thing to do what it does very well.^{2,3}

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Figure 1. Plato and Aristotle as depicted by the Italian Renaissance artist Raphael in his fresco entitled “The School of Athens”.

Following this discourse, these scholars were able to construct and understand Justice and its implication in achieving its inherent purpose. The exploration of Plato and Aristotle’s philosophy will assist us to understand the general and specific nature of Justice. That is, understanding fully the quality of Justice that allows the individual and society to do what they are meant to do very well: to live in harmony.

In his celebrated work, *The Republic*,^{4,5} Plato defines Justice as a critical virtue necessary to establish societal order. At a personal level Justice embodies personal order that is individual goodness and obedience of laws. According to Plato an individual is just insofar that he can achieve:

- i). wisdom or Justice of the mind
- ii). temperance or Justice of the senses
- iii). courage or Justice of the heart

These individual dispositions are characteristics that enable Justice to be achieved. At a societal level Justice is synonymous with piety, which symbolises a relationship with god(s) and the laws governing the Republic or State.

This form of Justice promoted harmony and non-interference among citizens of the Republic, by emphasising the need for boundaries among individuals and classes of people. Therefore, in a just society, persons would demonstrate self-control, non-interference, obey the law and have a relationship with deity. This definition provides the attributes of Justice as a central tenet of a well-functioning society.

Albeit helpful, the definition fails to indicate how and what Justice is, and how it could be realised. In other words, Plato did not clarify the roles of the State and individuals in bringing about Justice for all in the Republic, but rather what they ought to be like in building a just society.

Aristotle^{6,7} operationalised Justice as the quest to “treat equals equally and unequals unequally”.

Politically, Aristotle’s Justice was concerned with what is lawful and fair, hence the coining of the special forms of Justice, i.e. distributive and retributive (restorative) Justice. Retributive Justice is concerned with reparation, thereby ensuring that when societal rules of “fair play” have been violated, wrongs are righted through some legitimate mechanism. Distributive Justice or proportionate equality, means that to every man would be accorded dues, rights and rewards according to merit (desert), effort or contribution.

The disbursement of Justice, if based on need, would entail treating unequals unequally in order to achieve equal outcomes. If based on equity, an economic concept, resources would then be allocated based on input, effort, productivity or talent. Apportionment based on proportionate equality disregards needs or productivity while ensuring an equal split of available resources.

For example, each of every four persons would receive 25% of the resources, irrespective of their needs or productivity. The principles of need, equity, equality and outcome are often in tension, which warrants an adoption of a singular central criterion for a fair allocation of resources. Normally, a dominant position of view would determine which principle of allocation supersedes. It is also possible to find a plurality of principles used to allocate resources within a system.

Irrespective of the central criterion selected, the manner in which resources are allocated should be procedurally just, meaning that the adopted system must be fair, impartial, consistent, unbiased, transparent and trustworthy. The definition of Justice by Plato and Aristotle provides the foundational starting point for the understanding of this moral virtue.

b). Augustine and Aquinas (Medieval Christian)

These egalitarian moral theories have their origins in religious traditions and are probably the most intuitive of all moral theories. According to these theories, all men enjoy equal moral status and creation and therefore should be treated equally. The existence of inequalities in a society is a violation of this moral stance, and an indictment on the principle of equal distribution of benefits and burdens.

Augustine’s philosophical views on Justice represent a dialectical tension between his Christian beliefs and life under Roman rule. In his work, *The City of God*,⁸ Augustine asserts that all human beings are children of God, and are therefore equal and worthy of similar treatment by man and State. He observed that the Romans were self-servicing and used might rather than right in their dealings. This led to his conclusion that the Roman Empire was unjust, by veering away from the pursuit of love, peace, and commitment to service, especially for those who needed it the most. According to Augustine, Rome was unjust and its rules and laws could not be binding. Hence there was no obligation to obey such laws, indeed it was instead moral to revolt against such an unjust system. Another Christian philosopher, **Aquinas**^{9,10} believed that Justice was an extension of natural law, which is God’s law. Therefore, Justice as a virtue implies that one is in harmony with and should constantly act according to the natural law. These philosophers defined Justice as emanating from Christian morality and the belief in God, His purpose and wish for mankind.

Modern and Contemporary philosophers

Modern and contemporary philosophers represent a resurgence of scholars who challenge the political and religious influence on moral thought. These contemporaries embrace science and independence of reasoning as a means to understand society.

c). Kant, Bentham and Mill (Modern philosophers)

Kant’s philosophy is an example of deontology (Greek for science of duty), hence duty-based morality.

Accordingly, what is right or just is inherently right, independent of its consequences, outcomes and or utility. This absolute or categorical necessity requires a just system or person to respect the rights of others regardless of associated circumstances and consequences.¹¹ According to Kant’s theory, i.e. Categorical Imperative, Justice ought to be served unconditionally. To distinguish between a just, right or wrong act, he proposed that the following three formulae be applied:^{11,12}

- i). an act is just if it can become universal law;
- ii). acts are right if we regard all as intrinsically valuable, i.e. “treat all as ends in themselves and never as means to other ends”;
- iii). Justice is served when we regard a rational agent as morally autonomous.

Kant grounds Justice in freedom or autonomy of moral agents, and the need to respect others to live their lives as they wish. While Kant believed in moral agency, he thought it necessary to restrict freedom in accordance to universal law. For example, it would be just to defend oneself or imprison offenders as such acts violate the freedom of others. This form of retributive Justice represents a reasonable and logical intervention aimed at restricting such behaviours from becoming universal.

Bentham and Mill¹¹⁻¹⁴ regard Justice as a subservient aspect of utility. These philosophers do not recognise autonomy or freedom as necessary to Justice, but the practicality of ethics and politics in the promotion of the ‘greatest happiness for the greatest number’.

Therefore, the state and all its organs must be judged based on its utility (outcomes, consequences) and not idealism. Similarly, legislation and policies should maximise utility for the public.

d). Rawls and Daniels (Contemporary philosophers)

John Rawls is regarded as the most influential philosopher on the subject of Justice as it applies to constitutional democracy. Rawls' Theory of Justice as fairness, proceeds from Kantian morality that persons are 'free', 'rational', morally autonomous and not egotist, thus likely to not serve their self-interest. In his experiment, Rawls recognised natural position, which means persons involved in a social contract have varying interests, power, wealth and other attributes. These factors will naturally result in an unfair social contract due to differences in structural and personal influences.

However, should these persons adopt a veil of ignorance, then the social contracts developed are likely to represent deeply held and shared moral convictions. At this state the individual is neutral and free from influence or biases.

The question he poses is that given these circumstances, of what type of a society would each prefer to be a member of? In other words, what kind of a society would represent a fair or just society, if in its design, members were oblivious or free of assumptions and biases? In summary, Rawls¹⁵⁻¹⁶ developed a Theory of Justice as fairness based on the following principles:

- i). Equality of liberties – encompasses rights and liberties normally enshrined in constitutions and laws. This supersedes the principles below.
- ii). Equality of opportunity – requires that socioeconomic and political opportunities be open to all regardless of circumstances. Therefore, fair equality of opportunity seeks to correct disparity due to natural and social lottery.
- iii). Difference principle – in cases where socio-economic opportunities are distributed unequally, they should first benefit all, but most importantly those who are worse off.

Applying Rawls' Theory of Justice as fairness in health systems would incorporate i). freedom of choice - equality of liberties ii). creation of a functional universal healthcare service – equality of opportunity and iii). creation of safety net, such as free health care services for the indigent. In conclusion Rawls' Theory reflects a merger of Platonic, Aristotelian, Kantian deontology, Utilitarianism, libertarianism and aspects of Christian moral philosophy.

Norman Daniels developed a Theory of Justice which focussed on health as a prerequisite to Justice itself. The central premise of this theory is that Justice is achieved when there is equal and fair opportunity "... for all to realise their maximum species - typical level of functioning".^{17,18} Daniels premised his argument that healthcare needs were special and morally important due to their contribution to achievement of normal functioning and protection of equality of opportunity.¹⁹ Therefore any deficiency in health will minimise the attainment and maintenance of function; limit range of opportunity and predispose individuals to pain, suffering and unhappiness. Hence, all health activities are just

as far as they ensure the fair equal opportunity necessary for individuals to construct and achieve their life plans and objectives. The range of opportunities differ from one society to the other, as a function of the level and stage of development, cultural preferences, material possessions etcetera.

By implication, prioritisation of health needs and implementation of appropriate programmes should be a function of the relative importance attached to health needs and the expected impact on the achievement of life plans, given the intervention. If, for example, if it is envisaged that the deployment of Clinical Associates in rural district health institutions will protect and improve opportunities for individuals to realise their life plans, then such interventions should be prioritised and implemented, as failure to incorporate such plans into the design and policies of the health system would be detrimental to the normal functioning of the individual, and hence unjust.

CONCLUSION

The notion of Justice is fraught with a multiplicity of irrefutable and dominant viewpoints. Each of the theories, while logically constructed, are emotionally laden in suggesting any supreme value or system that Justice should promote. Suffice to say that Justice as a virtue should be conceptualised by its inherent quality to promote fairness and equality, subject to procedural and substantive merit.

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CPD questionnaire

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

GENERAL

Microbial contamination of denture polishing equipment

- Dental pumice has a neutral pH and is chemically benign, and as such is not an ideal medium for the growth of bacteria.
 - True
 - False
- Cross-contamination of pathogens between dentures can occur through aerosol formation during pumicing and polishing and by direct denture and skin contact during handling.
 - True
 - False
- Which of the following is not true of *Enterobacter cloacae* complex?
 - They are commonly found in terrestrial and aquatic environments
 - They occur as commensals in human and animal intestinal tracts
 - They may be responsible for nosocomial infections.
 - They may cause urinary tract and intra-abdominal infections
 - They are usually contracted through inhalation of contaminated aerosol
- Which of the following is not true of *Rhodotorula glutinitis*?
 - It is a common environmental bacteria
 - It may be found in air, soil, lakes, ocean water, milk, and fruit juice.
 - It has a strong affinity for plastic
 - It may be isolated from medical equipment
 - It is an opportunistic pathogen
- The results of this study revealed that wet pumice can harbour bacteria and fungi, so it should be allowed to dry out between uses to prevent cross contamination.
 - True
 - False
- are thought to depend on the triad of stem cells, bioactive molecules and non-degradable bioactive scaffolds to provide micro-environments suitable for tissue regeneration
- Identify the CORRECT statement. Neo-vascularisation is now approached on the basis of the biologic process of:
 - co-culture of progenitor/target cells with fibroblastic cells.
 - co-culture of progenitor/target cells with myoblastic cells.
 - co-culture of progenitor/target cells with endothelial cells.
 - co-culture of progenitor/target cells with erythrocytic cells
- Identify the INCORRECT statement. Low-intensity pulsed ultrasound (LIPUS) treatment may be useful in dental treatment because
 - mesenchymal stem cells may respond to LIPUS
 - LIPUS is relatively cheap
 - LIPUS may influence the cell nuclei to trigger re-vascularisation.
 - LIPUS is easy to apply
- Identify the INCORRECT statement. The concept of cell homing, central to dental pulp and dentin regeneration:
 - involves cell recruitment
 - involves cell differentiation
 - occurs only in immature tissue
 - may take place in adult teeth

Radiographic assessment of multiple pathoses and dental malocclusion: a case study

Current and future perspectives for dentin-pulp tissue engineering - an update

- Identify the INCORRECT statement. Regenerative endodontic procedures (REPs):
 - recognise that the blood clot is a means of ensuring adequate healing
 - allow for an increase in both the length of the root and the thickness of the root wall
 - are thought to depend on the triad of stem cells, bioactive molecules and degradable bioactive scaffolds to provide micro-environments suitable for tissue regeneration
 - Identify the INCORRECT statement. Gardner's syndrome
 - is a rare autosomal disease
 - presents intestinal polyposis
 - presents mild condylar hypoplasia
 - presents connective tissue tumours
 - presents multiple osteomas
- Should a dentist suspect Gardner's Syndrome, referral for colonoscopy is essential for final confirmation of the diagnosis and the surgical removal of colonic polyps.
 - True
 - False
- In the case under review, the extensive radiological assessment was not justified.
 - True
 - False

Chronic Suppurative Osteomyelitis of the Maxilla - rare case presentation

13. Identify the INCORRECT statement.
Chronic Suppurative Osteomyelitis of the jaws is an inflammatory condition:
- usually seen in the posterior region of the mandible
 - in which patients present swelling, pain, pus discharge, paresthesia, trismus and regional lymphadenopathy
 - occurring in regions of bone having high vascularity
 - involving the medullary component of the bone
14. Identify the CORRECT statement.
Chronic suppurative osteomyelitis is most often caused by:
- staphylococcus aureus* and *staphylococcus saprophyticus*
 - staphylococcus aureus* and *staphylococcus haemolyticus*
 - staphylococcus hominis* and *staphylococcus epidermididis*
 - staphylococcus aureus* and *staphylococcus epidermididis*

Introducing the Alveolar Moulding Obturator (AMO): an appliance for the early management of Cleft Palate Neonates

15. Identify the CORRECT statement.
The principle of the treatment approach using the Alveolar Moulding Obturator in cleft palate patients is:
- to apply forceful alignment to the alveolar ridges
 - to maintain the original alignment to stabilise before surgery
 - to progressively and gently align the alveolar ridges
 - to allow normal growth changes under a flexible appliance
16. Identify the CORRECT statement.
The timing of surgery for cleft lip and palate repairs may be determined by applying the “rule of ten” which dictates the baby should have:
- 10g haemoglobin, 10 weeks of age and 10 pounds of body weight
 - 10g haemoglobin, 10 weeks of age and 10 kgs of body weight
 - 10g haemoglobin, 10 months of age and 10 pounds of body weight.
 - 10g myoglobin, 10 weeks of age and 10 pounds of body weight

Maxillofacial and oral radiology

17. Juvenile rheumatoid arthritis starts after the age of fifteen?
- True
 - False
18. Men are affected by juvenile rheumatoid arthritis more often than women?
- True
 - False

What's new for the clinician: summaries of recently published papers

19. In the Rebelo et al., review, children with decayed teeth had significantly higher odds of having poor school attendance than those without dental caries.
- True
 - False
20. In the Nogueira et al., trial no differences between treatment groups regarding the overall improvement in masticatory performance were observed for both 20 and 50 cycles.
- True
 - False

ETHICS

21. Identify the INCORRECT statement. According to Plato an individual is just insofar that he can achieve:
- wisdom or Justice of the mind
 - patience or Justice of the emotions
 - temperance or Justice of the senses
 - courage or Justice of the heart
22. Identify the CORRECT statement. If Justice according to Aristotle, is based on equity, economic resources would then be allocated based on:
- perseverance, effort, productivity or talent
 - input, effort, productivity or talent
 - input, effort, commitment or talent
 - effort, results, productivity or talent
23. Identify the INCORRECT statement.
According to Augustine:
- all men are equal deserving equal treatment by man and State
 - Romans did not pursue love, peace and commitment to service
 - Roman rule and Roman rules were unjust
 - it was immoral to revolt against Roman rule
 - Romans were self-serving and relied on might
24. Identify the INCORRECT statement. Kant promoted a form of Retributive Justice based on his beliefs that:
- justice is based on freedom and such freedom entails no restrictions
 - justice is based on freedom, with respect to allow others to live as they wish
 - justice is based on freedom but such freedom could be restricted if there were a need to defend oneself or to imprison offenders
 - justice is based on freedom but such freedom does not allow for offensive acts to become universal
25. Identify the INCORRECT statement.
Daniels believed that Health needs were paramount and morally important because:
- health contributes to satisfactory normal functioning
 - health helps to ensure protection of equality of opportunity
 - ill health limits individual attainment of life plans and objectives
 - moral rectitude belongs to the healthy

Instructions to authors



Thank you for considering the submission of your work to the Journal for possible publication. We welcome papers which may be Original Research, Clinical Review, Case Reports, Letters or Notes.

We shall be obliged if your submission is prepared respecting all the details listed in these Instructions. This facilitates our process and ensures more rapid responses to you. The Journal is published ten times each year in electronic format. Hard copy is available by arrangement. Thank you.

Address for submission of articles

The Editorial Assistant, Mr Noko Reagan Mojela,
South African Dental Journal,
South African Dental Association (SADA),
Private Bag 1, Houghton 2041, South Africa.
Email addresses: nmojela@sada.co.za
and bill.evans@wits.ac.za

Language

All articles must be submitted in English. Spelling should be in accord with the Shorter Oxford English Dictionary.

Title

To be kept as brief, clear and unambiguous as possible.

Summary

The summary shall consist of not more than 200 words. This applies to both research and review articles. For research articles, the summary should be structured under the following headings: Introduction, Aims and Objectives, Design, Methods, Results and Conclusions.

Text

- Please submit the paper in electronic format to: nmojela@sada.co.za and to bill.evans@wits.ac.za, accompanied by a covering letter signed by the author(s).
- The paper should be submitted in a single file including all Tables and Figures and their accompanying Legends.
- Articles should be clear and concise.
- Text should be typed in Times New Roman font, size 11; double-spaced with a 3cm margin on sides, top and bottom. Each page must be clearly numbered.
- Please include electronic numbering of lines throughout the document.
- Tables should be clearly identified, using Roman numerals ie. Table I, Table II etc. The front page of the manuscript should list the title of the article, the author's(s) name(s), qualification(s), affiliations and positions held, telephone and fax numbers and address(es), including Email address(es) if available. It is especially important that details of the Corresponding Author should be clearly stated.
- Please submit on the front page a list of up to eight Keywords.
- In the case of multiple authors, the role played and the respective contribution made by each should be recorded. For example: "Principal Researcher - 40%, Writing Article - 30%, Tissue Analysis - 20%, Microscopic Examination - 10%", etc.
- Authors are requested to note and adhere to the current style of the Journal particularly with respect to paragraph settings and headings.
- A recent requirement is that authors should be registered with **ORCID**. You will be allocated a number registering you as an

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Length of the article

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Illustrations/graphics/photographs

- Illustrations/graphics/photographs must be appropriate to the content of the manuscript.
- Digital images with a DPI of at least 300 should be supplied. Photocopies and pdf. files of photographs are not acceptable.
- **Please note:** Figures should be included in the text **and** sent separately in jpg. format.
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Please supply **5-8 questions** related to your article, **at least five** of which should be in the multiple choice format. Answers must be either True or False or, if multiple choice, have only **one** correct answer. Please provide answers to the questions.

References

- References should be set out in the **Vancouver style** and only approved abbreviations of journal titles should be used (consult the *List of Journals Indexed in Index Medicus* for these details at: <http://www.nlm.nih.gov/tsd/serials/lji.html>).
- References should be inserted seriatim in the text using superscript numbers and should be listed at the end of the article in numerical order. Do not list them alphabetically. It is the author's responsibility to verify each reference from its original source. Please note that an article may be rejected if the referencing is inaccurate.
- Names and initials of all authors should be given unless there are more than six, in which case the first three names should be given, followed by 'et al'. First and last page numbers should be given. Where it is applicable the page numbers should be abbreviated by omitting redundant numbers eg. pages 456 to 478 is recorded as 456-78, and 456 to 459 as 456-9, but 398 to 401 is recorded as 398-401.
- Notice that volume numbers are not given in bold, authors are not linked by 'and' or '&', and the date of publication appears after the name of the journal. No item should appear in italics except for foreign terms, eg *in vivo*.

Journal references should appear thus:

Smith NC, Haines A. The role of the dentist in public health promotion. Br Dent J. 1983; 298: 249-51.

Book references should be set out as follows:

Terblanche N. Principles of Periodontology, 4th ed. London: Butterworth, 1985: 96-101.

Weinstein L, Swartz MN. Pathogenic properties of invading microorganisms. In: Sodeman WA, Smith RT, eds. Pathologic Physiology: Mechanisms of Disease. Philadelphia: WB Saunders, 1974: 457-72.

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Enquiries regarding Journal matters can be directed to Mr Noko Mojela, Editorial Assistant, at SADA headquarters on: Tel: +27 (0)11 484 5288, Fax: +27 (0)11 642 5718, Shared Line +27 (0)86 011 0725 or Email: nmojela@sada.co.za.

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30 August 2019 - 1 September 2019
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Note: Please print in block capitals.

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Postal Address: Code:

Telephone No. (W): Cellphone No.

Email Address: Company Vat No.

Accompanying Person

Surname: Initials: Title:

Section B: Registration Fees (Vat Included)

Registration Section

Note: Please mark the appropriate registration fee (with an X) according to your specific delegate category.

Delegate Category	Full Registration Fee: (3 Days) 30 August 2019 - 1 September 2019				Day Delegate Registration Fees Per Day							
	Early Bird before 30 June 2019	Mark X	Booked from 1 July 2019	Mark X	Early Bird before 30 June 2019	Fri 30 Aug	Sat 31 Aug	Sun 1 Sept	Booked from 1 July 2019	Fri 30 Aug	Sat 31 Aug	Sun 1 Sept
*SADA Core Member	R 4 840.00		R 5 540.00		R 1 940.00				R 2 220.00			
**SADA Educational Member	R 3 840.00		R 4 540.00		R 1 540.00				R 1 820.00			
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2nd Year Qualified Dentist in Practice	R 3 000.00		R 3 440.00		R 1 200.00				R 1 375.00			
Dental Students (1st - 5th Year)	FREE		FREE		FREE				FREE			
Registrar/Post Graduate Student	R 1 920.00		R 2 300.00		R 770.00				R 920.00			
Emeritus (70+ Years)	R 2 000.00		R 2 500.00		R 800.00				R 1 000.00			
Dental Technician	R 2 750.00		R 3 500.00		R 1 200.00				R 1 320.00			
Dental Therapist	R 2 750.00		R 3 500.00		R 1 200.00				R 1 320.00			
Oral Hygienist	R 2 165.00		R 2 500.00		R 850.00				R 1 000.00			
Dental Assistant	R 1 700.00		R 2 000.00		R 700.00				R 800.00			
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	Total R				Total R				Total No. of Days			
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Section C

Programme Session Bookings

Due to lecture room limited seating all bookings are processed on a first come first served basis. If you do not indicate which lecture you wish to attend you will not be registered to attend the lecture on that day and your registration will not be accepted. Please indicate your option in the white spaces provided with an '✓'.

Friday 30 August 2019

Time	Session	✓
Master Classes / Hands-On		
Session 1 - Lasers & Snoring		
08:00 - 10:00	Lasers & Snoring: Effective non-surgical treatment modality alleviating snoring - <i>Dr Sofia Aravopoulou</i>	
10:30 - 12:30	(Repeat) Lasers & Snoring: Effective non-surgical treatment modality alleviating snoring - <i>Dr Sofia Aravopoulou</i>	
13:30 - 15:00	Practice Management: Creating a quality practice - <i>Dr Raj Rattan</i>	
15:30 - 17:00	Practice Management: Managing failures and human error - <i>Dr Raj Rattan</i>	
Session 2 - Digital Dentistry		
08:00 - 12:30	Digital Dentistry: Aesthetic Excellence Chairside with CAD/CAM - <i>Dr Murray Orr</i>	
13:30 - 15:00	Digital Dentistry: Digital solutions for complex cases - <i>Prof Frank Spitznagel</i>	
15:30 - 17:00	Digital Dentistry: CAD/CAM in Implant Dentistry: Key to success - <i>Prof Johannes Boldt</i>	
Session 3 - Paedodontic Society of South Africa		
08:00 - 09:00	The 6 th sense of behaviour management - <i>Dr Nicoline Potgieter</i>	
09:00 - 10:00	Management of the medically compromised patients - <i>Dr Nadia Mohamed</i>	
10:30 - 11:30	Paediatric Zirconia Crowns - <i>Dr Mukul Jain</i>	
11:30 - 12:30	Silver Diamine Fluoride and Paedo-Rotary Files - <i>Dr Mukul Jain</i>	
13:30 - 15:00	Current trends in Paediatric Dentistry - <i>Prof Peet van der Vyver & Dr Martin Vorster</i>	
15:30 - 17:00	Glass ionomers from A to Z - <i>Dr Riaan Mulder</i>	
Session 4 - Young Dentist's Council		
08:00 - 10:00	Endodontics - back to the future - <i>Dr Hussein Seedat</i>	
10:30 - 11:30	Implant failure – a microscopic perspective - <i>Prof Erich Raubenheimer</i>	
	Update on oral and oropharyngeal carcinoma - <i>Prof Erich Raubenheimer</i>	
11:30 - 12:30	Sugar, caries and all things nice - <i>Dr Hanif Laher</i>	
13:30 - 15:15	An introduction to dental implantology - <i>Dr Bradley Bredenkamp</i>	
15:30 - 16:15	Problems & Solutions - <i>Dr Raj Rattan & Dr Alasdair McKelvie</i>	
16:15 - 17:00	From start to finish - <i>Mr Bruce Fordyce</i>	
Session 5		
08:00 - 10:00	Ethics: Problems & solutions - <i>Dr Alasdair McKelvie</i>	
10:30 - 12:30	Ethics: Problems & solutions - <i>Dr Kobus Barnard</i>	
13:30 - 15:00	Aesthetics: Cementation - <i>Dr Michael Dieter</i>	
15:30 - 17:00	Endodontics: Set your Endo on fire - <i>Dr Martin Vorster</i>	
Session 6		
08:00 - 10:00	Restorative: How to create flawless impressions for indirect restorations - <i>Prof Peet van der Vyver</i>	
10:30 - 12:30	Endodontics: Mastering Endodontic treatment on maxillary molars respecting the true anatomy - <i>Prof Peet van der Vyver</i>	
13:30 - 15:00	Aesthetics: Catherization of Ceramic Restorations - <i>Mr Tom Behaeghel</i>	
15:30 - 17:00	Orthodontics: Why restorative dentistry needs Orthodontics - <i>Dr Mark Bowes</i>	

Friday 30 August 2019

Time	Session	✓
Master Classes / Hands-On		
Session 7 - Endodontics		
08:00 - 10:00	The basic golden rules in endodontics - <i>Dr Boela van der Merwe</i>	
10:30 - 12:30	Fundamentals approaching challenging endodontic anatomy Technologies taking endodontics from darkness into the light - <i>Dr Grethé Koen</i>	
13:30 - 15:00	Predictability in Endodontics Clinical tips to better endodontics - <i>Dr Gavin Williams</i>	
15:30 - 17:00	Iatrogenic damage caused with Endodontics - <i>Dr Christo van Rensburg</i>	
Session 8 - Implantology		
08:00 - 10:00	Introduction to implant dentistry Implant engineering-geometry and implant-abutment connections - <i>Prof Andre van Zyl and Team</i>	
10:30 - 12:30	Applied anatomy for implants: a brief overview - <i>Prof Andre van Zyl and Team</i>	
13:30 - 15:00	Placement of a single posterior implant - from stent to provisional crown - <i>Prof Andre van Zyl and Team</i>	
15:30 - 17:00	Placement of a single posterior implant - from stent to provisional crown (Continued) Demonstration of impression taking on a single posterior implant - <i>Prof Andre van Zyl and Team</i>	
Session 9 - Style Italiano		
08:00 - 12:30	State of the art anterior composite restorations - <i>Dr Walter Devoto & Dr Ronaldo Saracini</i>	
13:30 - 17:00	(Repeat) State of the art anterior composite restorations - <i>Dr Walter Devoto & Dr Ronaldo Saracini</i>	
Session 10 - Dental Technician		
08:00 - 10:00	Dental Technician: TBA - <i>Speaker to be confirmed</i>	
10:30 - 12:30	Dental Technician: TBA - <i>Speaker to be confirmed</i>	
13:30 - 15:00	Dental Technician: TBA - <i>Speaker to be confirmed</i>	
15:30 - 17:00	Dental Technician: TBA - <i>Speaker to be confirmed</i>	

Saturday 31 August 2019

Time	Session	✓
08:00 - 17:45	Main Plenary	
08:00 - 17:45	Oral Hygienist	
08:00 - 17:30	Dental Assistant	
08:00 - 17:30	Practice Manager/Receptionist	
08:00 - 17:45	Dental Technician	
08:00 - 17:45	The South African Society for Periodontology, Implantology and Oral Medicine	
08:00 - 15:30	The South African Society of Maxillofacial and Oral Surgeons	
08:00 - 17:45	The Academy of Prosthodontics South Africa	

Sunday 1 September 2019

Time	Session	✓
08:00 - 15:30	Main Plenary	
08:00 - 15:30	Dental Technician	

Section D

Congress Social Functions

Indicate which functions you will attend by marking the appropriate block.
 Note: There is no cost related to these functions. A cash bar will be available.

Thursday 29 August 2019: Pre-Registration & Welcome Function Venue: Durban ICC Foyer	Yes <input checked="" type="checkbox"/>	No <input checked="" type="checkbox"/>
Delegate		
Accompanying Person		

Friday 30 August 2019: Cocktail Evening Venue: Durban ICC	Yes <input checked="" type="checkbox"/>	No <input checked="" type="checkbox"/>
Delegate		
Accompanying Person		

Indicate whether you will attend the Gala Dinner by marking the appropriate block.
 Note: The Gala Dinner costs R550 pp. A cash bar will be available.

Saturday 31 August 2019: Gala Dinner (R550 pp) Venue: uShaka Marine World	Yes <input checked="" type="checkbox"/>	No <input checked="" type="checkbox"/>
Delegate		
Accompanying Person		

Section E

Dietary Requirements

- The food served at the venue is certified by HFSA (Halaal Foundation of South Africa) at no extra cost. Please indicate your choice below.
- If you require a Halaal menu option certified by SANHA (South African National Halaal Authority), a surcharge is applicable. Please indicate your choice below.
- If you require a Kosher menu option a surcharge is applicable. Please indicate your choice below.
- If you have any allergies, please indicate this below.

Special dietary requirements: Register by - cut off date 20/07/2019.
 Please contact Marilize van der Linde on mvdlinde@sada.co.za in this regard.

Indicate your special dietary requirements if applicable:

	Standard Menu Requirement	HFSA Halaal Requirement	SANHA Halaal* Requirement	Kosher** Requirement
Delegate				
Accompanying Person				

*A surcharge is applicable for SANHA certified Halaal food.
 **A surcharge is applicable for Kosher food.

Indicate your allergies if applicable:

	Nuts	Wheat	Gluten	Lactose
Delegate				
Accompanying person				
Indicate any other allergies you have				

For more information contact: Marilize van der Linde

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Section F

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- Delegates are responsible for their own accommodation and travel arrangements.

Cancellations

- 25% Cancellation fee will be levied on cancellations on or before 30 June 2019.
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- No refund for cancellation or non-attendance from 1 August 2019.
- Cancellation must be received in writing.
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Signature

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Surname:

Date: DD / MM / 2019

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Section G

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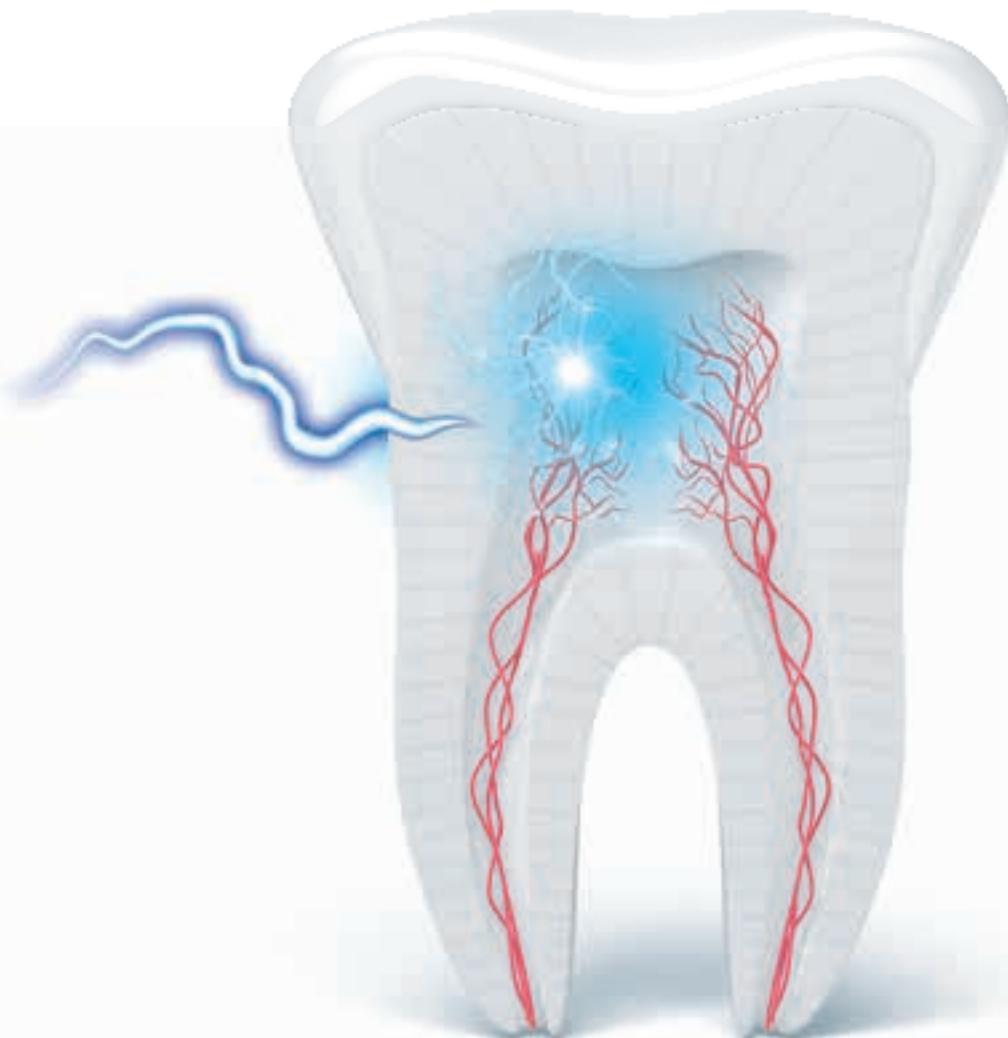


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