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Saint Apollonia

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The Patron Saint of Dentistry, Saint Apollonia was a devout believer who refused to renounce her faith. In the year 249AD her teeth were knocked out by an angry mob who threatened to burn her alive. Rather than yield to their demands she threw herself into the flames, invoking her beliefs. She has been depicted in art holding a pair of dental pincers.

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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.

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A roundabout approach to progress

SADJ November 2019, Vol. 74 No. 10 p523 - p524

WG Evans

A circle is a round straight line with a hole in the middle.

This is the last issue of the Journal for 2019.. and that convoluted definition of a circle, devised by Mark Twain, may have some application.

Two of the articles appearing in the issue consider the National Health Insurance Scheme. In particular the Association has responded to the invitation of the Portfolio Committee on Health to submit comment on the proposed NHI Bill. The Communique from Head Office considers some of the principles.

The 40 page Submission Document deals comprehensively with all sections and provisions. It is a genuine endeavour to find the straight lines amongst some of the rather circuitous clauses. The circle itself is completed when we affirm at the outset our commitment to the WHO statement that "health is a basic human right and supports all efforts to promote optimal health" and we then add "including oral health in South Africa".

Amongst the concluding remarks appear these words "SADA remains supportive of government and opportunities to work together to reform the Healthcare system in a manner that will result in improved access to quality affordable care for all South Africans".

Our commitment is plain. Perhaps some of the Bill is not so plain for between our two statements in the document commenting on the Bill are the Association enquiries and the responses and the constructive thoughts ...and the criticisms and the advice… all encircling the hole in the middle, which readily is seen to represent the Fund… at present closer to a hole than a solid centre!

A rare Letter to the Editor focusses on the need to work in unison to overcome perceived problems posed by the NHI scheme. Yes, we need to hold hands to complete the circle.

But Mark Twain was not the only author to suggest definitions of a circle. The Greek philosopher Heraclitus recommended that we survey a circle in this way… "On a circle, an end point can also be a beginning point." If we look at it in the way Roger von Oech* interpreted the slogan, then every problem may be an opportunity for the creative thinker. That philosophy would certainly hold for the NHI... but may also apply to another dilemma facing the profession... Denturism.

WG Evans: Managing editor, Email: bill.evans@wits.ac.za

Vitruvian man.
Another intriguing example of circles in life... Leanardo da Vinci proved the theory of Vitruvius, the Roman Architect, that a man with outstretched arms and legs described a perfect circle with the centre at his navel!
Image Source: Luc Viatour (CC BY-SA 3.0)

Positive approaches are recommended in the "brief review" appearing this month which offers thoughts on how best this opportunity may be grasped to enhance service to the community.

Two other papers identify end points, problems, stumbling blocks... one considers partial denture design, the other a method of monitoring growth… but both arrive at end points… and then suggest new applications, teaching and practice which will continue the circle. Thus advances dental acumen and skill.

Anish Kapoor** penned this advice "The work itself has a complete circle of meaning and counterpoint …but without your involvement there is no story." How apt for any Journal ...for a complex and numerous panel of colleagues are involved in the production of every issue... but the most important remain the readers.

It bears repeating... without your involvement there is no story. So the clinically oriented papers on Ortho-

dontic success with an innovative appliance and the equal success in testing recovery and healing in Periodontic cases are open to your critical appraisal.

"Windows" has identified an intriguing paper which pursues and advocates the omission of linings in restorative dentistry. For one who was rigidly schooled in the importance of protecting the pulp with a lining (which had to be perfectly rectangular and level!), this is a contradiction of note, **but** refer again to Mark Twain… take the (slightly) curved line to stay on the straight path to full circle enhanced Dentistry!

*The author of "Expect the Unexpected" and founder of "Creative Think".
**An Indian sculptor living in London.

The zemblanity* of the NHI

*the inevitable discovery of what we would rather not know

SADJ November 2019, Vol. 74 No. 10 p525 - p526

KC Makhubele

Many members will have acquired a clock from the Association in the past 12 months or so. It is a wall clock with blue lettering on a white plastic backing and "SADA" appears prominently at the centre.

Intriguingly the second hand is twisted in a corkscrew configuration. Some may say that is an indication of the convolutions of time, and indeed, we are facing just such a convolution when we consider the National Health Insurance Bill.

The Association has responded to the Bill by submitting to the Portfolio Committee of Health a 40-page document detailing the many problematical aspects which have been identified. At the outset the Association affirms adherence to the definition of "Health" adopted by the World Health Organisation ...that "health is a basic human right". We therefore do support all efforts to promote optimal health, including Oral Health in South Africa. We fully support the principles of Universal Health Coverage and access to quality health care for all South Africans.

It may then be viewed as paradoxical that the Portfolio Committee will be faced with the decided opinion that SADA is very concerned about how effectively the NHI will be implemented by the Government. The intention of the NHI is surely to provide access to quality health care for all South Africans. The SADA decision has not been taken lightly for it is based on an exhaustive study of the National Health Insurance Bill, leading to the detailed submission. That document is available to all members.

We also are very concerned that the Oral Health profession seems to have been left out in the main, yet this profession plays an integral role at all levels of oral health. It is an established fact supported by a wealth of research that there is a strong association between the health of your mouth and that of the rest of your body.

Periodontal disease is a risk factor for development of conditions such as heart and blood circulatory systems diseases, type 2 diabetes, low birth weights of babies,

osteoporosis, lung disease such as pneumonia and chronic obstructive pulmonary disease (COPD), digestive system disease such as gastric cancer and ulcers.

The NHI would therefore be making a mistake if the oral health profession were to be left out or not given the prominence it deserves.

The word "paradoxical" has been used ...and perhaps that is a vehicle which may assist in focussing on particular problems and dilemmas associated with the proposed legislation. Consider some of the problematical situations presented by the Bill, not necessarily in any particular order.

Paradox one

The provisions of the Bill envision controls over health providers regarding where they may practice, what fees they may charge, what treatment protocols they must follow, what diagnostic tests, medicines, medical devices and healthcare technologies they are permitted to use.

Faced with such restrictive control, many are likely to emigrate, paradoxically depriving the NHI of the very skills on which the scheme will depend.

Paradox two

Planning for the introduction of a National Health Insurance scheme has been active over the last ten years.

Khomi C Makhubele: Chief Executive Officer, SADA

The declared intention is “in order to achieve sustainable and affordable universal access to quality health care services”. But, paradoxically, there has been no costing of the model since the inception of the scheme.

True, the National Treasury is now preparing a financing paper which is expected to detail how much the scheme will cost and how it will be funded. Yet both the President and the Health Minister have stated that the NHI will be implemented regardless of costs.

Paradox three
There have been eleven pilot projects to test the concepts of the proposed NHI. The outcomes of those projects are certainly not encouraging and paradoxically it appears that the lessons learnt have not influenced current planning. Computers were sent to outlying clinics without internet access, treatment needs for children were not met, infrastructure was incomplete.

Paradox four
The proposed Health Care Benefit Pricing Committee is authorised to not only purchase services but also to set the price determination for those services. Hence the Committee will, paradoxically, be both a purchaser and arbiter of prices at the same time. Inevitably a bias may be expected so the Committee will save funds for the NHI… but providers could find themselves losing fair income.

Paradox five
In appointing the Board of the Fund, the Minister will establish an ad hoc Advisory Panel which will interview candidates and make recommendations to the Minister, who will confirm the appointments. Paradoxically the Minister may dissolve the Board “on cause shown “and replace Board members for a period of three months, hence enabling a structure entirely to his/her discretion.

Paradox six
The Board of the Fund is described as independent… in the 2018 White paper the Board was accountable to Parliament. Paradoxically the Bill now provides for accountability to be to the Minister, extending his/her powers considerably. The Minister will appoint virtually every position of importance in the vast network of public sector health departments and institutions.

Paradox seven
Despite the importance of health care professionals to the scheme, paradoxically the professions are not well represented on the various committees, rendering superficial the discussion on such critical items as evidence-based health care. In particular, the Bill makes no mention of any representation by clinical practitioners on the Health Care Benefit Pricing Committee, a most relevant omission.

Paradox eight
The NHI Bill is designed to include not only those of the community who have inadequate healthcare cover, but paradoxically may force the registration of people who already have cover through private contributions to a Medical Aid Society.

Paradox nine
All service providers will be paid the same rate irrespective of seniority, experience or ability. Paradoxically therefore a first-year graduate will receive the same remuneration as an experienced service provider, perhaps even one who taught him/her!

Paradox ten
The NHI Bill seeks to prevent even those who can afford the costs from using their Medical Aid cover, paradoxically increasing the financial and service demands on the NHI, draining the very resources required for those most in need.

In drawing attention to these and other discrepancies and problems, the Association is not dismissing the principles espoused in the objectives of the NHI scheme… to provide Universal Health Coverage. The Association believes that a supreme collective effort is required by all parties to secure improvement and equity in healthcare in South Africa. The clock is ticking, the second hand remains convoluted and we must untwist the future.

The Journal appoints a new Editorial Assistant

SADJ November 2019, Vol. 74 No. 10 p527

Mr Madumetja ("Dumi") Marius Ngoepe is our new Editorial Assistant, appointed on 15th November after having served a three month probation after the departure of Noko Mojele, his predecessor in the post.

Dumi has already proven his commitment and enthusiasm as he has embarked on a vigorous routine of establishing prompt and accurate communication. Indeed this is a prime objective he holds… to introduce a system whereby authors and reviewers have ready access to the papers and can track progress towards publication. To the post he brings background qualifications in a Diploma in Information Technology with a special emphasis on Network Architecture …skills which he will develop and rely upon in his contributions to the Journal.

Many members will know Dumi, a familiar tall figure at Head Office as an Office Assistant (and Congresses where company car driver) and at Congresses where he was to be found at all hours and busy with virtually any task which needed attention. A most willing contributor and team player.

Dumi describes himself as ambitious and goal driven… the Journal will benefit from these attributes of our latest member of the Journal congregation. Welcome Dumi!

http://dx.doi.org/10.17159/2519-0105/2019/v74no10a1

Closer liaison between dentistry and medicine is increasingly relevant.
The author presents an intriguing possibility which will strengthen that relationship.
Readers are invited to respond.

Physician and Dental Surgeon's roles in diagnosing hypertension in association with Lichen Planus and Geographic Tongue

- the perspective of a Clinician

SADJ November 2019, Vol. 74 No. 10 p528 - p529

VK Vaishnavi Vedam[1], G Sivadas[2]

Dear Editor,

Hypertension is a serious medical condition resulting in a high degree of mortality if undiagnosed and untreated in the early stages of its progression. Although public awareness of this cardiac manifestation has increased, asymptomatic cases still go undetected and untreated, resulting in complications.

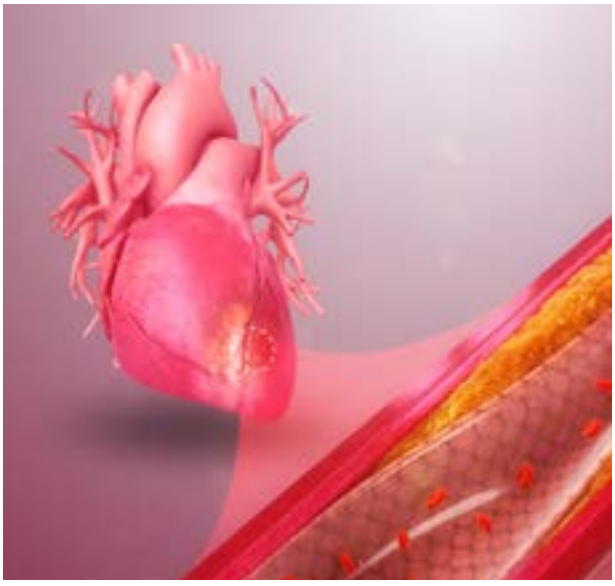
The General Physician (GP) is the first line of interaction with patients presenting varying degrees of hypertension. The Dental Surgeon (DS) encounters a wide range of patients with oral manifestations of Lichen Planus and Geographic Tongue (*Benign migratory glossitis, erythema migrans*).[1]

Liaison between the GP and DS in the management of these patients is rare as they usually limit themselves to the principal problems of patients. However, current researchers suggest a possible link between the occurrence of Lichen Planus, Geographic tongue and hypertension in adults.

Cardiovascular Diseases (CVD) have over the last few decades dominated the Malaysian National Health Survey as being the leading cause of morbidity and mortality and that statistic is likely to continue. Of all the risk factors contributing to CVD, hypertension poses the greatest risk for all genders, based on the latest literature.[2]

The relationship between high blood pressure (hypertension) and the risk of cardiovascular events is continuous, consistent and independent of other risk factors and it may lead to myocardial infarction, heart failure, stroke and kidney diseases.

The latest National Health and Morbidity Survey (NHMS) for risk factors for non-communicable diseases (NCD) showed an overall prevalence of hypertension of 35.3% among adults 18 years and above.[2]



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1. **Venkata K Vaishnavi Vedam:** Primary author - 60%
2. **Ganapathy Sivadas:** Secondary author - 40%

Lichen Planus and Geographic tongue in hypertensive patients have been reported infrequently in the literature. Lichen Planus (a chronic inflammatory disorder) and hypertension may interchangeably contribute as risk factors with alterations in the underlying immune system.

Notably, Lichen Planus could have occurred as an adverse reaction to the Anti-hypertensive ACE Inhibitor drugs and Statins.[3] Reports also suggest that in chronic inflammation, reactive oxygen species and cytokines (Tumour necrosis factor TNF, Interleukins IL-2, IL6) are released during keratinocyte degeneration in the pathogenesis of lichen planus. These may be implicated in the rise of dyslipidemia in hypertensive patients.[4]

Geographic tongue is an asymptomatic inflammatory disorder of the tongue of uncertain aetiology, but which may be associated with several factors such as vitamin deficiency, congenital anomaly, asthma, systemic diseases such as psoriasis, anaemia, gastrointestinal disturbances, candidiasis, hormonal imbalance and psychological conditions.[5]

Some of these, such as anaemia and vitamin deficiency, are secondary to underlying hypertension and may result in the development of Geographic tongue. Cases linking the occurrence of Lichen Planus or Geographic tongue with hypertension may have been under-reported in the Malaysian population, but that does not weaken the importance of the present discussion.

In view of the rise in the CVD mortality cases with hypertension in adults, the authors believe new associations may pave the way to a potential strategy for General Physicians and Dental Surgeons to identify hypertension at the earliest stages, decreasing the number of missed diagnoses.

An integrated approach is essential in routine clinical practice in the diagnosis, either directly or indirectly, of patients involved with hypertension and/or CVD. An awareness of the clinical and oral manifestations observed in the patient may lead to an effective and early diagnosis.

Both the General Physician (GP) and the Dental Surgeon (DS) could reduce the prevalence of the national problem by diagnosing undetected hypertensive cases and, indirectly, the CVD cases, with the help of the associated, although not common, oral manifestation of Lichen Planus or Geographic tongue.

Yours faithfully,

Dr VK Vaishnavi Vedam & Dr G Sivadas

Declaration

The authors declare no conflict of interest.

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What are some of the key inputs that we as the dental profession (Dentists, Therapists, Hygienists, Technicians, Specialist and Assistants) should agree upon and aim to achieve under the NHI?

- an opinion piece submitted to the SADJ

SADJ November 2019, Vol. 74 No. 10 p530 - p531

J Mthethwa

Dear Editor,

I am aware that the NHI Bill is out there with a deadline for comments by the end of November. I have decided to pen down some of my personal views and opinions on how we as the profession should go about implementing the NHI in this country.

These are my personal views as informed by the many years I spent in private practice as a dentist both in this country and abroad, my years as a Senior Government Official in the Province, my interaction with colleagues formally and informally and lastly my interaction with academics and students who are concerned about the future of the profession. I therefore write here in my personal capacity having perused through the summary of the Bill.

Below are some of the key principles on working arrangements on which we, as the profession, need to agree. **We need to ensure that in the NHI environment:**

- We promote a strong multidisciplinary approach. This implies that we need dentist-led teams with dental therapist, oral hygienist, dental technician and dental assistants working side by side, each freely exercising his/her scope of practice.
- We promote group practice models and discourage solo practice models.
- There are various contracting models for primary and secondary care in general dental practice and tertiary/quaternary services through Hospital care.

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- Acceptable and cost-effective clinical protocols and guidelines to be used to guide clinicians are developed by the profession.
- There is a proper referral system to guide the profession and to be followed by patients.
- There are local contracting mechanisms of dental services within district health authority, moving away from central government.
- Dental service packages are developed for all population groups, serving children, adults, elderly, special needs patients and for prison settings.

On the key Ministerial Committees, we need to ensure that at least one or two members of the dental profession are included in each of the key committees such as:

- Benefits Advisory Committee,
- Health Benefits Pricing
- Stakeholder Advisory Committees
- Technical Committee including
- Remuneration Committees

On the Benefits Advisory Committee, we need to ensure that:

- There is a recognition that Oral Health is not just Primary Health care alone.
- Oral Health benefits under NHI must be defined across all levels of health care from Primary to Secondary, Tertiary and to Quaternary services.
- The design of package of services will be executed by the Oral Health Profession.
- There are norms, standards and prescribed minimum benefits for Oral Health.
- Clinical protocols and guidelines for Oral Health are developed in this committee

On dental Information systems, we need to ensure that:

- A universal standardized electronic clinical record system for Oral Health should be developed.
- Such a system can interface with other data bases such as the medical fraternity, Home Affairs, etc.
- Minimum data indicators are developed for Oral Health at various levels of care.
- The system should include radiology, pharmacology, laboratory and clinical record modules.
- The system must be able to interface at all levels of care, primary through to quaternary care.
- The system must be compatible with other systems and be upgradable to ensure future sustainability.

On the role of central hospitals and academic Oral Health Centres, we need to consider that:

- There are four Academic Oral Health centres in the country.
- These are classified as central/quaternary services.
- These must be under the National Department of Health and be centrally managed as semi-autonomous centres focusing on teaching and research, with service delivery on tertiary and quaternary levels only. Each centre should be allowed to raise and retain its additional revenue.
- These four centres must support the nine provinces in terms of training, research etc.
- The country needs to invest in the KZN/UKZN Dental Therapy and Oral Hygiene School, developing it into a full Dental School offering all other disciplines and training.
- There is a need to consider the possibility of establishing an additional Dental School elsewhere in the country as driven by need and evidence.
- These training platforms must focus on primary prevention and develop middle level professional development over and above the tertiary and quaternary focus.

Finally, there are some grey areas that I think need more attention and consensus from amongst the professions:

- The Bill needs to be clear on the eligibility of refugees and foreign nationals for Oral Health services as the current model may be unsustainable.
- The Bill needs to define Oral Health services which may be excluded from the NHI and may then be channeled to private medical insurance.
- The Office of Health Standards and Compliance needs to strengthen the Inspectorate for Oral Health in the inspection of dental practices and dental facilities in the hospitals to ensure appropriate equipment and settings are available.
- The Capitation vs. the Fee for Service models of reimbursement need to be balanced in a hybrid system to counter the effects of both under- and over-serving of patients.

In conclusion:

Clearly there is a lot that the profession needs to work on and develop rapidly in the coming weeks, months and years. The profession needs to put differences aside, for it can ill afford fragmentation and fighting over small pieces of the pie. We must work together as one united Oral Health Profession voice.

The NHI Bill provides the profession with an opportunity to start afresh, to put its house in order and to fix Oral Health not just for now but for the benefit of future generations to come. If all these objectives are achieved it would be easier to ensure that Government listens to one voice of Oral Health and to ensure that Oral Health is an integral part of the General Health service.

Yours faithfully,

Dr Jimmy Mthethwa

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Remaining dentine thickness following preparation with different glide path techniques in combination with WaveOne Gold Primary File

SADJ November 2019, Vol. 74 No. 10 p534 - p537

M Vorster[1], PJ van der Vyver[2], F Paleker[3]

SUMMARY

Introduction

This study compared minimum remaining dentine thickness values after different glide path preparation techniques, in combination with WaveOne Gold Primary (PWOG) for final canal instrumentation.

Methods

Mesiobuccal canals of 60 extracted human mandibular molars were selected and randomly divided into four groups (15 canals each). Canals were brought to patency with a # 08 K-file before glide path preparation, which was performed by a single operator.

KF group: pre-curved #10-15-20 stainless steel manual K-files; PF group: #10 stainless steel manual K-file followed by PathFiles #1-3; WOGG group: #10 stainless steel manual K-file followed by WaveOne Gold Glider; and NG group: no further glide path preparation.

Minimum remaining dentine thicknesses were determined on Micro-Computed Tomography scans at levels 3 mm, 5 mm and 7 mm from the root apex after glide path preparation and again after final preparation with PWOG. One-way analysis of variance (ANOVA) was used to statistically compare groups.

Results

No statistically significant differences ($p<0.05$) were found amongst the groups.

Conclusion

The least dentine preservation was seen in the group with no glide path preparation prior to PWOG instrumentation. Within the limitations of the study, all the glide path groups in combination with the PWOG instrument seemed to preserve dentine thickness adequately.

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Author contributions:

1. **Martin Vorster:** Responsible for data collection, analysis and scientific writing - 50%
2. **Peet J van der Vyver:** Responsible for scientific writing and editing - 30%
3. **Farzana Paleker:** Responsible for editing and layout - 20%

INTRODUCTION

Prevention and elimination of periapical inflammation is one of the main objectives of endodontic treatment.[1] Microbial infection and invasion of the endodontic system remains the main cause of radicular and periradicular pathology.[2] Preserving the position and the size of the apical foramen is another important aspect of canal preparation.[3]

Maintaining the original canal anatomy of a root canal system is critical to the successful shaping of a root canal. Identification and accessing of main canals, establishing and maintaining working length, and geometric considerations concerning instrument size selection while a root canal is being prepared remain some of the most challenging and controversial aspects of endodontic treatment.[4]

Deviation from the canal axis will result in apical transportation,[5] leading to large areas of the canal being left unprepared. Preserving original canal anatomy and dentine thickness also improves the outcome of endodontic treatment.[6] For this reason it is important to investigate the ability of a file system to preserve the original shape of the root canal with conservative dentine removal.

Nickel-Titanium (NiTi) files were first introduced into the market for use in endodontics in 1988.[7] Prior to the use of NiTi endodontic instruments, canal shaping was performed mainly by stainless steel and carbon instruments.

Compared with stainless-steel endodontic instruments, NiTi instruments can endure higher torsional stress, reduce canal preparation time, and reduce the incidence of procedural accidents.[7] These unique qualities of NiTi also allow for consistent, efficient shaping with the use of fewer preparation instruments.[8]

Maintaining a smooth reproducible glide path when successive files are used is an important characteristic of proper glide path preparation.[9] A glide path is defined as a smooth tunnel extending from the canal orifice to the radiographic terminus or exit as determined by the electronic apex locator.[10]

Micro-Computed Tomography (micro-CT), together with histological sections, plastic model evaluation, serial sectioning and radiographic comparisons, has been used to evaluate NiTi prepared root canals between different systems.[11-14] Extensive information can be obtained from micro-CT evaluation, as internal and external structures can also be assessed either simultaneously or separately.[15,16]

The aim of this study was to evaluate the effect of different glide path/no glide path techniques in combination with the WaveOne Gold Primary instrument (Dentsply Sirona, Ballaigues, Switzerland) on the remaining dentine thickness after canal preparation in curved mandibular molar root canals.

MATERIALS AND METHODS

Sixty extracted mandibular first molars with two separate mesial canals and two separate mesial apical foramina were selected. Only previously untreated first mandibular molars with mesiobuccal root canals with curvatures between 25 and 35 degrees were used. The Schneider method was used to evaluate each canal curvature.[17]

After specimens were coded and randomly divided into four groups (n=15), access cavity preparation was done with an Endo-Access bur (Dentsply Sirona). The mesial canals were explored with a size 0.8 K-file (Dentsply Sirona) and canals were negotiated to patency. Working length was determined under a surgical microscope (Zumax Medical Co. Ltd, Suzhou, China) by subtracting 0.5 mm from the length of the canal measured to the major apical terminus.

Glide path preparation

Glide path preparation was performed by a single operator in strict accordance with the manufacturer's recommendations for each system. All rotary or reciprocating files were operated by a 16:1 gear reduction hand piece powered by the X.Smart IQ (Dentsply Sirona) cordless motor. RC Prep (Premier, Pennsylvania, USA) was used as a lubricating agent and 3% sodium hypochlorite (NaOCl) (Jik, Rekitt Benckiser, South Africa) for root canal irrigation.

KF group

For each canal (n=15) a glide path was prepared using pre-curved size 0.10, 0.15 and 0.20 stainless steel K-files (Dentsply Sirona). Glide path preparation up to an ISO size 0.20 was confirmed when the stainless steel size 0.20 K-file could be placed at working length, pulled backwards for 4 mm and pushed back with light finger pressure to full working length without any interference or obstruction.

PF group

For each canal in this group (n=15) a pre-curved stainless steel size 0.10 K-file was negotiated to working length with increasing amplitudes of 1–3 mm to ensure an initial manually reproducible glide path. Path Files no. 1-3 (Dentsply Sirona) were used to enlarge each canal in this group.

WOGG group

For each canal in this group (n=15) a pre-curved stainless steel size 0.10 K-file was negotiated to working length with increasing amplitudes of 1–3 mm to ensure an initial manually reproducible glide path. The WaveOne Gold Glider (Dentsply Sirona) was then used to enlarge each canal in this group.

NG group

No preparation was done after initial canal negotiation with a size 0.8 K-file (n=15).

After glide path preparation, the Primary WaveOne Gold (Dentsply Sirona) reciprocating instrument was used for final canal preparation on all 60 canals up to working length.

Shaping was done according to the manufacturer's instructions, using the X.Smart IQ (Dentsply Sirona) cordless motor. Each reciprocating file was used to prepare only one canal before being discarded.

Throughout the instrumentation process RC Prep was used as a lubricant and 5 ml of 3% sodium hypochlorite was used as irrigation solution.

Micro-CT (XT 225 ST micro-focus X-ray tomography system (Nikon Metrology, Leuven, Belgium)) was used to evaluate the thinnest dentine wall on three different levels before and after glide path instrumentation, as well as after final preparation with the Primary WaveOne Gold instrument.

The shortest distance from the prepared canal to the mesial or distal wall of the tooth at three different levels from the root apex was measured. The side where the remaining dentine thickness was the thinnest was recorded and compared with the other measurements.

Statistical analysis

Mean and standard deviations were determined for each group and analysis of variance was used to statistically compare the mean remaining dentine thicknesses after glide path and again after final preparation with the Primary WaveOne Gold between the different preparation groups.

Statistical procedures were performed on SAS Release 9.3 (SAS Institute Inc., Cary, NC) running under Microsoft Windows (Microsoft Corp., Redmond, WA) for a personal computer.

RESULTS

For each canal the minimum remaining dentine thickness was measured on levels 3 mm, 5 mm and 7 mm from the anatomical apex after glide path preparation as well as after final preparation with the WaveOne Gold Primary instrument.

Figure 1 illustrates the minimum remaining dentine thickness in the mesiobuccal canals after glide path preparation with the three different glide path preparation techniques.

Figure 2 illustrates the minimum remaining dentine thickness after final preparation with the WaveOne Gold Primary instrument in combination with the different glide path/no glide path preparation techniques.

Combined statistics for minimum remaining dentine thickness over the three levels measured after glide path preparation as well as after final preparation with the Primary WaveOne Gold instrument are presented in Tables 1 and 2.

DISCUSSION

No significant difference was found at the three levels from the root apex between the different glide path preparation groups when minimum remaining dentine thickness was compared across different groups.

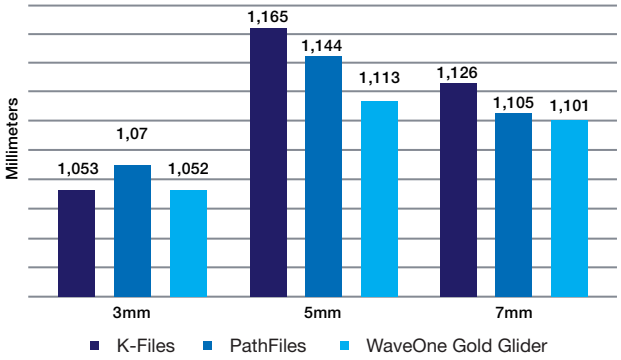

Figure 1. Minimum remaining dentine thickness after glide path preparation using three different techniques.

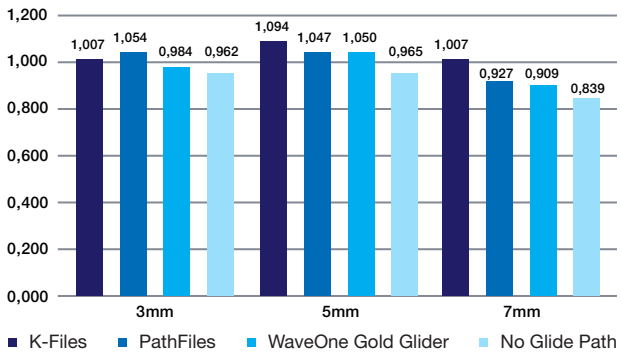

Figure 2. Minimum remaining dentine thickness after final preparation with WaveOne Gold Primary instrument in combination with different glide path/no glide path techniques.

When minimum remaining dentine thickness was evaluated after preparation with the Primary WaveOne Gold instrument, no significant difference between groups was found at the three levels from the root apex.

Although not statistically significant, the group that performed most poorly on the ability to preserve dentine thickness when mean remaining dentine thickness over all three levels was compared, was the group in which no glide path had been prepared.

The findings are similar to those of Elnaghy and Elsaka,[18] who concluded that there was no significant difference in the remaining dentine thickness after preparation with ProTaper Next in combination with different glide path techniques. Elnaghy and Elsaka[18] also found that where no glide path had been prepared before final instrumentation with ProTaper Next, the amount of dentine preserved was significantly less than in the groups where a glide path had been prepared before final preparation, irrespective of the glide path technique.

According to Lim and Stock[19] the minimum desired dentine thickness post-instrumentation was set at 0.3 mm. This minimum value was determined on the basis of sufficient resistance to obturation forces, as well as to forces occurring with normal function.

Caputo and Standlee[20] found in 1976 that 1 mm sound dentine was needed around a post for adequate resistance to root fracture. Although statistically not significantly different, most of the canals in the three glide path preparation groups had a remaining dentine thickness of over 1 mm when this dentine thickness was measured post-instrumentation.

There was no statistically significant difference in the amount of remaining dentine between different glide path groups in combination with final preparation using the WaveOne Gold Primary instrument (p>0.05).

Table 1. Descriptive statistics: means of combined remaining dentine thickness after glide path preparation with the different glide path preparation techniques.

Preparation method	Number	Mean	Standard deviation	Minimum value	Maximum value
K-files	45	1.11[a]	0.16	0.88	1.40
PathFiles	45	1.13[a]	0.21	0.92	1.64
WaveOne Gold Glider	45	1.09[a]	0.18	0.83	1.42

Mean values with the same superscript letters were not statistically different at p<0.05.

Table 2. Descriptive statistics: means of combined remaining dentine thickness after final preparation with the Primary WaveOne Gold instrument in combination with the different glide path preparation techniques.

Preparation method	Number	Mean	Standard deviation	Minimum value	Maximum value
K-files	45	1.04[a]	0.16	0.78	1.28
PathFiles	45	1.01[a]	0.22	0.75	1.47
WaveOne Gold Glider	45	0.98[a]	0.17	0.78	1.27
No glide path	45	0.92[a]	0.13	0.75	1.26

Mean values with the same superscript letters were not statistically different at p<0.05.

However, not having a glide path prior to final canal preparation with the Primary WaveOne Gold instrument resulted in the most unfavourable dentine preservation.

CONCLUSION

Within the limitations of the study, it appears that all of the glide path techniques in combination with the Primary WaveOne Gold instrument preserved the dentine conservatively.

Although not statistically significant, the least conservative dentine preservation was observed in the group where no glide path was prepared prior to final instrumentation with the Primary WaveOne Gold instrument.

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Comparing clinical outcomes of connective tissue grafts to platelet rich fibrin in gingival recession treatment - an extended case series

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F Peer[1], GU Mohangi[2]

SUMMARY

Aim

To appraise clinical and aesthetic outcomes of connective tissue grafts (CTG) and platelet rich fibrin (PRF) in managing marginal gingival recession.

Methods and materials

Five patients each with at least two contralateral Miller's Class I and/or Class II recession lesions underwent treatment in a case series with a randomised split-mouth design. Each site was paired with a similar contralateral lesion and randomly assigned to the CTG (control) or PRF (test) treatment.

Probing depth, recession depth, recession width, clinical attachment level, keratinised tissue width and gingival thickness were recorded and the data compared. Photographs were taken at baseline and at 24-weeks to evaluate aesthetics using the Pink Esthetic Score (PES). A questionnaire was used to assess patient satisfaction with treatment outcomes.

Results and conclusions

Both treatment options resulted in improved clinical measurements but CTGs demonstrated improvements at a greater number of sites than PRF (60% to 30% respectively).

The aesthetic scores improved at four sites for both CTGs and PRF with only one site in each group scoring lower, whilst elsewhere scores did not change. Patients were satisfied with the aesthetic outcomes. Both CTGs and PRF membranes can be effective in treating gingival recession, improving clinical and aesthetic outcomes.

ACRONYMS

CAL:	Clinical Attachment Loss
CTG:	Connective Tissue Grafts
CAF:	Coronally Advanced Flaps
EMD:	Enamel Matrix Derivative
FGG:	Free Gingival Grafts
GMTR:	Gingival Marginal Tissue Recession
GT:	Gingival Thickness
GTR:	Guided Tissue Regeneration
KTW:	Keratinised Tissue Width
MGJ:	Mucogingival Junction
PD:	Periodontal Depth
PES:	Pink Esthetic Score
PRF:	Platelet Rich Fibrin
RD:	Recession Depth
RES:	Root Esthetic Score
RW:	Recession Width

INTRODUCTION

Gingival marginal tissue recession (GMTR) is the exposure of a tooth's root surface as a result of apical migration of the soft tissue margin.[1] It is a common dental complaint and has varied consequences; the most common being dentine hypersensitivity, enamel abrasion defects, root caries and compromised aesthetics in patients, particularly in those with high smile lines.[2-5]

Traditional management of these lesions includes monitoring and preventative supervision of aetiological factors or symptomatic treatment with dentine sealants or restorations.[2,3] These conservative approaches neither restore lost gingival tissue nor aesthetics and in today's era of aesthetic perfection, the more discerning patient will be dissatisfied. Periodontal plastic surgery is the preferred treatment to address and enhance gingival architecture and to holistically improve aesthetics and function.

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1. **Fatima Peer:** Principal Investigator (requirement of MSc. Dent degree) - 50%
2. **Govindrau U Mohangi:** Sole supervisor & operator - 50%

Many surgical techniques have been used to treat GMTR. These include but are not limited to coronally advanced flaps (CAF), free gingival grafts (FGG), connective tissue grafts (CTG), guided tissue regeneration (GTR), allografts and xenografts.[6,7] CTG in combination with a CAF is considered the gold standard to treat GMTR.[5,7-14]

This technique is well described, is predictable and has demonstrated significant improvements in root coverage, clinical attachment gain, keratinised tissue gain and with superior colour matching to adjacent tissues.[4,11,15]

Despite these advantages, CTG's pose some limitations. Donor tissue is customarily sourced from the palate which not only exposes the patient to a second surgical site, but postoperative healing may be retarded.[4,16]

A systematic review by Chambrone et al. reported multiple adverse reactions associated with a second surgical site: among others, postsurgical oedema, increased pain and necrosis of the palatal flap during the initial healing phase.[8] Anatomical considerations such as the position of the palatine neurovascular bundle may increase the risk of paraesthesia or permanent anaesthesia at the donor site.[11,16] The palate is also limited in the amount of graft tissue it may donate, restricting the number of recessions that can be treated at one time.[11,16]

This may necessitate repeated surgical interventions to correct multiple recession lesions. Furthermore, patients are usually anxious at the prospect of undergoing surgery in general, but more so when the palate is a surgical site.[16]

Eliminating the need for a second surgical site will reduce the morbidity of this procedure and patients may be more inclined to accept corrective surgery.

Alternatives to CTGs are barrier membranes, allografts, xenogeneic collagen membranes and enamel matrix derivative (EMD). The use of these membranes can be technique sensitive and complications have been documented.[4,17] In cases where non-resorbable membranes are used, a second surgery is required to remove the membrane and newly formed periodontal tissue may be damaged at that time.[4] In some individuals, these materials are regarded as foreign bodies by recipient tissues and the natural healing process may be disrupted.[18]

Allografts and xenogeneic grafts remain associated with the risk of disease transmission, tissue rejection and may raise ethical concerns.[4,16] Additionally, commercial membranes are costly and affordability may be an issue.

Lastly, some patients may not be willing to use xenogeneic membranes for personal or religious reasons as they are commonly derived from bovine or porcine sources. In sum, these alternative membranes are not an adequate substitute for CTGs. A more economical and potentially viable alternative could be platelet rich fibrin (PRF); a natural autologous material.

PRF is a second generation platelet concentrate, developed by Joseph Choukroun in the early 2000s. PRF can "activate and facilitate healing with the regenerative capacity of the host tissue, by providing a strong fibrin scaffold, major growth factors and by allowing space for tissue regeneration".[18]

PRF is a healing biomaterial with a high-density fibrin network.[19] This gel-like fibrin network is created by a slow and almost natural polymerisation process which allows for the slow release of the growth factors and cytokines within its fibrin clot which acts as a scaffold for cellular migration and proliferation.[13]

PRF is wholly autogenous as it is prepared from the patient's own blood. The preparation protocol is simple, efficient and relatively inexpensive. The resultant fibrin clot is enriched with platelets, B- and T-lymphocytes, monocytes, stem cells, neutrophilic granulocytes and growth factors.[20] These physical properties can be harnessed to treat GMTR.

Both clinicians and patients have become more aesthetically astute, yet, soft tissue aesthetics is not routinely evaluated after gingival recession surgery.[5,21] This study sought to evaluate aesthetics from the perspectives of patient and operator. However, aesthetic outcomes can be subjective. A numerical scoring systemcan therefore be useful to eliminate such bias and to provide reproducibility when judging aesthetic outcomes.[21] The Pink Esthetic Score (PES) is such a system.

AIMS AND OBJECTIVES

This study set out to determine the clinical efficacies of PRF membranes and CTGs in treating GMTR. In addition, the authors wanted to evaluate the aesthetic outcomes using the PES and to determine patient satisfaction.

DESIGN

This six-month study was designed as a randomised split-mouth study and is presented as an extended case series.

METHODS

Patients were sourced from the Wits Oral Health Centre. Five patients, three males and two females aged between 29 and 69 years (mean age was 50.4) took part in this study.

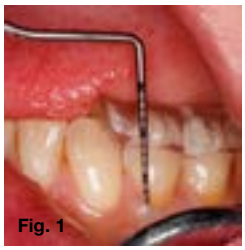
Informed consent was obtained and all protocols for research patient management were followed. Ethical clearance was obtained from The Human Research Ethics Committee (Medical) at the University of the Witwatersrand who issued clearance certificate number M150506.

The inclusion criteria were: presence of at least two contralateral Miller's class I and/or class II recession lesions, patients had to be at least 18 years old, non-smokers, in good systemic health with good periodontal health and able to maintain good oral hygiene.

The exclusion criteria were: recession lesions which were classified as Miller's class III or class IV recessions,

multi-rooted teeth with furcation involvement, patients who were pregnant, had bleeding disorders or who had had previous periodontal surgery in an attempt to correct recessions in the areas of interest.
Aetiological factors were identified and addressed accordingly. Prophylaxis was carried out and patients were given oral hygiene instructions. The plaque control in these patients was ≤20%.[22]

The following clinical variables were recorded to the nearest millimetre (mm) using a UNC 15 periodontal probe (Figure 1): periodontal depth (PD), recession depth (RD), recession width (RW), clinical attachment loss (CAL), keratinised tissue width (KTW) and gingival thickness (GT).



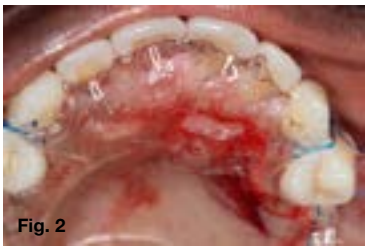


Figure 1. A UNC 15 Hu-Friedy periodontal probe used with acrylic measuring guide to record clinical parameters.
Figure 2. Palatal stent protecting donor site post-surgery.

All measurements except GT were recorded at weeks 0, 8, 12, 16 and 24. GT was measured using a rubber stopper at the end of an endodontic reamer and was recorded at baseline and at week 24.

Under local anaesthesia, the reamer was pushed into the attached gingiva at the point corresponding to the vertical line of the mid-buccal groove of the measuring guide and the mid-point of the apico-coronal width of keratinised gingiva. Tactile sensation was used to determine the point at which the reamer made contact with bone. The rubber stopper demarcated the distance from the bone to the gingival surface and this distance was measured.

Acrylic measuring guides (see Figure 1) were used to ensure reproducibility of clinical measurements. The fitting surface of the measuring guides were designed to fit snugly over the coronal surface of each tooth. An acrylic bur was used to create narrow grooves on the buccal side. Each groove corresponded to each measuring point i.e. mesio-buccal, mid-buccal and distobuccal. The periodontal probe was placed in each of these grooves when recording measurements, thus ensuring reproducibility.

Before and after photographs were taken to compare aesthetic outcomes between the two groups. The Pink Esthetic Score was used for aesthetic evaluation.[23] At the end of the study period, patients were asked to complete a questionnaire designed to assess their satisfaction with treatment outcomes.

Each patient received both types of treatment, one on either side. Each site was randomly allocated to the control (CGT) or test(PRF) treatment using the RAND function in Microsoft Excel 2016.

Surgical protocol

All sites were treated with identical surgical procedures performed by the same operator. A modified CAF was created at recipient sites. Intrasulcular incisions were made around the necks of the teeth using 15c Swann-Morton® surgical blades and Keydent® microsurgical discoid blades.

The incision was extended to the adjacent teeth on both sides. Hurzeler tunnelling instruments were used to extend the flap into the mucosal tissues.[24] With this type of flap design, the interdental papillae remained connected and intact avoiding vertical relieving incisions thus eliminating potential scarring that could have compromised the aesthetic result.

For the control, the CTG was obtained from the palate. A palatal acrylic stent (Figure 2) was used *in lieu* of sutures and exerted pressure onto the donor site aiding haemostasis and pain management. The CTG was trimmed as necessary, transferred to the recipient site and carefully placed and threaded into the gingival tunnel which had been created.

The flap was secured with Seralon® polyamide monofilament 4/0 sutures using the double-crossed suture technique described by Zuhr and Hürzeler.[25] Composite grooves (Figure 6) were created on the interproximal contact points providing a fulcrum to help advance the flap coronally and to provide maximum support for the graft.

At the test sites, Choukroun's A-PRF preparation protocol was used.[26] Just prior to surgery, intravenous blood was collected from the antecubital fossa in 10ml A-PRF+ blood vials and immediately centrifuged using a PC-O2 centrifuge (Figure 3) at 1500 rpm for eight minutes.

Table 1. Summary of clinical measurements.

Clinical Parameters	Mesio-buccal (MB)	Buccal (B)	Disto-buccal (DB)
PD (periodontal probing depth)*	MB	B	DB
RD (recession depth)*	MB	B	DB
CAL (clinical attachment loss)*	MB	***B***	DB
RW (recession width)**	RW was measured using a UNC 15 probe at the widest horizontal distance between the mesial and the distal margins of the recession defect.		
KTW (keratinised tissue width)**	KTW was measured using a UNC 15 probe along the vertical mid-buccal groove of the measuring guide.		
GT (gingival thickness)**	GT was recorded using an endodontic reamer fitted at the tip with a rubber stopper, measuring at the point where the vertical line of the mid-buccal groove of the measuring guide (see Figure 1) met the mid-point of the width of keratinised gingiva.		

*** Variables measured at three points. ** Variables measured at one point.**

Figure 3. PC-O2 centrifuge used to create PRF (A; Process, Nice, France).

Figure 4. PRF clot with fibrin clot above, red thrombin base below and buffy coat between the two layers.

Figure 5. PRF clot placed in a Process PRF Box.

The centrifugation process separates the different blood constituents into three layers: an acellular supernatant plasma layer, a middle PRF clot layer and erythrocytes below. PRF is made up of a yellow fibrin clot with a red thrombus base and a whitish buffy coat between the two (see Figure 4).

The fibrin clot was removed and compressed into a membrane using a Process PRF Box (Figure 5).[27] The compressed membrane was placed at the recipient site and sutured in the same way as the control site.

Post-surgical protocol

Patients were prescribed analgesics: paracetamol 500mg, 8-hourly for five days and ibuprofen 200mg, 8-hourly for three days, and a 0.2% aqueous chlorhexidine gluconate mouthwash for two minutes twice daily for two weeks.

Sutures were removed two weeks post-operatively. Patients were recalled at 8, 12, 16 and 24 weeks. On each occasion, the full set of measurements were recorded. At the end of the study period, photographs were taken and patients were requested to complete a questionnaire which required them to rate the following outcomes along a Likert scale: the position of the gingival margin, gingival colour, gingival shape and dentine hypersensitivty, rating from one (much worse than before) to five (noticeable improvement) (Table 2).

Data analysis

Descriptive statistics were presented for each variable in each patient at baseline and at 24 weeks. Each patient was a unit of analysis and outcomes were summarised and analysed independently.

In patients with multiple paired sites (patients E and F), the mean of each variable was used for statistical analysis and t-tests were used to compare baseline and 24 week values. In addition, the percentage root coverage, as well as root coverage (yes/no) was derived. Data analysis was carried out with Microsoft Excel 2016 statistical analysis software.

For each patient with single paired sites, data was ordinal and was summarised and analysed individually. In those patients with multiple paired sites, data were summarised as a mode.

RESULTS AND DISCUSSION

The sample population consisted of five patients, three males and two females aged between 29 and 69 years (mean age was 50.4). Patients were enrolled and surgical treatments completed between January and June 2016. Patients were seen for a total of five recall appointments over six months and the observational period concluded in December 2016.

Table 2. Likert 5 point scale for patient questionnaire.

Much worse than before	Slightly worse than before	No change	Slight improvement	Noticeable improvement
1	2	3	4	5

Table 3. Patient demographic information.

Patient	Pair/Site	Age	Gender	Tooth	Control (C) /Test (T)
A	1	69	M	13	C
				23	T
B	2	66	M	23	C
				13	T
C	3	29	F	14	C
				24	T
D	4	41	F	14	C
				24	T
D	5	41	F	45	C
				35	T
D	6	41	F	44	C
				34	T
E	7	47	M	15	C
				45	T
E	8	47	M	14	C
				24	T
E	9	47	M	13	C
				23	T
E	10	47	M	34	C
				44	T

Between the five patients, there was a total of twenty sites (i.e. ten paired sites). Patients A, B and C presented with one pair of recession sites each, patient D presented with three paired sites and patient E with four paired sites.

The results for each patient are presented in the Tables below. Tables 4a and 4b summarise baseline and 24 week measurements of all clinical variables and the PES. Table 4c summarises the scores from the questionnaire.

The purpose of this study was to evaluate the clinical and aesthetic results achieved with the use of CTGs and of PRF. Each patient was a unit of analysis and independently analysed.[29] Single paired sites are presented as Pairs 1, 2 and 3, whilst pairs 4, 5 and 6 were from one patient and pairs 7, 8, 9, and 10 were from another patient.

Clinical outcomes

The primary variables analysed to determine clinical improvements in root coverage were RD and RW. Keratinised tissue changes (KTW and GT) were secondary outcomes. Although there were improvements at both CTG and PRF sites, there were a greater number

Table 4a. Tabulation of the mean for clinical results PD, RD, RW and CAL.

	PD				RD				RW				CAL			
	Control		Test		Control		Test		Control		Test		Control		Test	
	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24
Pair 1	2	2	2	2	3,67	2,33	2,67	2,33	7	6	7	6	5,67	4,33	4,67	4,33
Pair 2	2	2	3,33	3	2,67	1,33	3	1,33	5	4	5	4	4,67	3,33	6,33	4,33
Pair 3	2	2	2	2,33	0,67	0,33	0,67	0,67	3	0	4	3	2,67	2,33	2,67	3
Pair 4	2	2	1,67	2	1,33	1,33	1	0,67	4	4	3	3	3,33	3,33	2,67	2,67
Pair 5	2	2,33	2,33	2	1,33	2,33	1,67	1,33	3	3	4	4	3,33	4,67	3,67	3,33
Pair 6	2,33	1,67	2	2	1,33	1	1,33	1,33	3	3	4	3	3,67	2,67	3,33	3,33
Pair 7	2	2	1,67	2,33	1,67	1,33	1,67	1	5	5	4	5	3,67	3,33	3,33	3,33
Pair 8	1,67	2	1,67	2	2,33	2,33	1,33	1,33	5	5	5	5	4	4,33	3	3,33
Pair 9	2	2,67	2	4,67	0,67	1,33	1,67	2	4	5	6	6	2,67	4	3,67	6,67
Pair 10	2	2,67	2	2,33	2,67	2	1	1,33	5	5	4	4	4,67	4,67	3	3,67

Abbreviation key: PD = probing depth, RD = recession depth, RW = recession width, CAL = clinical attachment level.

Table 4b. Tabulation of the mean for clinical results KTW, GT and PES.

	KTW				GT				PES			
	Control		Test		Control		Test		Control		Test	
	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24	Week 0	Week 24
Pair 1	2	2	2	2	1	1.5	0.5	1	11	12	10	12
Pair 2	3	2	4	5	0.5	1	1.5	1	8	8	11	12
Pair 3	4	6	4	6	1	1.5	1	1	14	13	14	14
Pair 4	4	1	3	5	1	1	1	1	11	12	14	14
Pair 5	2	3	2	2	1.5	1.5	1	1	14	14	14	14
Pair 6	1	1	2	2	0.5	0.5	1	1	13	13	14	14
Pair 7	4	4	2	2	1	2	0.5	1	8	11	11	11
Pair 8	3	4	6	5	1.5	2	1.5	2	10	10	9	10
Pair 9	4	4	4	3	1	1.5	1	1	10	10	11	10
Pair 10	3	1	3	3	1	1	1	1	11	13	12	13

Abbreviation key: KTW = keratinised tissue width, GT = gingival thickness, PES = pink esthetic score.

Table 4c. Tabulation of data from patient questionnaire.

	Margin Gingival Level		Gingival Colour		Gingival Shape		Dentine Hypersensitivity	
	Control	Test	Control	Test	Control	Test	Control	Test
Pair 1	3	3	3	3	3	3	4	4
Pair 2	4	4	5	5	3	3	3	3
Pair 3	3	3	3	3	3	3	5	5
Pair 4	2	4	3	3	3	3	2	5
Pair 5	2	4	3	3	3	3	2	5
Pair 6	2	4	3	3	3	3	2	5
Pair 7	5	5	5	5	5	5	5	5
Pair 8	5	5	5	5	5	5	5	5
Pair 9	5	5	5	5	5	5	5	5
Pair 10	5	5	5	5	5	5	5	5

The scores are based on the Likert key tabulated on a 5 point scale: 1 = much worse than before, 2 = slightly worse than before, 3 = no change, 4 = slight improvement, 5 = noticeable improvement.

of CTG sites which demonstrated improvements in measurements of recession. Of the total sites treated, six of the ten control sites and five of the ten test sites demonstrated root coverage.

In the single paired sites 1 and 3, the control sites showed greater improvements in RD measurements than did the test sites while test site 2 showed a greater improvement than its corresponding control site (Table 4a).

In patients with single paired sites, RW improved at all sites in both groups. RW changes between the control and test sites for pair 2 were the same. However, control site 3 showed a 100% improvement while test site 3 showed a less favourable 25% improvement (Table 4a).

Overall in the single paired sites, CTG recorded the better performance. At the two week recall appointment, patient B reported that some tissue had been lost from the CTG (control) site. Poorer results at this site (2) could be due to this loss, leading to a compromised outcome at this particular CTG site.

CAL decreased at all single paired sites (Table 4a). In patient 1, the control site performed better with a 24% improvement whereas the test site demonstrated a 7% improvement.

In patients 2 and 3, the control and test sites showed similar decreases in CAL (patient 2: 29% at the control and 32% at the test site; patient 3: 12% at the control and 13% at the test site). This demonstrates that both CTGs and PRF have similar potential to improve clinical attachment levels.

In patients D and E, descriptive statistics and t-tests revealed similar improvements for both control and test groups. In patient D, the individual test sites displayed slightly better results in RD and CAL than did the control sites (the test sample variance results were slightly lower if not similar and the mean was lower than the hypothesised mean).

Descriptive statistics and t-tests revealed that while the improvement for both control and test was the same, i.e. the high p-value indicates that the null hypothesis is supported (Tables 5a and 5b), skewness and kurtosis could only be calculated for the RD and CAL distributions. However, in patient E these distributions differed in that the control favoured negatively scored distributions while the test positively scored. This supports that the test sample variance results were slightly lower if not similar and the mean is lower than the hypothesised mean. In patient E, t-Tests cannot be reliably used for the RW, KTW and GT since Microsoft Excel returned undefined (divide by zero) scores for the distributions. These are noted as "U" in the table. In patient F, the RD and CAL distributions exhibited similar scores. This supports the use of the findings. However, in patient F, t-Tests cannot be reliably used for the RW, KTW and GT the score for the other three measures were fairly extreme.

These results in patients D and E are mirrored in a similarly designed study by Jankovic et al. where CTG performance was compared with that of PRF.[30] It was found that RD improved in both groups with no statistical difference between groups.[30] RW measurements in these patients remained unchanged at most sites (11 of the 14 sites).

Of the three sites that demonstrated a change in RW, only one site improved (test site 6 improved by 1 mm). The other two sites worsened by 1mm each (test site 7 and control site 9). These results demonstrate that both CTGs and PRF have the potential to improve recession lesions (Table 4a).

There were improvements in GT at many sites, 60% of CTG sites demonstrating an increase in GT while only 30% of the PRF sites increased in GT (Table 4b).

CTGs demonstrated an increased tendency over PRF to improve GT. Few studies report on changes in GT, only two being found. Both were over a six month observational period and GT was recorded at baseline and six months.[10,11]

One of the studies was conducted by Eren and Atilla, evaluating and comparing CTGs and PRF in combination with a CAF. The authors found similar statistically significant improvements in GT measurements in both groups.[11] The present study, on the other hand, showed a greater increase at the CTG sites. A second study; by Aroca et al. tested a CAF alone with a CAF combined with PRF and found statistically significant improvements in GT in the PRF group.[10]

These results demonstrate that a CAF in combination with PRF can be more beneficial than using a CAF alone in treating gingival recession. The present study has

Table 5a. Tabulation of descriptive statistics and t-test results for patient E.

		RD		CAL		RW		KTW		GT	
Patient E	P(T<=t) two-tail	0.35		0.71		0.42		0.55		N/A	
	Kurtosis	-0.01	0.73	-1.25	1.13	U	U	U	U	U	U
	Skewness	-0.50	1.62	-0.68	0.02	U	1.73	1.29	-1.73	U	U

Table 5b. Tabulation of descriptive statistics and t-test results for patient F.

		RD		CAL		RW		KTW		GT	
Patient F	P(T<=t) two-tail	0,79		0,12		1,00		0,79		0,18	
	Kurtosis	-0,19	-0,86	-0,25	-1,28	4,00	4,00	2,23	-6,00	1,50	-6,00
	Skewness	-0,09	0,00	-0,14	-0,46	-2,00	-2,00	1,13	0,00	0,00	0,00

demonstrated that CTGs provide greater improvements in GT over PRF. The increase in GT at the CTG sites can be explained by the influence of the type of connective tissue involved. Subepithelial connective tissue from keratinised mucosa contains the biological signals that induce the overlying epithelium to differentiate into the keratinised form.[11,31-33]

The increase in GT in the PRF group may be explained by the influences of the growth factors trapped within the PRF membrane.[11] These growth factors positively influence proliferation and differentiation of the gingival and periodontal ligament fibroblasts and epithelial cells, encouraging angiogenesis.[30]

The dense 3-dimensional fibrin structure of PRF may also function in a similar fashion to an extracellular matrix by providing stability to the wound and acting as a scaffold for cellular interactions, thereby increasing the thickness of the overlying epithelium.[19]

An increase in GT contributes to complete root coverage, long-term periodontal stability and helps prevent further gingival recession over time.[29,30] Therefore, increases in GT is a desired outcome of any surgical treatment. Although both CTGs and PRF demonstrated the potential to positively influence GT, CTGs performed better at this than did PRF.

The KTW results showed improvements in only six of the twenty sites (control sites 3, 5 and 8 and test sites 2, 3 and 4). There were decreases in KTW at three control sites (2, 4 and 10) and at two test sites (8 and 9) while at the remaining sites the levels remained unchanged. In their CTG and PRF study, Jankovic et al. observed a different outcome over six months with a statistically significant gain in KTW in both groups.[29]

Overall, both CTGs and PRF can improve clinical outcomes in treating gingival recessions but CTGs demonstrated improved clinical outcomes at a greater number of sites. These findings support the view of many authors that CTGs together with a CAF produce the best results in treating recessions.[5,8,10,34-36]

Aesthetic outcomes

According to Chambrone et al. improved gingival aesthetics is considered the primary goal of root coverage procedures.[37] Zucchelli et al. states that root coverage success should be determined not only by reductions in recession measurements but also by soft tissue coverage, the thickness and colour of which should be indistinguishable from those of adjacent soft tissue.[38] Photographs were taken and the PES was used as an objective aesthetic scoring system. The PES uses seven variables on a scale 0-1-2 for a total score of 14. Aesthetic outcomes were determined on how close/short of this total were the recorded values.

The application of both CTGs and PRF can result in improved aesthetic outcomes. The aesthetic results in both groups were similar and no patient was dissatisfied. Across the groups, there were eight sites with an increased PES, ten sites with no change and two sites that decreased in their score. The increases in the PES were distributed equally between the control and test sites i.e. control sites 1, 4, 7 and 10 and test sites, 1, 2, 8 and 10.

The decreases in the PES were at control site 3 and test site 9. At both sites, there was a change from a perfect score of two ("natural") on soft tissue contour to a "fairly natural" score of one. This change in tissue contour may be the result of the surgical incisions into the sulcus and not necessarily as a result of the graft or use of the PRF membrane. The remaining sites displayed an improvement in the PES or an unchanged aesthetic score i.e. the aesthetic score did not worsen. Therefore, both CTGs and PRF have the potential to improve gingival aesthetics or at the very least, to maintain aesthetics.

There are limited studies that have systematically evaluated aesthetic outcomes using various types of visual scoring systems. Some studies simply comment on aesthetic outcomes using either general terms such as "aesthetically pleasing" or "good aesthetic results", or a by using a scale similar to "good", "regular" or "poor".[39,40]

In a study by Rosetti et al. aesthetic results were evaluated on a scale of "good, regular and poor".[41] The authors recognised that this type of scoring system is dependent on a subjective clinical impression.[41] Another study by Bouchard et al. used a scoring system of "good, moderate and poor".[42] They too acknowledged that this type of evaluation was subjective and tried to eliminate this bias by using independent examiners to evaluate the aesthetic outcomes.[42]

These methods of scoring aesthetics are not ideal as they are not only subjective but also are not reproducible. In contrast, the present study relied on a more objective means to evaluate aesthetics. The PES is a reproducible, reliable and predictable scoring system which evalu-

Table 6. Variables of the Pink Esthetic Score.[23]

Variables	Details	0	1	2
Mesial papilla	Shape vs. reference tooth	Absent	Incomplete	Complete
Distal papilla	Shape vs. reference tooth	Absent	Incomplete	Complete
Marginal Tissue Level	Level vs. reference tooth	Major discrepancy >2mm	Minor discrepancy 1-2mm	No discrepancy <1mm
Soft Tissue Contour	Natural matching reference tooth	Unnatural	Fairly natural	Natural
Alveolar Process	Alveolar process deficiency	Obvious	Slight	None
Soft Tissue Colour	Colour vs reference tooth	Obvious difference	Moderate difference	No difference
Soft Tissue Texture	Texture vs reference tooth	Obvious difference	Moderate difference	No difference

ates seven specific characteristics of gingival tissue.[23] Studies which evaluated aesthetic results prior to the development of an aesthetic scoring systems cannot be compared with the results of this study.

Patient-based outcomes

According to Bouchard et al. the success of root coverage procedures should be determined by the patient and not the clinician.[40] The ultimate goal of any treatment is patient satisfaction.

To this aim, patients were given a questionnaire to score treatment outcomes on a Likert type scale. The questionnaire was given to patients at the end of the study period. Patients were asked to score four features of each site: marginal gingival level, gingival colour, gingival shape and dentine hyper-sensitivity.

The scoring system was a five point scale: 1 – much worse than before, 2 – slightly worse than before, 3 – no change, 4 – slight improvement and 5 – noticeable improvement.

All patients appeared satisfied with the aesthetic results. According to the patient questionnaire, most sites across both groups either improved or remained unchanged. Patient D was the exception.

She scored the gingival level at all three control sites as "slightly worse than before" and the corresponding test sites as "slightly improved". Her perception is mirrored in the clinical results where the statistical analysis showed that the control group worsened by 16% and the test group improved by 16.54%. With regards to aesthetic outcomes, this patient scored gingival colour and shape as unchanged at all sites.

Again, this is reflected in the PES. The PES for these sites showed either an improvement (control site 4) or it remained unchanged at a perfect score of 14. Analysis of patient D's questionnaire supports the concept that patients can constructively contribute to determining the success or failure of clinical outcomes.

On the other hand, patient E scored all control and test sites as 5 -"noticeable improvement". The clinical assessment of the results differed in that some of these sites worsened (i.e. control site 9 and test sites 9 and 10), three sites improved (control sites 7 and 10 and test site 7) and two sites remained unchanged (both control and test sites 8) over the study period.

These incongruities between clinical results and the patient's perceptions show a tendency of bias on the part of the patient. He may be simply wanting to favour a good result for the investigators. This shows that a patient's perceptions can be skewed with respect to the reality of outcomes.

Similarly, patient B scored the gingival margin as "slightly improved" and gingival colour as "noticeable improvement" at the CTG site even though there was no change in the PES. Clinicians may not deem this site an aesthetic success but the patient seemed satisfied with the overall result. Again, the patient may be eager to favour good study results. This concept is known as participant bias and is well documented in psychological studies.

Participant bias occurs when participants want to make a useful contribution to the study and so will provide what they think are the "correct" answers to provide the investigators with what they want.[43]

Despite this limitation, patients overall appeared satisfied with the aesthetic outcomes. There were no scores in the PRF group that worsened. Very few studies have considered aesthetic outcomes from a patient-based approach. In their systematic review of root coverage procedures, Chambrone et al. found only three randomised clinical trials that evaluated aesthetic outcomes according to patient opinions.[37] As with the present study, Chambrone et al. found that when patients were asked to evaluate aesthetic results, most were satisfied with the outcome.[37]

Rotundo et al. set out to determine aesthetic perceptions after root coverage and interestingly found that clinicians expect patients to be fully satisfied with aesthetic results only when complete root coverage is achieved.[44] However, the present study found that patients can be satisfied with the aesthetic result even in the absence of complete root coverage.

Outcomes

In this study, procedures using both connective tissue grafts (CTGs) and platelet rich fibrin (PRF) demonstrated clinical and aesthetic improvements in the management of gingival recession. The results obtained for recession depth (RD), clinical attachment loss (CAL) and gingival thickness (GT) were better in the CTG group whereas PRF demonstrated better results for recession width (RW) and keratinised tissue width (KTW).

This study appears to be the first to have relied on an objective and a reproducible aesthetic scoring system, the Pink Esthetic System (PES). The aesthetic outcomes were judged to be the same for both groups. The protocol ensured the best possible results by not only using a tunnel flap, previously shown to enhance aesthetic results, but also with a microsurgical approach to minimise soft tissue trauma during surgery.

This study also considered patient based outcomes. The results from the questionnaire demonstrated that in the opinion of the patients, PRF performed better than CTG.

The results of this study indicate that both CTGs and PRF membranes can be effective in treating gingival recession and both treatments can improve clinical and aesthetic outcomes.

Limitations

This study used photographs and the PES to evaluate aesthetics. The PES does not accommodate the mucogingival junction (MGJ) in its analysis. In com-

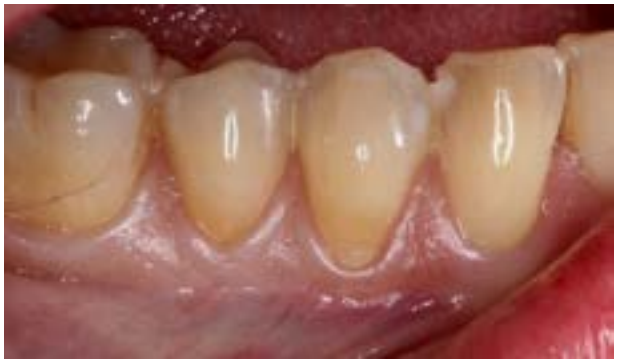


Figure 6. CTG sites on 44 and 45 at baseline.
Note: the interproximal composite rests created to support the sutures.

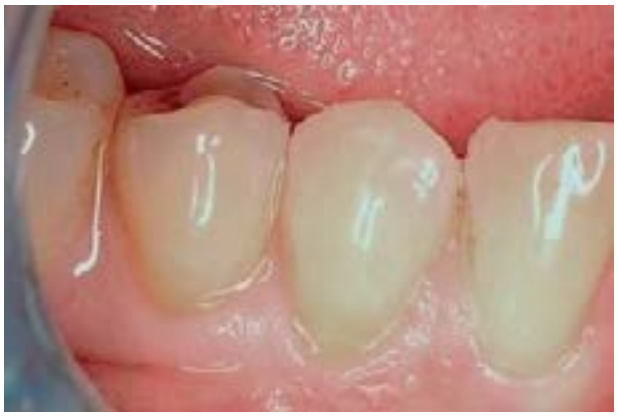


Figure 7. CTG sites on 44 and 45 at 6 months.

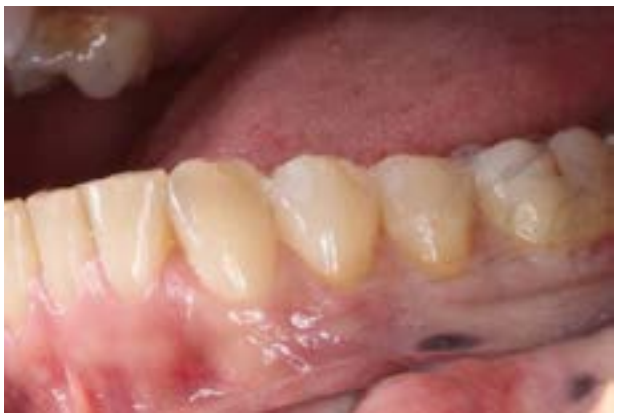


Figure 8. PRF treated sites on 34 and 35 at baseline.

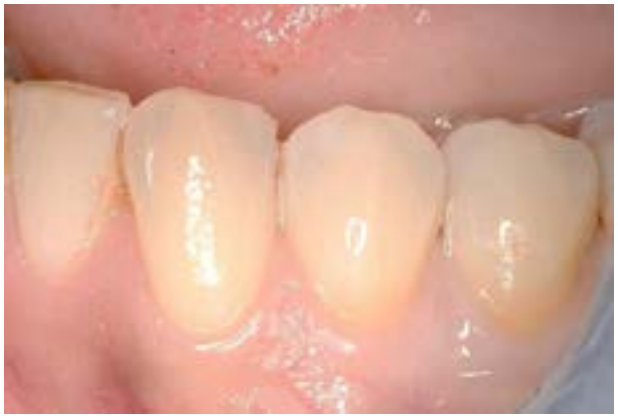


Figure 9. PRF sites on 34 and 35 at 6 months.

fically designed to evaluate the aesthetic outcomes of root coverage procedures and as such uses clinical assessment of MGJ alignment as one of its variables.[21]

It can be challenging to identify the MGJ on photographs. By evaluating aesthetics clinically using the RES, the aesthetic score may be more representative of the outcomes of root coverage treatments.

Another limitation of this study was the method used to determine patient satisfaction. In the nature of our work, we develop relationships with our patients. This is expected as we build a rapport with our patients and develop trust over time. Despite this being a clinical study, the relationships still establish and anonymity cannot be secured in the clinical setting. Patients may therefore feel "obligated" to provide what they consider as favourable outcomes. Ensuring complete anonymity with regards to every aspect of the questionnaire may overcome this bias.

In future studies, an additional questionnaire before treatment to assess initial patient assessments of their aesthetic status may be helpful to enable comparison with their perceptions of treatment outcomes.

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Conflict of interest

The authors report no conflict of interest related to this study.

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Outcomes of mandibular Kennedy Class I and II prosthetic rehabilitation - an observational study

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SUMMARY

Loss of teeth may have a negative impact on appearance, nutrition and function. Removable prostheses for mandibular distal extension areas have been associated with more negative outcomes than with tooth-bounded saddles.

Aim

To describe the outcomes of rehabilitation with *Kennedy Class I* and *II* dentures five years after insertion.

Methods

Dental laboratory and patient records were accessed to identify patients fitted with mandibular distal extension dentures between January 2011 and June 2017 by the Oral Health Centre of the University of the Western Cape. Information on the prosthesis, oral health status and study outcomes was recorded and augmented by telephonically interviewing 30 patients, randomly selected from the initial sample.

Results

Observed outcomes included 'low frequency of use' and 'high patient dissatisfaction.' Most common were: remakes (n=26), abutment tooth extractions (n=12) and repairs (n=9). A large proportion (n=105) of the sample received no follow-up treatment. No statistically significant associations existed between the outcomes and the variables of age, gender, type of opposing dentition, number of recalls and denture base material used.

Conclusion

Most commonly reported oral health problem associated with wearing Kennedy Class I and II dentures was abutment tooth loss. Remakes and repairs were frequent outcomes.

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ACRONYMS

FPDPs:	Fixed Partial Denture Prosthesis
RPDPs:	Removable Partial Denture Prosthesis
RPI:	I-Bar System
SDA:	Shortened Dental Arch

Keywords

Clinical Outcomes, Mandibular distal extension dentures, Abutment tooth loss, Denture replacement, Repair, Patient opinion.

INTRODUCTION

Tooth loss due to caries, periodontal diseases and trauma is sometimes unavoidable.[1] The World Health Organization (WHO) guidelines indicate that the highest prevalence of partial edentulism occurs between the ages 35-44 years[2] and that 12.6% of that sector of the adult population was completely edentulous.[2]

However, according to the South Africa Demographic and Health Survey (SADHS), 23% of adults aged between 35-44 years were completely edentulous.[3] Many South Africans must therefore be partially edentulous. The patterns of tooth loss do vary amongst different populations,[4] and various studies have attempted to investigate the link between tooth loss and the different socio-economic factors between communities.[5-7]

Whilst not all lost teeth need to be replaced, rehabilitation of tooth loss is related to enhancing functions such as mastication and speech and aesthetics and may therefore be important.[2]

From the clinician's point of view, prosthetic rehabilitation aims to improve the distribution of occlusal forces on the remaining teeth, maintain the stability of the dentition and increase masticatory performance. In contrast, the perception of the patient of prosthetic rehabilitation is centered on the improvement of aesthetics and mastication with minimal discomfort and disruption to oral functions.[1]

Rehabilitation of shortened or posteriorly reduced dental arches, though, is not always necessary as sufficient masticatory function can be achieved with 20 teeth, having 9-10 posterior occluding pairs of teeth.[8] Indeed it has shown that patients have scant knowledge of the consequences of missing teeth.[9]

Oral rehabilitation in partial edentulism, however, is not just to correct problems such as impaired mastication, aesthetics and speech, but also addresses the decline of patient-assessed quality of life that accompanies tooth loss. The major determining factor for treatment is the location of the lost tooth or teeth. The literature has shown that partial edentulism is more common in the mandible than the maxilla.

Younger adults tend to present with Kennedy Class III and IV partial edentulism. This is attributed to the early loss of the first molars as these teeth erupt first (and therefore become exposed to possible disease factors) and to loss of anterior teeth due to the susceptibility of children to trauma that affect these teeth.[5]

As individuals get older and lose more teeth the Kennedy Class III extends into a Class I and Class II. The Kennedy Class I and II partial edentulism is more common in the mandible while Classes III and IV being more common in the maxilla.[5]

Removable partial denture prosthesis (RPDPs) placement is more common with Kennedy Classes I and II while rehabilitation of Classes III and IV is usually with a fixed partial denture prosthesis (FPDPs) and implant-supported prostheses, depending on patient factors such as preference and finances, and on the condition of remaining teeth, and supporting tissues.[5]

Clinicians are more often faced with challenges in providing adequate support, retention and stability when restoring the mandibular distal extension spaces using RPDPs. Individuals may present with severely resorbed ridges due to disuse, migration and mal-positioning of posterior teeth, lost inter-arch space due to over-eruption of opposing natural teeth; and teeth that are unable to serve as abutments due to their poor periodontal condition or unfavorable position after drifting.[1,4-5]

These sequelae also occur with other classes of partial edentulism. The impact is often magnified when mandibular posterior teeth have been lost early and distal partial edentulism is of long-standing duration.[10]

The most important factors that influence the success of prosthetic rehabilitation of Kennedy Class I and II mandibular arches maybe categorized as follows:[1,11-18]

1. **Mechanical factors:** Fractures of the major and minor connectors,[17] requiring retreatment of the free-end RPDPs.

2. **Biological factors:** The wearing of RPDPs may be associated with an increased risk of caries and periodontal disease.[16] Retention of a RPD is through tooth and ridge coverage, predisposing the teeth to plaque accumulation and bacterial overgrowth, possibly but not always leading to caries and periodontal disease.[16]

   Isidor and Budtz-Jorgensen (1990) recalled patients biannually for the first two years then annually for three years and recorded high plaque scores and gingivitis but, remarkably, with no significant changes in probing depths.[18] Their study does highlight the positive influence of recall visits on the success of newly placed RPDP's.[18]

3. **Patient factors:** Ensuring patient satisfaction is as important as treatment planning in defining success with the use of a prosthesis.[1,3] Patients who consider the discomfort of a dental prosthesis to outweigh the perceived benefits will not wear it, with negative consequences on success.

   Thus, a dentist considering prosthetic rehabilitation is wise to ensure he or she addresses all concerns expressed by patients. It has been recorded, though, that dental practitioners may be limited by the patients' poor oral hygiene, chronic illness (like diabetes) adverse social habits (like smoking) and, by the implications of financial cost.[17]

4. **Biomechanical factors:** Restoration of Kennedy Class I and II partially edentulous mandibles with RPDPs has historically posed biomechanical challenges because they derive support from two different tissues.[15] A mandibular distal extension denture is supported by the periodontal ligament *via* the teeth, through the action of the rest seat, and by the mucosal tissues of the residual ridges.

   Variable degrees of displaceability occur between these two tissues.[11,12,19,20] These will definitely impact negatively on the comfort of patients and their ability to wear these prostheses and eventually on treatment outcomes.

In an effort to counteract these challenges, certain measures in RPDP treatment have been developed and applied, with varying degrees of success, including: special impression techniques, alternate RPDP designs such as the mesial rest combined with a proximal plate and I-bar (RPI) system, shortened dental arch (SDA), use of precision-attachments and implant-supported dentures.[11,12,19,21-23]

The aim of this study was to assess outcomes of treatment with mandibular Kennedy Class I and II prosthetic rehabilitation during a period of 5-6 years after insertion, by inspecting the file records of patients and through telephonic interviews. The following objectives were addressed:

1. To determine a demographic analysis of the patients and the types of dentures constructed, and to track the clinical history of the dentures.

2. To assess the opinions of patients of their prosthetic rehabilitation through telephonic interviews.

METHODS

This was a retrospective observational study involving qualitative data collection methods including a telephonic interview section including open-ended questions to allowing some of the sample of patients to share their opinions. From the records of the Oral Health Centre at the University of the Western Cape (UWC), a

convenience sample was selected of patients who had been fitted with posterior mandibular prostheses during the period January 2011- June 2017. A smaller sample of 30 patients, a subset of this initial sample, was telephonically interviewed using a questionnaire with open- and closed-ended questions. Records accessed were:

a). **Dental laboratory records:** On these records were clearly documented the personal details of patients, the type of the prosthesis, which dental arch, whether it was an acrylic or cobalt-chrome RPDP and when it was delivered to the patient.

b). **Patients' dental records:** Data recorded included the patient's age and contact details, the design of the prosthesis (Hospital instructions are to include a design within the patient folder), any repairs and remakes of the prosthesis, the loss of abutment teeth, and any recorded patient opinions concerning the prosthesis.

c). **Telephonic interviews with patients:** The information obtained from the Hospital records pertaining to the outcomes of the prosthetic rehabilitation was complemented by conducting 15-minute telephonic interviews with a small sample of patients, a subset of the initial sample.

These individuals verbally answered 12 questions related to the treatment received. Follow-up questions were asked where necessary to clarify answers to open-ended questions. The interviews were recorded to ensure an accurate account of the patients' responses, which were then entered into the personal files.

Patient participation was voluntary and informed consent was obtained before administering the questionnaire, following the principles of the Declaration of Helsinki.[24]

The following patients were excluded from the sample: if they: were fully edentulous; had incomplete dental records, wore prostheses rehabilitating Kennedy Classes III and IV, rehabilitation of Kennedy Class I and Class II using FPDPs, overdentures (ODs) or implant-retained prostheses and patients with any prostheses fabricated and fitted in other public or private clinics.

Data collection involved the completion of Excel spreadsheets with the information gleaned from accessed records, and from the summaries of the recording of the responses to the questionnaires used for the telephonic interviews. Data analysis included computation of standard descriptive and comparative statistics.

Frequency calculations of demographic details, patient records and questionnaire responses were completed and one sample or two sample t-tests of significance were calculated to determine the outcome of any associations; the information was grouped to ascertain the distribution of variables amongst specified intervals and in order to make meaningful deductions. Data collection and analysis were completed using Excel and SPSS software.

RESULTS

Ethical clearance was obtained from the UWC Biomedical Ethics Committee (Registration Number: BM 16/7/25). All participants had at the outset of treatment signed a consent form meeting the requirements of the Declaration of Helsinki.[24]

According to the technical laboratory records, 335 lower RPDPs had been made during the period January 2011 to June 2017. Of these, 160 were lower partial acrylic and 175 were lower partial metal (cobalt-chrome) RPDPs.

Access was gained to 269 patient clinical files (66 patient records were not found, 19.7%). These recorded a total of 217 mandibular partial dentures, and the occurrence and percentage prevalence of the different dentures are shown in **Table 1**. From amongst the total patient records accessed, 152 complete patient records were found for patients who had been supplied with either a Kennedy Class I or Class II mandibular RPDP. Kennedy Class I (n=95) was the most common, whilst only 57 Kennedy Class II dentures had been delivered during the study period.

Table 1. Distribution of dentures delivered, according to Kennedy classification.

Kennedy Class	Number	Percentage %
Class I	95	44
Class II	57	26
Class III	58	27
Class IV	7	3
Total	217	100

From the compiled data the observed outcomes recorded were:

a). **Recall:** At the time of the study, most patients (69%) had not returned to the Oral Health Centre for any follow-up treatment.

b). **Remakes:** Twenty-six remakes had been required (17%), usually due to poor fit, to reports of pain and discomfort, or mechanical failures and loss of abutment teeth.

c). **Extraction of abutment teeth:** Recorded were 12 instances (8%). The reasons for extractions, whether due to periodontal disease or caries, were not clear.

d). **Repairs** were not commonly required (n=9, 6%), but were due to loss of an abutment tooth and subsequent tooth addition, and also to midline fractures or fractured clasps.

These outcomes were all considered an indication of treatment failures. Most remakes or repairs had occurred within the first two years of denture delivery. Relines and restored abutments could not be analyzed as outcomes because of the minimum occurrence.

Only one prosthesis of the 152 RPDP Kennedy Class I and Class II sample included in this study had been relined and only one individual had an abutment tooth restored following denture delivery.

a). Age distribution and outcomes

The most common outcome recorded for this cohort is the number of 'remakes' of RPDPs, especially for those patients in the age category 65-74 and 75 years and above. No remakes were reported for individuals aged 25-34 years (Figure 1).

It was found that all expected cell frequencies were not greater than five, resulting in a chi squared test being unsuitable. A Fisher's Exact Test for association was therefore conducted between age categories and reported failures or study outcomes. Only a rather moderate weak negative association was found between age categories and study outcomes ($\varphi = -0.298$; $p = 0.119$).

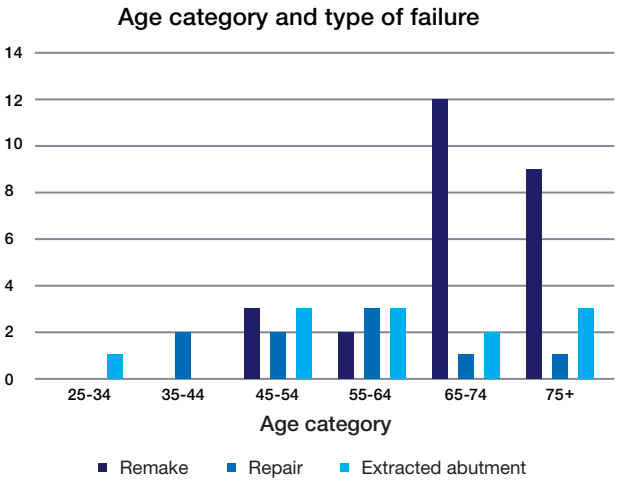

Figure 1. Graph indicating age distribution and study outcomes.

b). Gender distribution and mandibular distal extension RPDPs

Females constituted the greater proportion (72%) of individuals who had been rehabilitated with either mandibular Kennedy Class I (72%) or Class II (58%) RPDPs. A moderately weak association was shown between gender and Kennedy Classification ($\varphi = 0.1403$; $p = 0.082$).

More denture failures were recorded for the female participants than their male counterparts. The most common negative outcome in both gender groups was 'remakes' of dentures.

Figure 2 is an illustration of the distribution of study outcomes in relation to differing conditions in the opposing maxillary arch and shows that the most common outcome for patients with mandibular distal extension RPDP treatment is 'remakes'.

However, Fisher's exact test did not reveal a statistically significant association and therefore the nature of the opposing arch did not significantly affect the outcome of the prosthetic treatment.

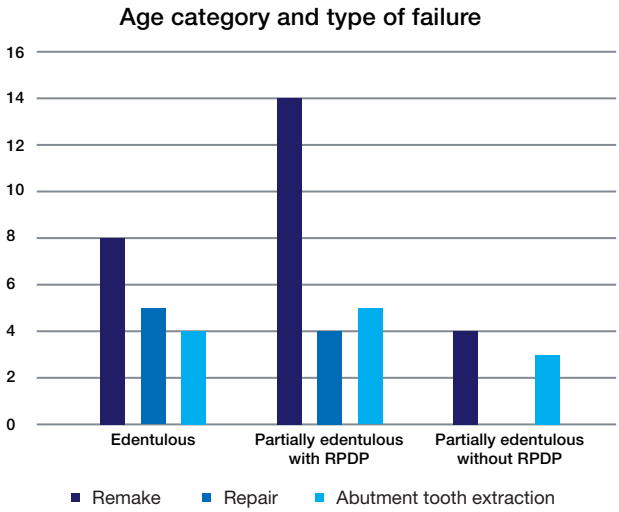

Figure 2. Frequency distribution of outcomes related to opposing dentition.

Type of denture material and outcomes

Having the denture remade was the most common outcome for both types of denture materials used as denture bases as shown in Figure 3. The graph also shows that the majority of denture failures occurred with those made with cobalt-chrome denture base material.

In determining whether an association exists between denture material and Kennedy Classification a chi square test was carried out, for the expected cell frequencies were greater than five.

The result showed there was no significant association between denture material and Kennedy Classification ($\chi 2 = 0.0502$; $p = 0.823$). The type of denture material, therefore, did not significantly influence the resulting outcome.

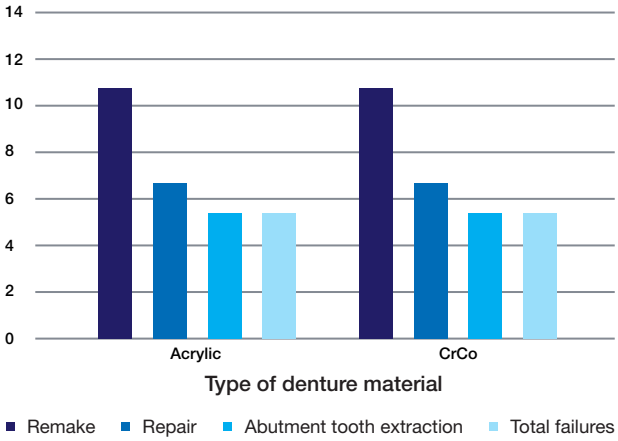

Figure 3. Graph indicating the two types of denture materials and study outcomes.

From the quantitative analysis the most common observations were that a large majority of the patients did not return for follow-up treatment, the prosthesis was either remade or repaired or the patient lost an abutment tooth. About 27% of the remakes were prompted by the loss of an abutment tooth. Half of the repairs were tooth additions after the loss of an abutment tooth.

There was, however, no statistical relationship between any of the outcomes including the loss of abutment teeth and the other measured variables. Since the remakes or repairs occurred within a short period of time (all occurred within two years of denture delivery) they are considered to be treatment failures as is the loss of abutment teeth.

The combined total number of these failures was 47 from amongst the sample of 152 (31%). The remainder of the cases should not be considered as successes because when the sample of 30 individuals were interviewed, their responses made it clear that that was not always the case.

After consulting the literature, the following criteria were selected for further investigation through the telephonic interviews: the frequency and impact of wear, replacement and satisfaction with RPDPs.

Patient comments recorded with regards to the frequency and impact of wear indicated that most of them seldomly wore or did not wear the denture at all.

The reasons given were 'discomfort', 'painful', 'didn't fit properly' and 'can't eat or chew with it.' Their comments also centered on the position and poor aesthetics of the clasps necessary for retention, yet these were included according to the design and as per standard Oral Health Centre protocol.

The responses of patients regarding the replacement of dentures were hardly answered, and those who responded said 'they did not go back for another denture' or 'they were on a waiting list'.

Patients were requested to score their rate of satisfaction with dentures on a scale of 1 to 10. The low scores (mostly below 4) which 67% of individuals gave confirmed their dissatisfaction with their RPDPs.

They recounted their experience of a negative impact on wearing of RPDP such as 'nothing improved with their dentures'. The contrary was obviously true for those minority of patients who reported wearing their 'denture all the time' or 'most of the time', as they were totally satisfied (with scores of 6 or more) and did not require replacement dentures. These individuals reported a positive impact on chewing and functioning.

All the RPDP patients wanted their appliances to ensure an improvement in their aesthetics and functioning, but many were clearly disappointed. They seemed unaware of the option of returning to the treatment center to have these denture problems corrected, which could have improved the denture experience (Many did return but for other reasons such as scaling and restorations).

DISCUSSION

The success of prosthetic rehabilitation is the shared responsibility between the clinician and the patient.[25] This implies correct diagnosis, correct treatment planning and careful execution of the work together with patient education, the initial step in management and which continues throughout the treatment and maintenance stages.

Communication between the clinician and patients is key to successful treatment outcomes. The patient must understand the benefits and limitations of the treatment so that unattainable expectations are lowered and misuse of the prosthesis is prevented.

The patient also has a role to play in maintaining the oral tissues and the denture prosthesis through consistent hygiene practices.[25] The literature has shown that RPDP wearers are prone to tooth loss as a result of periodontal breakdown and caries and the action of the denture as a Class I lever.[11,13-16,19]

The delivery of the denture does not signify the end of treatment but the patient is expected to attend follow-up visits to mitigate, at an early stage, any adverse effects of wearing the denture.[14,16,26-27] The negative influence of RPDPs on oral health status can be minimized when a system of periodic recalls is implemented, studies showing a low incidence of caries, abutment tooth loss and periodontal disease.[3,14,16,26-27]

A significant proportion of the patients did not return to the treatment centre for monitoring. The outcome of loss of abutment teeth in this study could be attributed to multiple factors: poor oral hygiene practices by the patient, incorrect diagnosis, inadequate patient education about maintenance, poor selection of treatment options and improper denture design.

Patients showing poor adaptability to previous RPDPs may have benefited from fixed alternatives instead of multiple remakes.[28] Certain individuals in the study population had their distal extension RPDPs remade three or four times in the period under observation.

The use of the RPI system (n=6) was limited in the study sample population and may indeed be regarded as outdated. The treatment choice based on the diagnosis and as it related to the problems observed was, therefore, poor. Satisfied patients, who scored the prosthetic treatment as 6 or higher, were pleased with how the denture improved their mastication.[29] However, sixty seven percent of patients reported seldomly wearing the denture or not wearing it at all if discomfort or pain was experienced.

Some patients were functioning well with a complete maxillary prosthesis and the remaining anterior mandibular teeth. thus, a misdiagnosis of treatment could have been made as these patients may have been better suited for management with SDAs.[22]

Carr and Brown (2011) included the use of the altered cast technique as part of the six phases to providing a distal extension denture with the best support.[25,27] The technique was not used at all to make the 152 prostheses observed during this study.

The outcome of loss of abutment teeth in this study could be attributed to multiple factors: poor oral hygiene

practices by the patient, incorrect diagnosis, inadequate patient education about maintenance, poor selection of treatment options and improper denture design.

Status of the prosthesis

The study indicates that remakes and repairs are not only a parameter for measuring the status of the prosthesis but also of oral health and patient satisfaction, for remakes were prompted by three reasons: complaints about the fit of the denture, lost abutment teeth and fractures.[26]

Patient opinion

Koyama and colleagues (2010) carried out telephonic interviews of patients who had received an RPDP.[30] Their criteria of determining successful frequency of wear were:

a). **Successful:** the original RPDP was worn daily for five years.
b). **Remake:** the original was replaced within five years.
c). **Failure:** the RPDP was not used or rather used sporadically.

The patients in the current telephonic study relayed the information that the most important patient factor in the success of treatment was the perceived benefit of the prosthesis and level of comfort.[1] When these were not met, the denture was hardly or never worn. Most assessed their level of satisfaction as below 4, an indication of disappointment.

CONCLUSION

Within the limits of this study, it can be concluded that patients' expectations of rehabilitation with mandibular distal extension RPDPs are largely unmet and that they need to be educated in this regard not just about treatment prospects, but about alternatives such as overdentures, shortened dental arch and/or implant retained prostheses.

It can also be said that patient dissatisfaction with mandibular distal extension RPDPs is significant, though clinicians appear unaware of this. Patients are not informed of the need and of their right to return for further management or correction of treatment following the initial rehabilitation.

Implications for practice

Due to the high prevalence of partial edentulism in SA, it is crucial that successful rehabilitation with RPDPs must be enhanced, so that improved function, esthetics and satisfaction ensure successful prosthetic treatment outcomes. University teaching and clinical protocols should be revised to assist in overcoming the negative outcomes as reported with this study.

Limitations

This study relied on the records of patients who had received RPDPs and on telephone conversations with a limited number of patients. Had clinical examinations been conducted more precise information may have been gathered. Comparison of outcomes with patients wearing dentures other than those rehabilitating Kennedy Class I and II edentulous spaces would be instructive.

Account was not taken of the duration of time since fitting the denture, although it was noted that most repairs and remakes occurred within two years of denture delivery. More detailed investigation into the influence of different materials and of the opposing arch may have been warranted.

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The Oral Health Section of the Road to Health Chart (RtHC)
- how useful is it?

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SUMMARY

Oral diseases are a major worldwide public health problem. Eighty per cent of caries goes untreated, below the 50% goal set by the South African National Department of Health. 80% of the SA population depends on state services for oral healthcare. The American Academy of Pediatrics advises commencement of screening when the first tooth appears, or no later than at 12 months of age. The Road to Health Chart (RtHC) is a convenient home-based method of monitoring and improving child health. How effective is it?

Methodology

A multistage cluster sampling technique selected seventy-seven health professionals as study participants for a review of their RtHC and for questionnaires and focus group interviews.

Results

243 oral health pages of RtHC's were reviewed. Only 27% had completed oral health sections, of which dental professionals had better knowledge.

Conclusion

Those who work in Baby Well clinics are ill-informed and have a lack of knowledge of the relevance and importance of the oral health section of the RtHC, which is not adequately utilized.

INTRODUCTION

Among the strategies to improve the survival and development of children, as set out by the World Health Organisation (WHO) and the United Nations Children's Fund (UNCF), are the monitoring of growth patterns, oral rehydration and the promotion of breastfeeding, an adequate food supply, family planning and female education.[1] The WHO framed a global strategy on child development, specifically designed for developing countries where it identified best practices for child monitoring in terms of measuring growth, feeding practices, nutrition and immunizations.

The child development-monitoring tool, the Road to Health Chart (RtHC) is a recommended method of growth monitoring. It is intended to assist parents, caregivers and health professionals in determining normal targets and any deviations in the growth of the child.

Accurate record keeping is important for continuity and quality of care. Globally, patient-held maternal and/or child health records for literate and illiterate patients and healthcare personnel have been used since 1973 to track the health status and document the immunisation status of the patients. These records, though designed to record patient health histories and to facilitate continuity of care among healthcare personnel, also empower patients to track their own health.[2]

In 1993, the World Health Organization (WHO) undertook a comprehensive review of the uses of child monitoring charts. The review concluded that the use and interpretation of the charts were sadly lacking.

In response, the WHO Multicentre Growth Reference Study (MGRS) was implemented between 1997 and 2003 to develop international standards for children below five years of age. In South Africa, the RtHC was revised in line with global standards. Since then the chart has been updated four times, with the last update being in 2017. New WHO growth standards and changes in the immunisation schedule necessitated revision of the current RtHC while simultaneously providing an opportunity for the addition of other health information, including an oral section.

ACRONYMS

ECC:	Early Childhood Caries
MGRS:	Multicentre Growth Reference Study
NDOH:	National Department of Health
RtHC:	Road to Health Chart
UNCF:	United Nations Children's Fund
WHO:	World Health Organisation

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All children born in South Africa are issued with a RtHC document that is to be completed by the health professional at every clinic visit. It records essential information on the growth of the child, the immunization history, vitamin A supplementation, deworming, the presence of deciduous teeth and any illnesses.

An oral health section was included in the booklet in 2011. Among other benefits, health professionals can use anthropometric indicators such as milestone developments and teeth present in the mouth as a guideline when parents are unsure of the age of the child.[3]

The American Academy of Paediatric Dentistry[4] recognized that maternal prenatal oral health, along with infant oral health, is one of the foundations upon which preventive education and dental care must be built to enhance the opportunity for a child to be free from preventable oral diseases.

The newly revised RtHC was implemented by the Department of Health (DoH) in February 2012, which included an oral health section that was based on global WHO standards.[5] Unfortunately, there was no training of health and dental professionals regarding the completion of the newly revised chart before its implementation.

According to Cloete[5] the evaluation of the findings in the RtHC on nutritional practices, breast-feeding practices and bottle-fed practices are poorly monitored and not followed up. Although there is little evidence related to poor nutritional and bottle-feeding practices there is clinical consensus among dental professionals that prolonged breast feeding and certain bottle feeding practices increase the risk of early childhood caries (ECC).[6]

This problem and poor nutritional and feeding practices need to be identified early together with other putative risks and protective factors including sociodemographic influences, environmental (fluoride exposure) and behavioural factors (such as feeding and oral hygiene practices).[6]

Early intervention, health promotion messages and school-based programmes can be with integrated with other services and, together with an evidence-based approach, can be contextualised into a response to local oral health needs to address dental caries prevalence rates in children.[7]

The report on the National Children's Oral Health Survey[8] found that 40% of six year olds in South Africa are caries-free. This is below the goal of 50% set by the National Department of Health.[7] In the Western Cape 82.3% of children under age 5 presented with dental caries.[8] This is a major public health problem, as 80% of children are reliant on public health service for treatment needs.[9]

This paper presents an evaluation of the oral health component of the RtHC regarding the capturing and monitoring of the oral health information in the Cape Metropolitan region.

METHODOLOGY

The oral health sections of 243 RtHC booklets were reviewed. The sample size calculation was based on the assumption that half of the RtHC reviewed in PHC clinics would have incomplete or inaccurate information.

A multistage cluster sampling technique was used to select the study participants for the review of their RtHC, while the primary health care facilities were randomly selected in the Cape Metropolitan region. Seventy-seven health professionals participated in the survey that elicited their opinions regarding completion and usefulness of the oral health section.

For the three parts of the study, the instruments used to collect the data were (i) a structured checklist to determine how complete were the RtHC's, (ii) a questionnaire survey administered to medical doctors, healthcare workers (including dentists, oral hygienists and dental therapists), and (iii) a focus group discussion with health professionals was implemented to elicit their opinions regarding the usefulness of the oral health section in the RtHC booklet. The focus group discussions with 10 participants was audiotaped and transcribed by the researcher.

The Senate Research Ethics Committee of the University of the Western Cape (ref. 14/7/16) as well as the Health Research Committee of the Western Cape Department of Health approved the study.

Signed informed consent was obtained from the parents and health professionals allowing the researcher access to the RtHC's and providing for the health professional to complete the questionnaire. Anonymity and confidentiality was ensured by the allocation of a code to each participant in the study.

RESULTS

Two hundred and forty-three RtHC booklets were reviewed. **Figure 1** summarises the number of children in a particular age group for each visit and records the extent of completion of the oral health section in their RtHC. The largest group consisted of children aged 12-24 months, the smallest group, children aged 48-60 months.

Just over a quarter (n = 66, 27%) of the oral health sections of the RtHC were filled in. **Figure 2** shows the number of complete records (n=66) versus the oral health records which had in previous years been completed (n=10).

Seventy-seven health professionals completed the questionnaire. Oral health professionals had the highest awareness (100%) of the oral health section, while professional nurses had a 70% awareness of that section, However, 80% of certified nurses (5) and both the two involved doctors were not even aware of the oral health section in the RtHC (**Figure 3**).

As regards utilising and completing the oral health section, the dental professionals were the most confi-

dent (75%) and the least confident were the certified nurses (20%) (Figure 4).

Dental hygienists and dentists found the oral chart easy to use (63% and 80% respectively), while health professionals not related to the dental field (nursing professionals, councillors and those who are involved in community service) did not find the oral health-charting table so user friendly.

The knowledge of oral health practices among the primary nursing staff and community care workers was poor. While the professional nurses were aware of the oral section in the RtHC, this knowledge was not translated into practice in early identification when there was a problem nor by appropriate referral to a dental professional.

Ten health professionals participated in a focus group discussion designed to determine their views and opinions on the oral health section in the RtHC. The focus group was comprised of a doctor, a dentist, four oral hygienists, a dental assistant, a professional nurse, a certified nurse and a community care worker (breastfeeding counsellor). Three broad themes emerged from the discussions - a lack of training and orientation to the RtHC, a lack of structure to the RtHC booklet and a lack of accountability and responsibility amongst the parents.

DISCUSSION

Monitoring child health is a widely accepted practice and is strongly supported by health professionals, being a standard component of community paediatric services throughout the world.[10] Its value is twofold - health professionals have a track-record of child development, and secondly, it provides a source of accountability to the carer and a continuity in care.[10]

Healthcare providers at primary health care centres are generally the 'first line' of healthcare workers confronting basic health needs. Parents take their young chil-

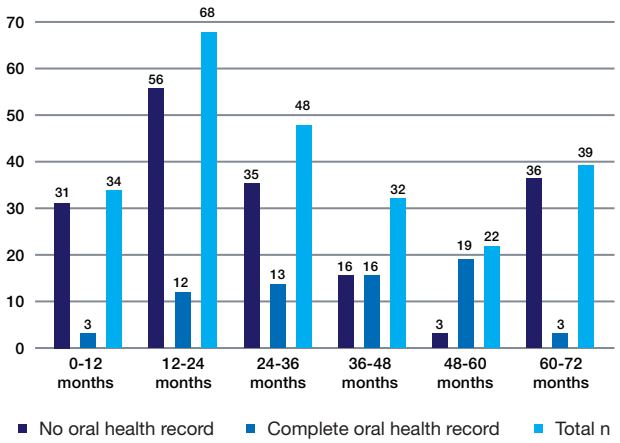

Figure 1. Completion of Oral health records (n=243).

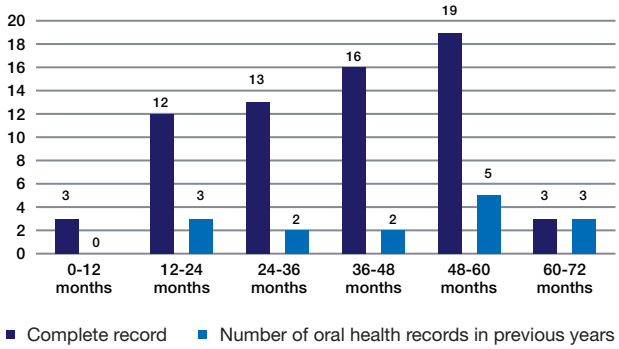

Figure 2. Number of complete records (n=66) versus records actually filled in over previous years (n=10).

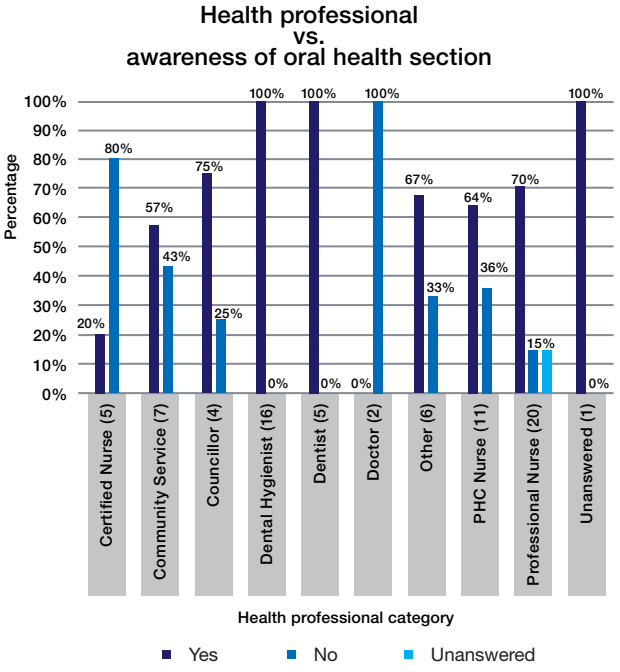

Figure 3. Health professional's awareness of the oral health section, per category.

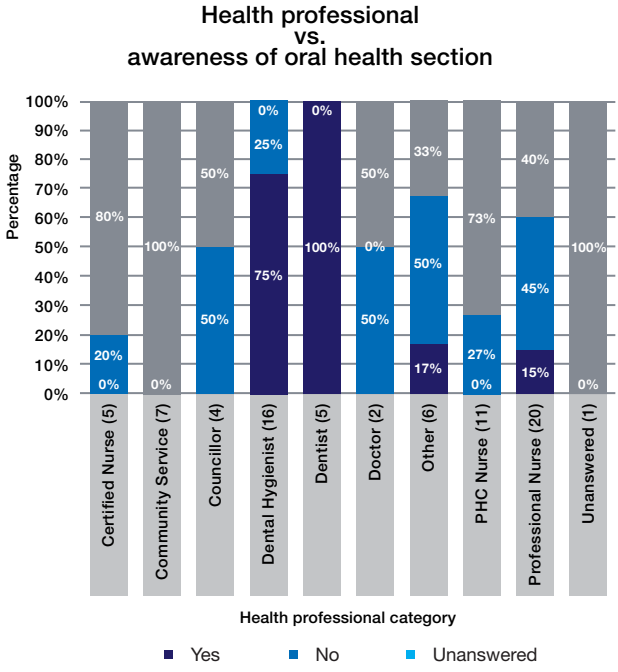

Figure 4. Health professionals' confidence in completing the oral health section of RtHC.

dren to primary health care clinics for child monitoring, which includes weighing, growth recording, assessment of feeding practices and administering of vaccinations.

Some primary health care facilities have access to a dental professional in their setting, yet the primary health care nurse seldom refers the young children to the dental clinic.

Therefore, an integrated approach to health that includes oral health should be adopted by the public health services and primary health care nurses should be trained to conduct a basic oral examination for early detection of oral diseases as well as other oral-related abnormalities.[7]

Incompleteness of oral health section

A summary of the completion of the oral health section in the RtHC appears in Figure 1. The data show that just over a quarter (27%) of the RtHC had the oral health section filled in, while the charts of one hundred and seventy-seven children had not had the oral health section completed at every visit made to the clinic (Figure 1). The largest group consisted of children 12-24 months of age, the smallest of children 48-60 months old.

There was a clear lack of understanding amongst the healthcare workers of the purpose of the inclusion of the oral section in the booklet. The study showed that due to the poor design of the section in the RtHC, dental professionals had to use their own judgement in the completion of this record. This has resulted in inconsistencies, and professionals relying on their own interpretation of the information sought in the oral health section in the RtHC.

The allied health professionals not associated with dentistry indicated it was not their job to complete the oral section. However, other sections such as recording breast-feeding practices, health promotion messages, dietary factors and milestone developments were also often incomplete.

Lack of knowledge of the non-dental participants

During the focus group discussions, the nursing professionals indicated that a dental professional should complete the oral section. They reported that after training it was their responsibility to coach the rest of the nursing and allied members. However, while training was in breastfeeding, infant guidelines, weighing and immunization, nurses were never informed of nor trained in using the oral health section in the RtHC. Medical doctors took no responsibility for the RtHC other than completing their own notes of child illness and left the entries recording the developmental, health promotion and dietary factors solely to the nurses.

Focus group discussions

The following health care workers participated in the focus group: a dentist, four oral hygienists, a dental assistant, a professional nurse, a certified nurse, nursing student, community care worker (HIV, TB), and a breastfeeding counsellor.

The majority of health professionals, including dental professionals, indicated they were not orientated, made aware of, nor informed of the use and implementation of the oral health section in the RtHC.

Dental professionals observed that in its present state the oral health section was of no benefit to parents or other health professionals as it lacked clarity and guidance. Nursing professionals reported they were not aware of the oral health section in the RtHC and therefore could not comment on its purpose: *"We are yet to see something in writing coming to our clinic informing us of the oral health section of the RtHC"*.

"If there is no policy, I will not do or implement anything unless I was informed by my superior". This comment is reiterated in a study conducted by Makanyeza et al.[11] and Balfour[12] who suggest that success of new policies occurs only when there is consultation with the relevant health professionals on the policy structure and design. The lack of consultation on the structure and implementation of the oral health section in the RtHC has resulted in a lack of accountability among health professionals regarding its use.

The importance of child monitoring as a tool is useful not only for the health professional, but also for parents and carers. However, nurses despaired on the lack of accountability of parents: *"The nomadic lifestyles of many of the parents of the children who attend the public health clinics often results in loss or damage to the chart"*.

"Parents do not look at the chart or show any interest when we write or plot information in the booklet; it's just like a tick list for them." The success of using child-monitoring cards is dependent on parents' knowledge and cooperation, but, if the professionals are unaware of the value and benefits of child monitoring, how will they be able to educate the parents?

CONCLUSIONS

One of the most important aspects of early childhood development is the quality of life. A child should have access to health care, education, food security, healthy living environment and be pain-free.

If a child's oral health needs are not identified early, discomfort and pain may ensue, impacting on the child's and the parent's qualities of life. The National Department of Health (NDOH) believes that better use of the RtHC would help to move children onto a higher trajectory towards better health and development.

The sampling size was based on the hypothesis that at least half of the RtHC would have been completed, but in the event, the completion rate was significantly low. Of the 243 records that were reviewed, only 2.9% children had had their mouths examined and the RtHC signed by the time the first tooth had appeared.

Only 27% of the two hundred and forty-three RtHC reviewing children from age 0-72 months had the oral section partially completed.

The present study showed a lack of knowledge on the importance of the first oral health visit and of establishing a "dental home" for children. While health professionals were aware of the importance of dental visits for children, they did not see the link between oral health and the importance of good nutrition and feeding practices.

The present study found that there was very poor and inadequate completeness of the oral health section of the RtHC. This outcome was similar to findings by Scherdel et al.[13], Kitenge[3] and Mudau[1] who reported poor completion of child monitoring data.

A solution may be to organise an integrated approach with parents and health professionals, leading to a successful knowledge status, attitude and practices of effective curative, preventive and promotive tools in monitoring child health.

Recommendations

1. An index page be added to the RtHC directing the health professional and parent to specific information.

2. Oral Health messages be included in the oral section including the importance of the baby teeth, risks of sweet sugar contents in feeding bottles, especially when the child sleeps with the bottle teat in his/her mouth, graphic images of the dangers of the consumption of sweets, positive oral health messages of good dietary practices, the importance of brushing the teeth of babies with a smear layer of fluoride toothpaste.

3. Protocol or emergency care guidelines covering the situation when a tooth is knocked out of the child's mouth or if a tooth fractures, including referral guidelines for parents and health professionals in the case of other dental emergencies such as dental abscess and toothache.

4. Training for health professionals on the completion of the oral health section of the RtHC, *via* continuous education programmes.

Limitations

This was a fairly small sample drawn from only one region in South Africa. A wider investigation could reveal different results.

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The Mandibular Anterior Repositioning Appliance (MARA)
- A report of three cases

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JH Weber[1], P Botha[2], SH Dawjee[3]

SUMMARY

Introduction
The MARA (Mandibular Anterior Repositioning Appliance) is a fixed functional appliance used in the treatment of mandibular deficiencies.

Aims and objectives
To demonstrate the clinical capabilities, treatment effects and the expected duration of treatment when using the MARA, therefore creating awareness of the MARA as a treatment alternative to other functional appliances designed for correction of Class II malocclusions.

Methods
A retrospective study exploring the anteroposterior dimensional changes in the maxilla and mandible brought about by the MARA and the associated treatment time. The samples were the first three cases treated by a clinician inexperienced with the clinical application of the MARA and served as an ideal introduction to the treatment technique.

Results
In this study mandibular growth stimulation and temporomandibular joint remodeling may have been the main contributing factors in the resolution/improvement of the Class II malocclusions under treatment.

Conclusion
The MARA is a useful non-compliance appliance that produces exceptional treatment results when applied in combination with full fixed appliances. The changes observed were predominantly of a skeletal nature in the anteroposterior dimension. Maxillary growth restriction may also have played a role in the correction of these treated Class II abnormalities.

Keywords
MARA, Mandibular changes, Maxillary changes, SNA, SNB, ANB, WITS, Y-axis, Tweed angle, Facial angle, Mandibular growth.

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2. **Piet Botha:** Treatment, research and writing - 35%
3. **Salahuddien M Dawjee:** Writing and advisor - 10%

INTRODUCTION

The idea of using a fixed functional appliance to stimulate mandibular growth was proposed by Angle and others of his peers many years ago, but the materials to make the concept an actuality in clinical practice were lacking. The development of stronger adhesives overcame this limitatation. The MARA was developed by Dr. D Toll and modified in 1994 by Dr. James E Eckhart to function as a fixed non-compliance appliance to correct Class II malocclusions.[1,2]

The decision as to which is the most effective technique to use in the treatment of growing patients with skeletal and dental Class II malocclusions has long been the source of considerable debate in the orthodontic literature.[3] A scientific orthodontic study yielding insightful and meaningful results must ensure that the individual/samples studied must be of the same clinical and functional characteristics, age and gender.

Some widely utilized treatment techniques in the correction of Class II malocclusions include:

- space creation by performing selective extractions of teeth, especially upper first premolars, in order to camouflage the Class II malocclusion, or a reduction in upper tooth size by enamel stripping, by palatal expansion, utilization of the leeway space, or by orthopedic manipulations of the mandible and maxilla produced by headgear.
- functional appliance therapy together with full fixed appliances.
- temporary anchorage devices (TAD's) used in the distalization of molars.
- orthognathic surgery.[4]

The lack of success with removable functional appliance treatment has been attributed to a lack of patient compliance and the inability to control the amount and direction of mandibular growth.[3]

The MARA is a fixed functional appliance that eliminates the compliance factor. It has the added advantage of no inter-jaw restrictions, thereby allowing the patient to open his/her mouth unhindered in order to function normally. This device can be used in combination with full fixed appliances while skeletal correction is being achieved.

Although the MARA has been accepted as an effective non-compliance solution, it is not widely used as a functional non-extraction method of treatment of Class II malocclusions for various reasons. In one study, it was reported that the MARA was used clinically by only 5,8% of the orthodontists comprising the sample.[5]

The possibility of extra cost could play a role as well as operator and/or patient considerations with regards to handling/placement difficulties and the perceived longer chair time.

The aim of this study is to illustrate the MARA's clinical proficiencies, treatment effects and advantages by presenting three Class II cases, all selected and treated by the same operator.

The relatively uncomplicated nature of these cases was considered to make them an excellent introduction to the MARA as a supplementary treatment technique. The information gathered from the treatments may support the increased utilization of the MARA in the clinical orthodontic environment.

Description of the MARA

The MARA is a unique noncompliance Class II corrector that does not directly connect the maxillary and mandibular arches. It advances the mandible so that the patient functions in a new protrusive position.

It is claimed that this forced protrusive mandibular position stimulates bone remodeling and, if the patient is treated during the pubertal growth spurt, may result in the correction of the Class II malocclusion.

The MARA basically has six immoveable parts, including the transpalatal arch, that are manufactured and assembled as two separate units, fixed to the maxillary and mandibular first permanent molars respectively.

Stainless steel crowns are placed on the maxillary and mandibular first molar teeth. Ideally, a palatal bar can join the maxillary crowns, but it is not mandatory. In the mandible the crowns are joined by a rigid lingual arch that can be supported by bonded occlusal rests on the first premolars should clinical circumstances necessitate this.

The maxillary first molar stainless steel crown supports a large .062"x.062" square tube on its buccal aspect, into which slides a .060"x.060" removable square elbow, the position of which can be varied anteroposteriorly by the placement of spacers which are available in 1, 2, 3 and 4 mm lengths. The vertical arm of the elbow extends occlusally about 10 cms from the first maxillary molar and is then bent distally (Figure 1).

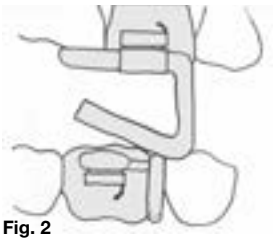
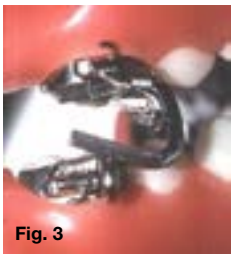


Figure 1. Components of the MARA.
Image Source: *Components of the MARA,* Tsibel G (http://www.getyourbraces.com/) Accessed on 27.08.14

Figure 2. MARA trying to occlude in Class II.
Image Source: *MARA in situ. 2007,* Julie` D (http://www.ortho-concept.com/mara) Accessed on 27.08.14



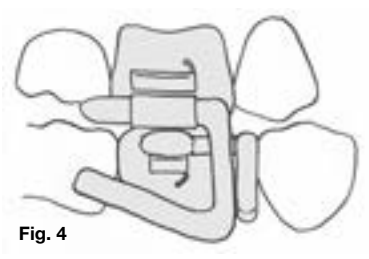


Figure 3. Trying to occlude in Class II.
Image Source: Courtesy J. Eckhart.

Figure 4. Closed into Class I.
Image Source: Courtesy J. Eckhart.

To the mandibular first molar stainless steel crown is fixed a recurved rectangular wire arm that extends buccally about 5 mms from the mesial aspect. This could be called the lower arm or shoulder 6 (Figure 1).

During attempted jaw closure into the habitual Class II relationship, the inferior horizontal leg of the maxillary elbow contacts the mandibular arm, preventing functional occlusion in a retrusive position (Figures 2 and 3).

The Class II patient is therefore obliged to protrude the mandible until the lower arm is anterior to the vertical leg of the maxillary elbow component of the MARA, when closure into a forced protrusive position Class I position is possible (Figure 4).

The inferior horizontal leg of the upper elbow projects distally and prevents the patient from occluding into a Class II (Figure 3). Thus the TMJ is placed under constant strain similar to that caused by for example the Herbst appliance.[6]

Advantages of the MARA

The MARA has several advantages over the other noncompliance Class II appliances. These include:

- uncomplicated design – no inter-maxillary and mandibular connections. Sturdy and break resistant;
- aesthetically pleasing – no extra-oral headgear (decreased visibility);
- simple hygienic maintenance resulting in less oral mucosal infection/irritation;
- mandibular mobility is maintained – less functional movement impairment;
- fewer anchorage points resulting in less side-effects.[7]

Side-effects and possible solutions

The MARA is not without drawbacks. The treatment effects of the MARA in post-pubertal patients are limited due to lessened available mandibular growth.[8]
Side effects may involve:

Mobility of the mandibular first molars
Mobility of the lower first molars is caused when the upper elbows of the MARA contact the lower posterior aspect of the mandibular arms as the patient functions in the newly advanced position of the mandible.[8] The solution to this side-effect is to simply place full fixed appliances and/or MARA occlusal rests on the mandibular first premolars during treatment to ensure stability.[8]

Increased space between the mandibular anterior teeth
Spacing of the mandibular anterior teeth may occur in patients treated with a MARA incorporating a lingual arch. The mandibular first molars may move forward (due to the maxillary elbows pushing on the back surface of the mandibular arms), the lingual arch will contact the posterior surfaces of the mandibular anterior teeth, causing anterior tipping and a flaring.

The solution to this complication is including occlusal rests which are bonded to the occlusal surfaces of the premolars and second molars thereby resisting mesial forces. Full bonding and selection of the correct negative torque (-6 degrees) for the lower incisors will provide more resistance to labial tipping.[8]

Distal tipping and intrusion of the maxillary first molars together with possible extrusion or distal tipping of the maxillary second molars as both molars tip distally around their centroids (**Figure 5**).

Figure 5. Distal tipping of molars.

When the MARA results in mandibular protrusion, the maxillary molars receive a distal force. This could cause distal tipping and intrusion of the maxillary first molar teeth. A simple solution would be to add a rest onto the occlusal surface of the maxillary second molar, extending distally from the first molar crown.

This will prevent extrusion of the second maxillary molars and intrusion as well as distal tipping of the maxillary first molars.[8] Another aid to prevent distal tipping of the maxillary first molar is a transpalatal arch.

Class II relapse may also be a point of concern. It has been suggested that an adult patient treated with a MARA would have greater tendency to relapse than a child who has undergone the same treatment, as the correction in adults is mostly of a dento-alveolar nature.

Adults have larger muscle forces than children and this may result in a greater possibility for relapse if the apparent correction was partially due to temporary forward posturing of the mandible. If relapse is suspected, overcorrecting of the Class II malocclusion may be successful.[8]

In order to avoid distal tipping or dento-alveolar movement of the upper molar, the arch wire of the fixed orthodontic appliance should be cinched back behind the first molar. In cases where dento-alveolar movement is desired, as is needed in some adult cases, this is not done.

MATERIALS AND METHODS

This is a retrospective study of cephalometric and panoramic radiographs, study models and photographs of three adolescent male patients that presented with Class II malocclusions and were treated with the MARA.

The study aimed to determine the antero-posterior dentoskeletal treatment effects which were achieved and the respective durations of treatment. The cases selected were the first three such cases treated by the operator. They were deemed to be a suitable introduction to the use and clinical capabilities of the MARA.

All three cases were adolescent Caucasoid males with an average age of 16.7 years at the commencement of treatment. According to Proffit et al., the adolescent growth spurt in boys usually occurs between years 11-16 with the related physical changes peaking at around 14 years of age.[4]

Although the three patients were nearing the end of their adolescent growth spurt, it was determined that enough growth was still to be completed to warrant the use of the MARA.

The subjects received full arch fixed appliances concurrent with the MARA. One of the subjects presented a Class II division 2 in whom a lingual fixed appliance was placed in the maxilla.

Total treatment time (**Table 2**) referring to the duration of active treatment from the placement to removal dates of the full fixed appliances was as follows: patient 1 with a total treatment time of ±37 months (1109 days).

Treatment time for patient 2 from beginning to end was ±20 months (603 days). Treatment time for patient 3 was ±27months (817 days).

The MARA treatment time (**Table 2**) for patient 1 was ±14 months (514 days), that for patient 2 was approximately ±11 months (343 days). Patient 3 had a MARA treatment time of ±13 months (406 days).

RESULTS

The two main criteria that were analyzed in this study were:

- The cephalometric measurements important in diagnosis and assessment of Class II malocclusions.
- Treatment time referring to total treatment time including the initial placement and removal of full fixed appliances, and time under treatment with the MARA.

The following antero-posterior cephalometric and vertical relationships (Table 1) were utilized in illustrating the treatment effects of the MARA on the three cases:

DISCUSSION

Treatment effects of the MARA

The pubertal growth spurt, according to literature and previous clinical studies,[4] is the most ideal time to treat Class II malocclusions resulting from mandibular deficiencies, because the growth of the jaw of the patient could be utilized and manipulated.[9]

The MARA produces several clinical changes which can be measured post operatively through clinical, radiographic and study model analysis.

Some of the changes observed in this study included a small degree of restriction of maxillary growth, the mesial movement of mandibular molars, pre-molars and incisors and the distalization of maxillary molars and premolars – the so-called "head gear effect". The glenoid fossa and mandibular condyles may also undergo remodeling as the mandibular condyles rest in their newly advanced position on the articular eminence of the temporal bone.[6] Proffit et al. state that the remodeling is facilitated by two phenomena; the reduced pressure on the condylar tissues accompanied by a change in the muscle tension acting on the condyle.[4]

Mandibular changes

The results showed a significant change in the SNB, with an average increase of 3,33° in this value. The second mandibular value that is of clinical importance is the cranial base to chin point relationship or facial angle (FH/N-Pog). The cephalometric analysis revealed an average increase of 1°, indicating some anterior movement of the chin.

The third value indicating notable mandibular growth in the three patients evaluated is the measurement of the distance (in millimeters) between Pt-point to A-point and Pt-point to B-point respectively. Pt-point (Pterygoid fissure) is considered a stable reference point from which the measurements were taken. The before-and-after treatment values of Pt-point to B-point revealed that there was an average increase of approximately 5,33 mm, indicating significant horizontal/forward growth of the mandible while under treatment with the MARA.

Maxillary growth expressed as the difference in the before-and-after values of Pt-point to A-point was an average of 2,33 mm. The resultant treatment effect of the MARA is therefore interpreted as being a relative 3 mm mandibular advancement (Pt-point to B-point average – Pt-point to A-point average).

Finally, an average reduction of 4° and 6° of the Tweed angle and $\bar{1}$ to NB angle respectively, together with reductions in the linear distance of the lower incisors to NB, is a clear indication of mandibular advancement and mandibular incisor inclination correction toward a more favourable Class I occlusion.

Table 2. The total treatment times and MARA treatment times.

	Patient 1	Patient 2	Patient 3
Total Treatment Time (Months)	37	20	27
MARA Treatment Time (Months)	14	11	13

Table 1. Cephalometric values.

	Patient 1		Patient 2		Patient 3	
	Before	**After**	**Before**	**After**	**Before**	**After**
SNA	95	92	84	83	81	84
SNB	84	87	78	80	77	82
ANB	11	5	6	3	4	2
WITS	8	2	6	4	5	2
Y-axis	59	58	67	67	67	62
Facial Angle	90	91	86	85	90	93
Tweed Angle	104	99	106	100	104	103
$\bar{1}$ to APO	0 mm	1 mm	-3 mm	-2 mm	2 mm	0 mm
$\underline{1}$ to NA	8	14	3	22	24	30
$\bar{1}$ to NB	33	27	29	20	26	23
FH: GoGn	21	17	18	17	16	12
GoGn: SN	26	21	26	22	26	20
Mandibular growth in mm from Pt-point to A&B points respectively.	Pt point to A-point		Pt point to A-point		Pt point to A-point	
	72 mm	75 mm	72 mm	75 mm	68 mm	69 mm
	Pt point to B-point		Pt point to B-point		Pt point to B-point	
	88 mm	95 mm	92 mm	97 mm	88 mm	92 mm
Mandibular growth in mm from Sella to A&B points respectively.	Sella to A-point		Sella to A-point		Sella to A-point	
	105	104	100	101	92	92
	Sella to B-point		Sella to B-point		Sella to B-point	
	119	132	120	132	112	118

Patient 1: Before treatment.

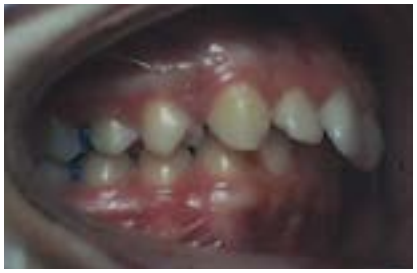


Figure 6A.

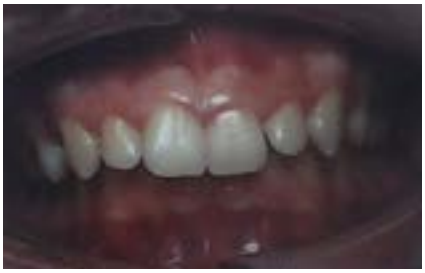


Figure 6B.

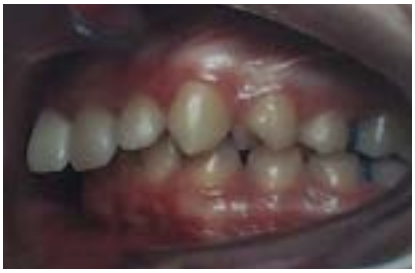


Figure 6C.

Patient 1: During treatment.

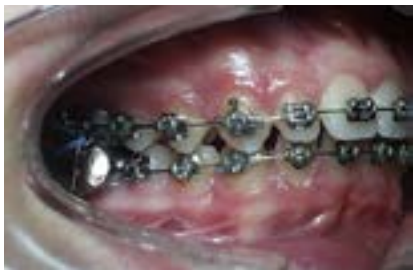


Figure 6D.

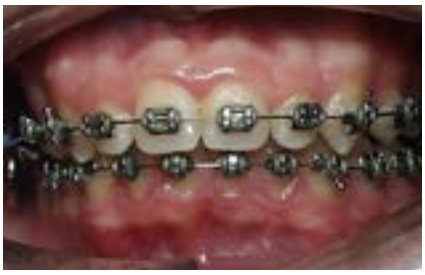


Figure 6E.

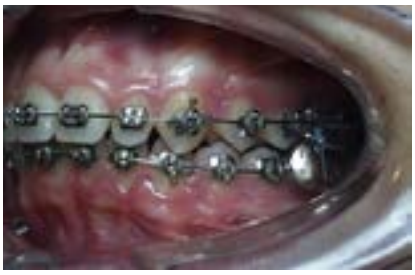


Figure 6F.

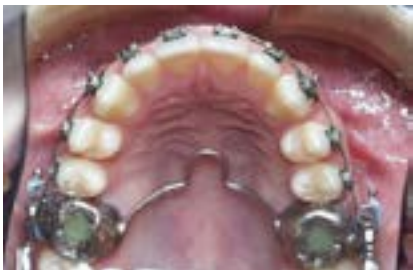


Figure 6G.

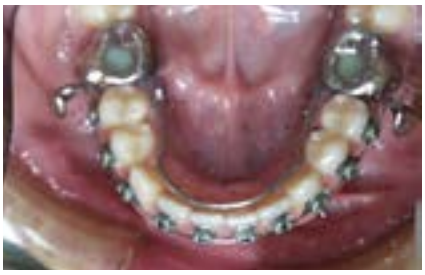


Figure 6H.

Patient 1: Treatment completed.

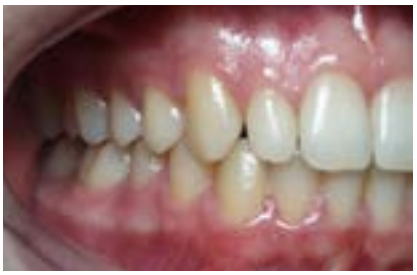


Figure 6I.

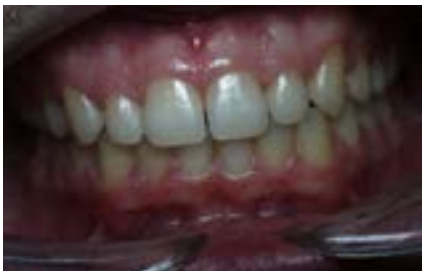


Figure 6J.

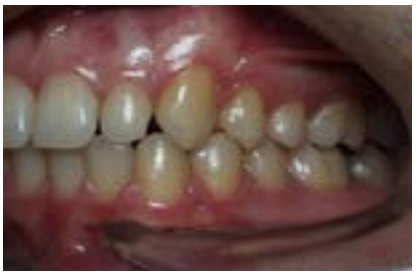


Figure 6K.

Patient 1: Facial profile before and after treatment:

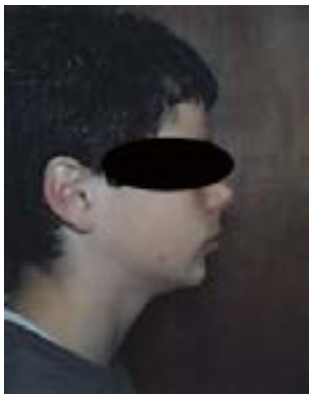


Figure 6L.

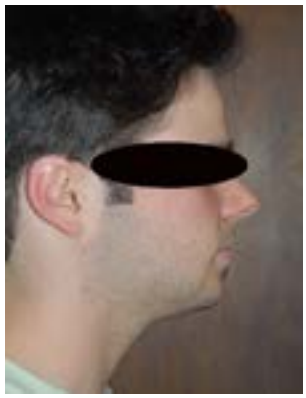


Figure 6M. Note the improvement in the nasio-labial angle.

Appliance-induced mandibular advancement resulting in possible mandibular remodeling with subsequent anteriorly directed growth produces an improvement of the Class II malocclusion. Al-Jewair, Preston, Moll & Dischinger[10] found comparable results.

Maxillary changes

In this study, a change was also noted in the SNA value, with an average reduction of 0,33° which is in accordance with the observations made during other investigations. These results indicate some maxillary growth restriction through the headgear effect produced by the MARA.

Notable intrusion of the first maxillary molars was observed on removal of the MARA. Occlusal and masticatory forces acting on the stainless steel crowns that were placed on these teeth to facilitate anchorage of the device, are responsible for this intrusion. The amount of first molar intrusion also depends on how much the bite is opened after the cementation of the stainless steel crowns. Apparent extrusion of the maxillary second molars was also noted, most probably due to the tip back on the upper first and second molars.

Maxillary-Mandibular changes

The average change obtained in the ANB angle was a reduction of 3,66°, resulting from mandibular anterior repositioning in combination with maxillary growth restriction, producing improvement of the Class II malocclusion.

An average reduction of 3,66 mm in the WITS value was observed after treatment with the MARA. The reduction in the WITS value further indicates a significant improvement of the Class II malocclusion in the treated patients.

The correction of the Class II malocclusions was achieved by several factors of which mandibular growth is the most significant. Other factors include the distalization and intrusion of the maxillary first and second molars together with the mesial movement of the mandibular molars and labial tipping of the lower incisors as well as the headgear effect on the maxilla as a whole.

The changes observed were mostly in the anteroposterior dimension with the vertical alterations being less significant.

Growth direction

Although the Y-axis relationship is viewed with reservation (due to S and SN variability), it was found that the pre-treatment values were relatively normal.

Post-treatment values however showed that there was an average decrease of 2° of this value, indicating a slightly more horizontal pattern of growth which is consistent with mandibular advancement and closing rotation of the chin, contributing to the resolution of the Class II malocclusions.

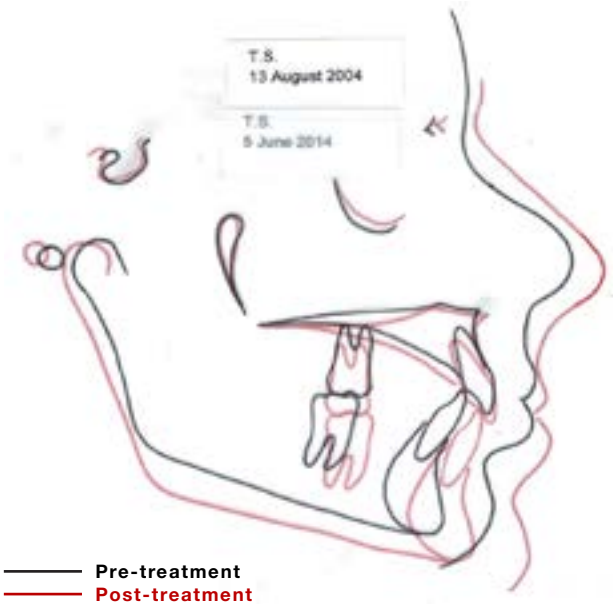


Figure 7A. Superimposition of cephalometric radiographs at Pterygoid fissure (Pt) showing the pre-treatment situation and the total post retention status (10 years later) obtained in case 1.

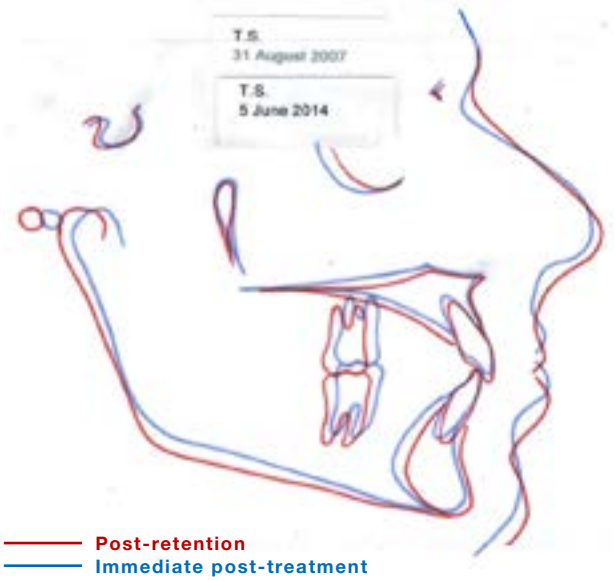


Figure 7B. Superimposition of cephalometric radiographs at Pt-point showing long-term treatment stability obtained in case 1 (±7 years following post retention). No relapse to a Class II malocclusion had occurred following MARA treatment.

Treatment times

The average *total treatment* time of the three cases was 28 months, while the average *MARA treatment time* was 12,7 months. The prolonged treatment times as seen with the first of the above three cases can be ascribed to the relative inexperience of the operator with the handling of the MARA, a conservative amount of appliance activation leading to longer treatment times and patients not necessarily complying with appointment times/schedules.

The accepted time span for the treatment of a Class II malocclusion with a fixed functional appliance like the MARA may vary from each individual case but usually ranges from 6 - 8 months.[4]

Patient 2: Before treatment.

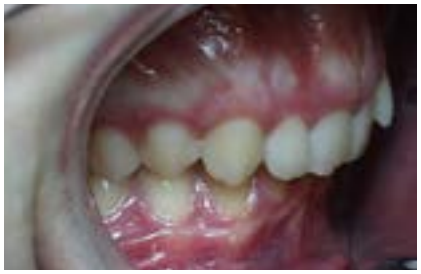


Figure 8A.

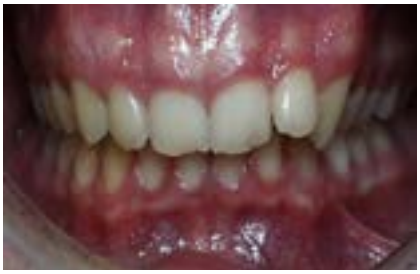


Figure 8B.

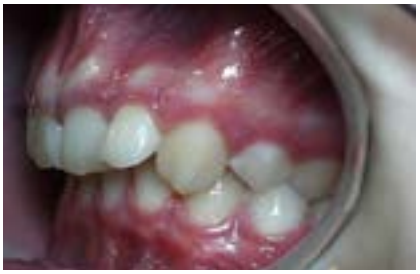


Figure 8C.

Patient 2: During treatment.

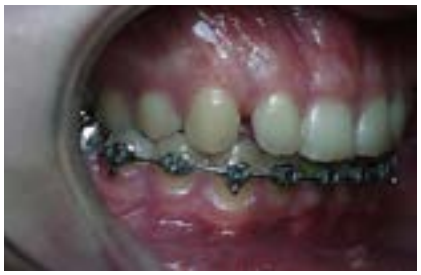


Figure 8D.

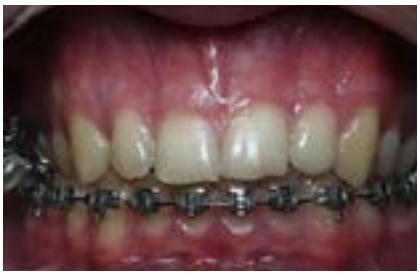


Figure 8E.

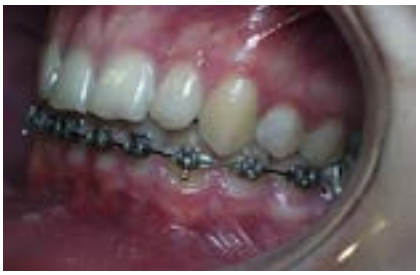


Figure 8F.

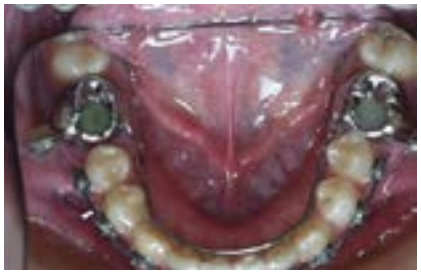


Figure 8G.

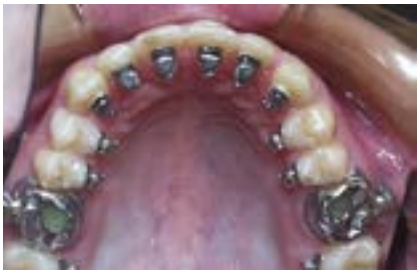


Figure 8H.

Patient 2: Treatment completed.

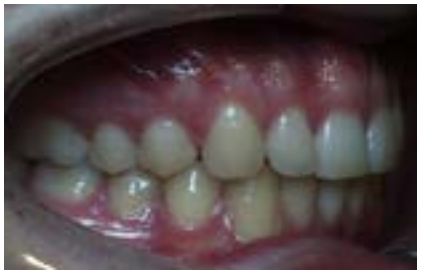


Figure 8I.

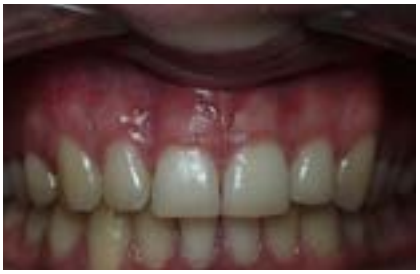


Figure 8J.

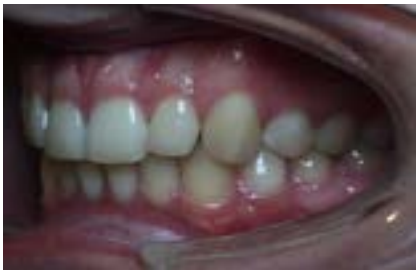


Figure 8K.

Patient 2: Facial profile before and after treatment:

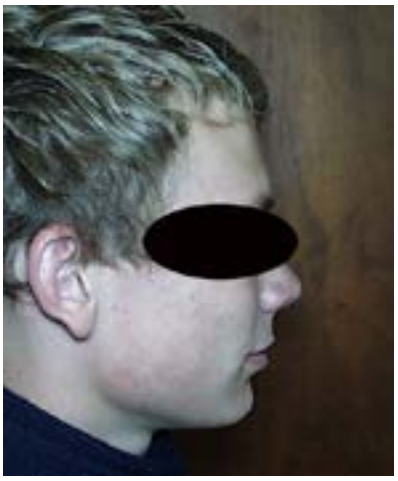


Figure 8L.

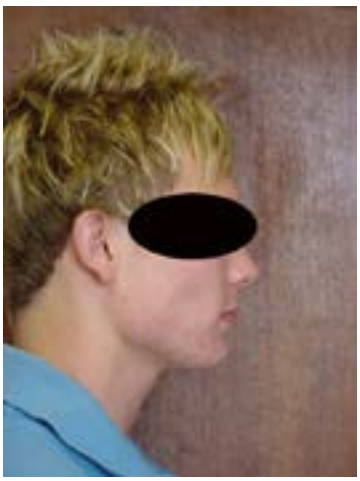


Figure 8M.

Below is a compilation of intra-oral and facial profile images taken prior to, during and after treatment showing the MARA in combination with full fixed appliances. Correction or improvement of the Class II defect is clearly visible in all three cases (Patient 1: **Figure 6a-m**, Patient 2: **Figure 8a-k** & Patient 3: **Figure 10a-j**).

Superimposition of three cephalometric radiographs with reference point at the pterygoid fissure (Pt point) was done. The treatment stages include pre-treatment, directly following treatment and several years after completion of orthodontic treatment.

The images show significant clinical and skeletal improvement of the Class II malocclusions, with the second superimposition demonstrates the post treatment stages to long-term stability of the changes obtained with the MARA (**Figures 7a&b**, **9a&b** and **11a&b**).

The black tracing corresponds with the pre-treatment findings, the blue tracing demonstrates the results immediately following treatment and the red tracing a few years after treatment was completed.

CONCLUSION

The MARA is an effective fixed non-compliance appliance that works well in conjunction with full fixed appliances in the treatment of Class II malocclusions as demonstrated in the three cases reported in this study Treatment time is predictable as seen in the three cases.

The time required during the placement and removal of the MARA is more than compensated by the shorter and fewer follow up visits involved. No or very little patient motivation is necessary.

In the three reviewed cases a favourable facial profile was achieved with the nasolabial angle more desirable than that which would have been obtained with selective extractions and extra-oral traction.

The three subjects presented here may be regarded as uncomplicated cases. Experience over many years in the treatment of several MARA cases with the MARA has shown that more difficult cases can indeed be treated; often with unexpectedly favourable results.

In many of these instances the general consensus would probably have been that orthognathic surgery would be the treatment of choice.

Although orthognathic surgery is integral to the treatment of severe Class II malocclusions, the MARA may be seen as a possible alternative to certain surgical interventions, being especially useful in cases where the patient refuses surgery as a treatment option.

There will of course always be indications and contra-indications for using the MARA and no claims may be made that treatment with the appliance will routinely eliminate the need for surgery in a major percentage of those patients who would otherwise be treated with surgery.

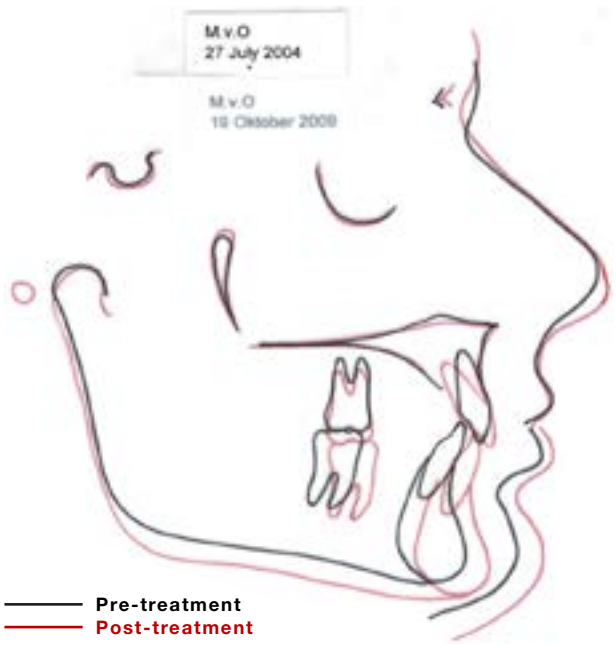


Figure 9A. Superimposition of cephalometric radiographs at Pt-showing the pre-treatment situation and the total post retention changes (5 years later) obtained in case 2.

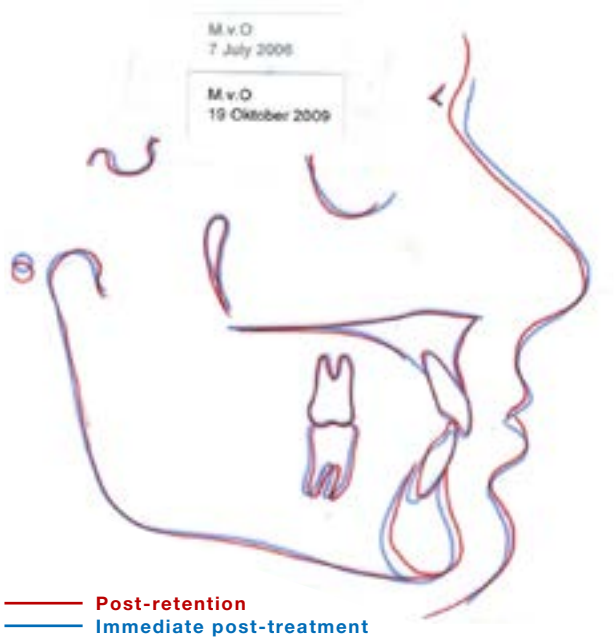


Figure 9B. Superimposition of cephalometric radiographs at Pt-point showing long-term treatment stability obtained in case 2 (±3 years following post retention). No relapse to a Class II malocclusion occurred following MARA treatment.

As always, proper diagnosis, sound judgment as well as full informed consent are important and the clinician should be careful not to create the impression that all surgery could or should be avoided.

References

1. Ghislanzoni LTH, Toll DE, Defraia E, Bacetti T, Franchi L. Treatment and post-treatment outcomes induced by the Mandibular Advancement Repositioning Appliance. Angle Orthod. 2011; 81(4): 684-91.
2. White LW, Eckhart JE. Functional non-extraction treatment. Clinical Impressions. 2009; 17(1): 32-43.

Patient 3: Before treatment.

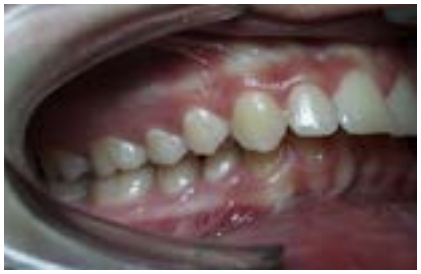


Figure 10A.

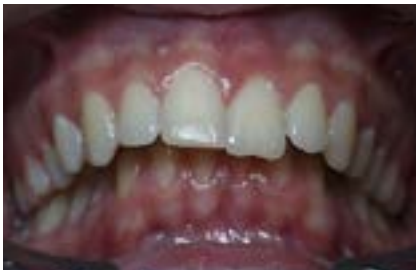


Figure 10B.

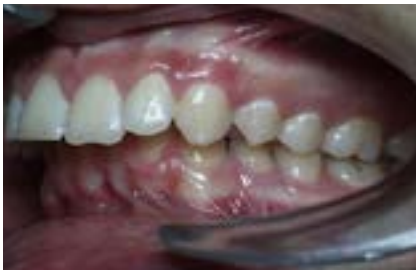


Figure 10C.

Patient 3: During treatment.

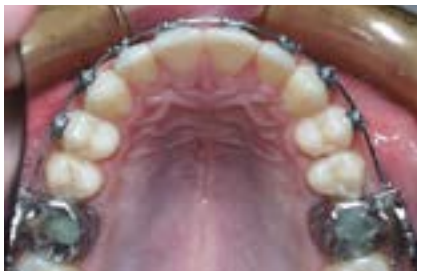


Figure 10D.

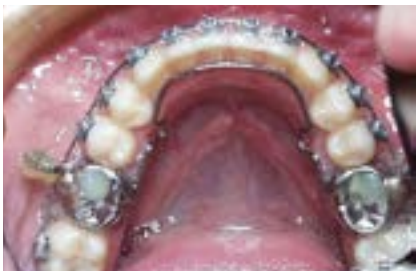


Figure 10E.

Patient 3: Treatment completed.

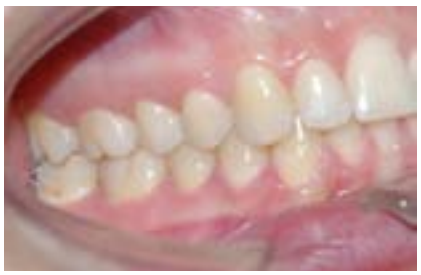


Figure 10F.

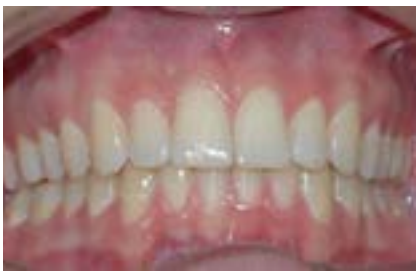


Figure 10G.

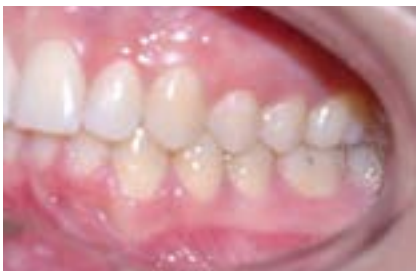


Figure 10H.

Patient 3: Facial profile before and after treatment:

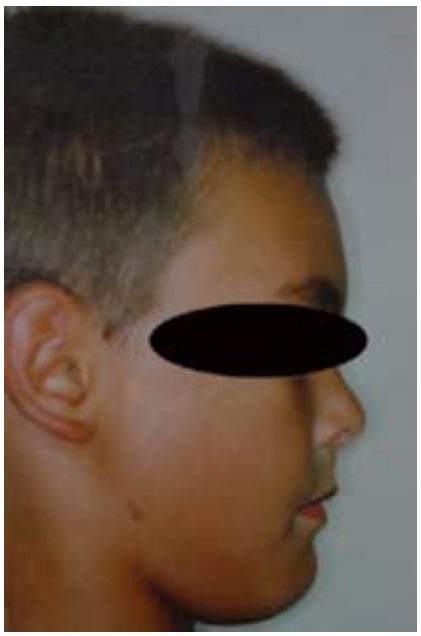


Figure 10I.

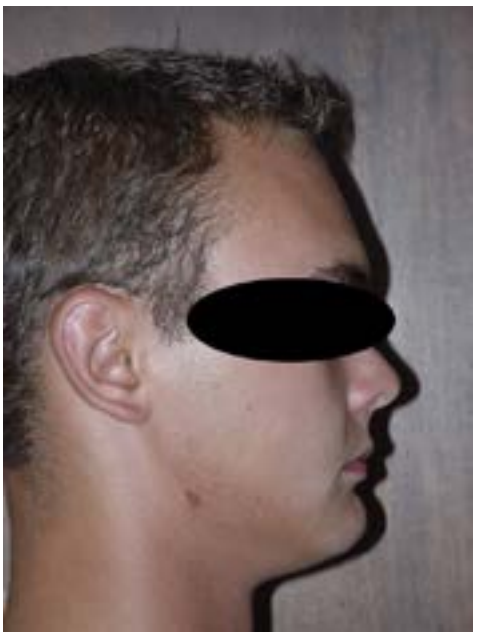


Figure 10J.

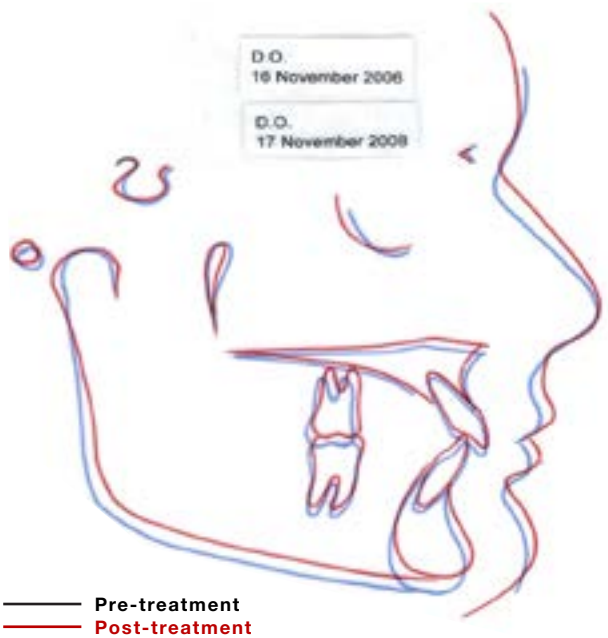


Figure 11A. Superimposition of cephalometric radiographs at Pt-showing the pre-treatment situation and the total post retention changes (5 years later) obtained in case 3.

Figure 11B. Superimposition of cephalometric radiographs at Pt-point showing long-term treatment stability obtained in case 3 (±2 years following post retention). No relapse to a Class II malocclusion occurred following MARA treatment.

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Endodontic treatment of a maxillary second premolar with three roots and three root canals - a case report

SADJ November 2019, Vol. 74 No. 10 p571 - p574

V Bookhan[1], GD Buchanan[2], ZI Vally[3]

SUMMARY

Introduction

There are currently no documented publications on an endodontic procedure performed on a maxillary second premolar with three roots and three root canals within a South African population.

This is a rare root canal configuration (0.3%-2%), which, according to the endodontic literature, can be related to factors such as ethnicity, racial groups, and gender. Familiarity with root canal configurations within various ethnicities and racial groups is important in understanding the nature of the root canal system for successful endodontic procedures.

Objectives

The aim of this case report is to describe endodontics performed on a maxillary second premolar with three roots and three root canals, the patient being a South African female patient of African ethnicity. In addition, consideration is given to a suitable restorative option for the endodontically treated tooth.

The endodontic procedure is described in detail to inform dental practitioners. The diagnosis, location, instrumentation, and obturation of all the canals were successful. The location of the three canals required a large access cavity design that reduced the strength and support of the mineralized tissues. Therefore in this study, the preferred restoration for a maxillary second premolar with three roots and three root canals is a ceramic post crown.

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2. **Glynn D Buchanan:** Co-author - 40%
3. **Zunaid I Vally:** Co-author - 10%

Keywords

Maxillary second premolar, three root canals, endodontic procedure, ceramic post crown

INTRODUCTION

Maxillary second premolars have a variety of root canal configurations.[1,2] The most common configuration is one canal (60%) followed by two canals (40%).[1] The maxillary second premolar with three root canals is rare (0.3%-2%).[1-3,5,6] These configurations, according to the endodontic literature, can be related to factors such as ethnicity, racial groups, and gender.[1-3,5-13]

It is very important to be familiar with root canal configurations which may be characteristic of various ethnic and racial groups because oral health practitioners who understand the nature of the complex root canal system can better locate and negotiate root canals and manage endodontic procedures successfully.[4-6]

The endodontic literature indicates that many countries have published articles on maxillary premolars within their population.[1,4,14-20]

Oral health practitioners are therefore able to familiarize themselves with the various root canal configurations that they may encounter when performing an endodontic procedure within their populations.

No documented publications have been found on endodontic procedures performed on maxillary second premolars with three roots and three root canals within a South African population.

Restoration of the endodontically treated tooth remains a challenge.[21,22] A successful endodontic procedure requires a final restoration to restore the form, function, and aesthetics of the tooth and to improve the long term prognosis[23] An endodontically treated maxillary second premolar is susceptible to fracture because of cusp deflection.[24] It is therefore essential that oral health practitioners choose a suitable restorative option for this tooth to improve the long term prognosis.

The aim of this case report is to describe an endodontic procedure performed on a maxillary second premolar with three roots and three root canals, in a South African female patient of African ethnicity. In addition, the report will consider a suitable restorative option for this tooth after completion of the endodontic procedure.

MATERIALS AND METHODS

A South African female patient of African ethnicity was referred to the Division of Endodontics at the School of Dentistry for the completion of a root canal treatment on a maxillary second premolar with three roots and three root canals. An emergency root canal treatment had been previously performed in 2016.

The tooth was asymptomatic at the initial consultation and had a temporary zinc–oxide eugenol restoration in place. Informed consent was obtained from the patient. A local anesthetic using 2 % Lignocaine (Xylotox E80, Adcock Ingram, South Africa), was administered with 1:80 000 adrenaline content, using the infiltration technique both buccally and palatally.

The tooth was isolated with a nitrile rubber dam (Henry Schein, Gillingham, UK) and the entire procedure completed under a dental operating microscope (Global Surgical Corporation, St. Louis, MO). The temporary restoration was removed using a diamond-coated cylinder bur (Edenta, Hauptstrasse 7, Switzerland) in a fast handpiece.

The residual Ledermix paste (Lederle Pharmaceuticals, Wolfsratshausen, Germany) was rinsed out of the canals using a 3.5% sodium hypochlorite solution (NaOCl, Jik, Reckitt Benckiser, South Africa).

The large oval access cavity design was completed using an Endo Z bur (Dentsply, Maillefer, Switzerland) to outline the walls and cavity floor of the pulp chamber.

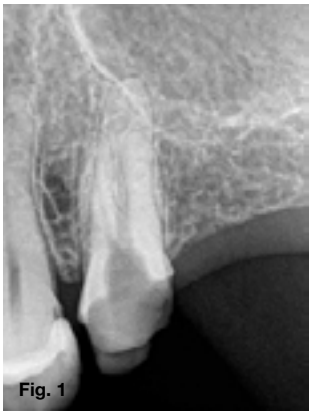
Three distinct canal orifices were identified. The pre-operative diagnostic radiograph demonstrated a palatal canal (P), mesiobuccal (MB) canal and disto-buccal (DB) canal (**Figure 1**).

The following instrumentation procedures were performed:

- Working length determination using periapical radiographs and electronic apex locator (Propex Pixi, Dentsply Maillefer). The length of each canal was established and recorded on the patient's file (**Figure 2**). The canals were scouted and coronal flaring completed using a #10 K-file.
- The glide path was prepared in all canals using a Proglider glide path file (Dentsply Maillefer, Ballaigues, Switzerland).
- The mesiobuccal and distobuccal canals were prepared using WaveOne Gold Primary reciprocating files (Dentsply Maillefer, Ballaigues, Switzerland).
- The palatal canal was initially prepared with a WaveOne Gold primary file and then further enlarged with a ProTaper Gold F3 and F4 file (Dentsply Maillefer, Ballaigues, Switzerland).
- Irrigation of the canals was performed using a 3,5% NaOCl solution (Jik, South Africa) and a penultimate rinse of 17% EDTA liquid (Top clear EDTA) was used to remove the smear layer.
- Obturation (**Figure 3**) was completed using matching taper gutta-percha cones and BioRoot RCB Bioceramic sealer (Septodont, Saint Maur Des Fosses, France).

The single cone technique was used in the MB and DB canals and the conventional cold lateral condensation technique in the P canal. The excess sealer was removed using ultrasonics and water.

- The orifices were sealed with a resin-modified glass ionomer (Vitrebond, 3M ESPE, St. Paul, MN) and a final bonded composite restoration (Filtek Supreme XTE, 3M ESPE, St. Paul, MN, **Figure 4**).
- The entire procedure was completed in a single session.
- The patient was referred to the restorative clinic for a ceramic crown supported by a fibre post and composite core restoration on the 25 and replacement of the DO restoration on the 24 which had been affected by recurrent caries.



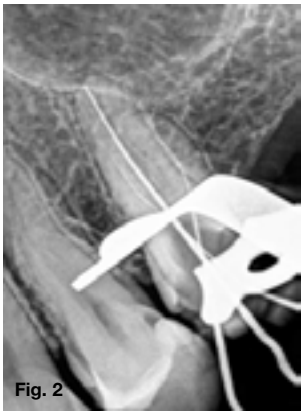
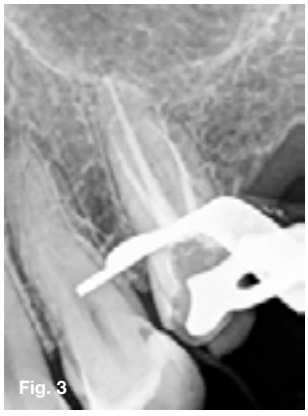


Figure 1. Pre-operative diagnostic radiograph.
Figure 2. Radiographic image of working length determination.



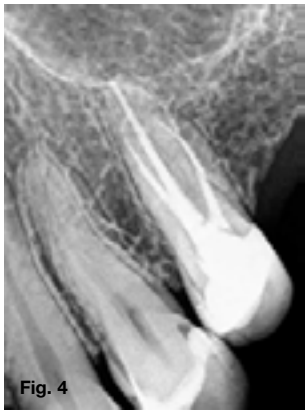


Figure 3. Radiographic image of obturation of 3 canals.
Figure 4. Radiographic image of completed endodontic treatment and composite restoration.

RESULTS

The diagnosis, location, instrumentation, and obturation of all three canals were successful.

DISCUSSION

Endodontic treatment of maxillary premolars remains a challenge because of the variety of root numbers and root canal configurations.[1,2] It is important to identify all the root canals to ensure that the oral health practitioner can endodontically manage all the canals successfully.[1,3-5,7]

The location, negotiation, and obturation of each root canal require the accurate interpretation of radiographic images.[1] During endodontic treatment, periapical radiographic images are frequently used for identifying the number of roots and root canals of teeth with a variety of configurations in order to make an accurate diagnosis.[1,7,9,11,12]

However these radiographs provide only a two-dimensional image and it may be necessary to take radiographic images from multiple angles to ensure that the additional canals within the three-dimensional root are not missed by the oral healthcare practitioner.[1,7,9,15,12]

Cone beam computed tomography (CBCT) is another accurate option for consideration as it allows a three-dimensional view of teeth with complex root canal variations.[21-24] In this case the diagnosis, location, negotiation, and obturation of the patient's maxillary second premolar was completed without the need for radiographic images from multiple angles since all the canals and roots were clearly visible on the initial radiographic image (**Figure 1**).

Magnification of the operating field using the dental operating microscope ensured improved visual acuity and favorable ergonomics for the oral health care practitioner resulting in an efficient and effective endodontic procedure.[25]

This variation of the maxillary second premolar with three roots and three root canals demonstrated morphology similar to the maxillary premolars described in the international endodontic literature.[1,4,14-20]

Research involving the maxillary second premolar within a South African population is required to determine if other similarities or differences exist so that the results can be compared with the published research results of other countries.

The restoration of an endodontically treated premolar can be a challenge because the tooth is prone to fracture due to cusp deflection.[26-28] It is therefore advisable to restore form and function with a reliable long term final restoration such as a bonded ceramic restoration that provides cuspal coverage.[28,29]

The success of the final restoration, however, depends on the structure of the remaining tooth.[29,30] Accommodating straight-line access of three endodontic files into the openings of three root canal apertures frequently requires the destruction of a large part of the tooth crown.[1,2]

The ideal access cavity for a maxillary premolar with three canals is the classic "T shape" with two buccal canals (mesial and distal) and one palatal canal.[2] However a more frequent design, due to caries destruction, is the oval-shaped access cavity and that may compromise the structure and strength of the mineralized tissues of the natural crown.[2]

This results in the natural tooth having insufficient support and strength to support the recommended ceramic restoration. Resistance and retention features to support the ceramic restoration must then be borrowed from the walls of the root canal space, applying adhesive techniques and the use of fibre-reinforced composite posts.[29,30]

A ceramic restoration with cuspal coverage with or without the use of a fibre reinforced composite post is the preferred restoration.[29,31] The oral health care practitioner should, therefore, ensure that the root canal space selected to receive the post is instrumented to a sufficiently wide degree and to check that the root has sufficient length to accommodate a fibre-reinforced composite post.

This case report suggests that the palatal root canal space of a second maxillary premolar is the preferred root canal space to receive a fibre-reinforced composite post. The following factors must, therefore, be taken into consideration before entering the restorative phase of a maxillary second premolar:

1. Affordability (can the patient afford to pay for the ceramic crown),
2. Design of the retention space (can the root and root canal space support a post and core).
3. The health of the periodontium (is the periodontal status and oral hygiene favourable).
4. The abutment design (can the abutment incorporate a ferrule design to support a post and core).

If the answer to any of the above factors is a "no", then an alternative treatment plan, suitable for the particular patient, should be considered.

CONCLUSION

Anatomical variations of premolars have a direct effect on the diagnosis, treatment plan and prognosis of endodontic treatment.[32] This case report is intended to help oral health care practitioners improve their awareness of the procedural and restorative challenges that they may face when performing endodontic treatment on a maxillary second premolar with three roots and three canals.

The location of all three canals required a large access cavity design that reduced the strength and support of the mineralized tissues. The suggested long term restoration for such a maxillary second premolar is a bonded ceramic restoration that provides cuspal coverage with a fibre reinforced composite post.

Patient consent

The authors certify that consent for the procedure performed on the patient was obtained. A waiver of informed consent for the publication of this case study was obtained from the Research Ethics Committee.

The patient's identity was not disclosed.

Conflict of interest

No conflict of interest is declared by the authors.

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Denturism (Clinical Dental Technology) - a brief review

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CP Owen

SUMMARY

The term 'denturism' is most commonly used worldwide for either dental technicians who are trained clinically, usually in removable prosthodontics, or for people who are trained specifically in that field to carry out both the laboratory and clinical procedures.

In South Africa the term used is 'clinical dental technologist' and was introduced as an amendment to the Dental Technicians Act in 1997. However, this oral health professional has never been defined and no regulations have been promulgated.

The South African Dental Technician's Council will be investigating the appropriate regulatory framework to provide for the enactment of clinical dental technology, and so the purpose of this paper is to give some background to denturism in general and to make suggestions as to the guidelines to be followed were it to be established in South Africa.

Keywords

Denturism, denturist, dental prosthetist, clinical dental technologist.

INTRODUCTION

"Denturism" is the most commonly used term worldwide for what is essentially a clinical dental technologist. The latter term has entered the legislation in South Africa but this has never been enacted.

In this brief review, the term "denturism" will be used throughout. The South African Dental Technician's Council will be investigating the appropriate regulatory framework to provide for the enactment of clinical dental technology, and so it was felt that some background to this profession may be useful.

A brief history

Denturism had a somewhat patchy start in different parts of the world, but seems to have developed from wartime experiences, emerging as dental technology from the 1914-18 war when dental assistants were trained to help military dentists not only at the chairside but also in the laboratory.[1] Subsequently some remained as dental technicians in independent laboratories.

However, during the depression years, it was discovered that some dental technicians were providing a clandestine service and this seems to have been the origin of the subsequent and ongoing distrust between dentists and technicians.

In Canada these dental technicians started to organise amongst themselves and by the mid-1970s were known as Denturists. Only two Canadian provinces still prohibit denturism. The same appeared to have happened in New Zealand, a country which was the first to introduce a range of dental auxiliaries, including denturists.

Several countries now allow for denturists, though each with different legislation governing their scopes of practise. These include all but two of the provinces of Canada, New Zealand, Australia, five states of the USA, Belgium, Denmark, Holland, Malta, Finland, Poland, Iraq, Israel and Switzerland.

In the UK, there has been quite vehement opposition to denturism and the British Dental Association (not unlike the South African Dental Association) is a strong political force that is antagonistic toward the profession (although in the scope of maxillo-facial prosthodontics, dental technicians are allowed to be in contact with patients, but only for extra-oral prostheses).[2]

There has been very little published in peer-review journals concerning denturism, but much emotive and anecdotal information can be found on the internet.

This brief review will only look at peer-reviewed articles and try to draw some conclusions that may be pertinent to South Africa.

Scope of practice

This seems to vary from treating only edentulous patients to the provision of all removable prostheses. Most countries seem to have started with the treatment of edentulous patients and some have then expanded this to include removable partial dentures (RPDs).

In four of the five states in the US that allow denturism, denturists must practice under the supervision of a dentist. Only in Oregon can they enter independent

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practice. In Finland, denturists are only licensed to provide a complete denture service (including relining and repairing) for "an already edentulous jaw free of pathological or congenital anomalies".[3] However, a large number of RPDs are carried out illegally by denturists as well as dental technicians, often when a patient requires a complete denture as well as an RPD.

The study concluded by stating that "The results of this study give reason to believe that denturists' right to provide complete dentures directly to the public leads to illegal provision of partial dentures as well" which must be of some concern to any country wishing to introduce denturism.

In New Zealand, denturists provide complete dentures as well as RPDs, but a dentist must provide on oral health certificate before a denturist can treat patients for RPDs.[4] Four out of five denturists reported that they provide both metal and acrylic-based RPDs.

In Australia denturists are registered to manufacture complete dentures, partial dentures, and mouthguards.[5]

Education

Very little has been published on the training of denturists. In Canada, it appears that there is little or no training in pathology or diagnoses[1] and in some provinces denturists must, prior to undertaking treatment, refer patients to dentists for confirmation that the mouth is sufficiently healthy to support a denture.

In an Australian survey of denturists, 99% of respondents reported that they checked new patients and 86% checked recall patients for oral mucosal pathology; 86% reported that they had detected a suspicious lesion and 77% had referred for a suspicious lesion.[5]

An advanced diploma of dental prosthetics in that country is completed part-time over two years, comprising 20 units of study.[5] However, because only a single unit is devoted to oral mucosal pathology, there have been calls to increase the length and level of training to a 3-year bachelor's degree.

In a 1994 review of denturism in Canada,[1] MacEntee pointed out that the dentists, dental technicians, and denturists operated largely in ignorance of each other and with considerable distrust, and this may have been due to the fact that education and training was entirely separate.

A working group of the International Federation of Dental Educators and Associations recommended in 2008 that "all members of the oral health team, to the extent possible, should be educated/trained together, in order that they may understand the roles they play as members of the team".[6]

The same group reported that the length of training of denturists varied throughout the world, from 18 months to three years, and part-time to full-time.[6] There appears to be no common internationally accepted core curriculum.

Economic issues

In most countries there has been a perceived benefit that competition for the provision of dentures would bring down the costs and indeed Denturist Associations have used this as a major motivating factor, such as in Australia and some states in the US.

In other countries, the Denturist Associations have claimed that they can provide a better or more satisfactory service.[1] This was the argument in the UK and Ireland, and has also been put forward in South Africa.

However, not only is there no objective clinical evidence of a superior service, but there is no evidence that the cost of denture provision is substantially different between denturists and dentists, especially in countries with a fairly robust national public health service with a regulated fee structure (which may be the case here in South Africa with the proposed National Health Insurance).

In New Zealand, although most denturists provide both metal and acrylic-based RPDs, the fees charged for the acrylic based RPDs were similar to those charged by dentists.[4]

In the USA, denturist services did not seem to be improving accessibility to low-income patients; it was felt that this was because denturists and dentists were serving patient groups from similar socio-economic backgrounds.[3] In Finland, the availability of denture services in remote areas had not improved because both denturists and dentists were concentrated in the larger cities.[3]

In emerging economies such as South Africa, where almost all dental and laboratory equipment and supplies are imported, the overhead costs for a dentist and a denturist are likely to be fairly similar. How this will translate into lower costs for the patient, is not known.

It has been recommended that for emerging economies, the denturist should form part of the oral health team.[6,7] This is because public funding (which is supposed to improve access) is likely to only be feasible if the workforce takes on shared responsibilities; which means that each member of the oral health team should provide competent and cost-effective care appropriate to their level. That is the main economic argument for the inclusion of denturists in that team.[6]

Quality of service

The fear expressed by especially some dental associations, that denturists would be unable to cope with denture-induced conditions could be allayed by better cooperation between dentists and denturists, including cross referrals. Patients with resorbed ridges often complain of looseness and an inability to chew and many dentists refer such patients to specialists.

Similarly, denturists should be encouraged to refer. Complaints such as denture stomatitis and denture-induced hyperplasia respond favourably to improved oral hygiene and minor denture adjustment;[1] so if dentists

could provide a diagnostic service for denturists this could alleviate any fears and denturists might blend in better as part of the oral health team.

In a study of the clinical quality of removable dentures provided by dentists, denturists and laboratory technicians in Finland, it was found that dentures provided illegally, whether complete or partial, had significantly higher occurrences of 'unacceptable characteristics', such as poor stability when speaking and eating, and 'food often catches underneath'. However, there seemed to be few differences between prostheses provided by dentists and denturists.[8]

Occupational health

Only one study could be found on the occupational health hazards in denturists, but it did not separate the hazards into those arising from clinical work from those arising from work in the laboratory. Nevertheless, denturists and those advocating for denturism should take note of some of the findings.

Clinical work on patients means an exposure to the risk of infection, notably from such biological contaminants as Hepatitis B and C. There is a known relationship between the occurrence of back pain and paraesthesia in the arms and fingers, and this has been related to the long working hours of denturists (average 12–13 hours).[9] In a study of Polish denturists the most common (defined as occurring daily or at least once a week) health problems were: back pain (70%); chronic fatigue syndrome (62%); irritation, itching and rashes on the hands (51%); restlessness and aggression (43%); and watery and itchy eyes (42%).[9]

Professional relations

In New Zealand there appears to be a good relationship between dentists and denturists, with a relatively high proportion referring to each other.[4] It is not clear, however, just what clinical procedures are carried out for the provision of RPDs (such as modification of the teeth to receive rests and guide planes) as this has not been reported in the literature.

In Finland, it was found that dentists and denturists in small towns or rural areas cooperated more often than those in urban areas.[10] An investigation into the attitudes of dentists towards auxiliaries found that in Belgium and Greece, there was little or no support for any auxiliaries compared with the other countries investigated (Finland, UK, Canada and New Zealand), where the use of dental hygienists was supported, but not therapists and denturists.[11]

CONCLUSION

There seems little doubt from reported experiences around the world, that denturists can provide a valuable service in the provision of removable prostheses.

However, there would seem to be several caveats for this to happen without any detriment to the patient (or indeed to either profession).

These are:

1. The relationship between dentists and denturists needs to be respectful, cooperative and mutually supportive. This requires the acceptance by the dental profession and its associations of the principle of denturism.
2. The training of denturists must include the recognition of oral mucosal pathology.
3. If licensed for removable partial dentures, the design of the denture and the modification of the teeth must be carried out by a dentist.
4. Denturists, through their training, must understand when to refer cases which may be beyond their ability to treat successfully.
5. The scope of practice must be clearly regulated and based on the clinical treatment needs of the country as assessed scientifically.
6. It is suggested that initially, the scope should be confined to the edentulous patient only, and that scientific monitoring and evaluation of the services provided be undertaken independently, with a comparative monitoring and evaluation of general dental practitioners providing similar services.
7. The education and training could take a variety of forms. For example, from a post-graduation (from dental technology) course to a dedicated course only covering the scope of practice of the denturist as defined.
8. The dental profession (and preferably prosthodontists) must undertake the clinical aspects of the education and training of any category of denturist.

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

SADJ November 2019, Vol. 74 No. 10 p578 - p581

Compiled and edited by V Yengopal

1. Digital versus conventional impression method in children

H Yilmaz, MN Aydin. Int J Paediatr Dent. 2019; 29: 728-35.

Since the emergence of 3D systems, research has been conducted to examine their accuracy and reliability, and only clinically insignificant differences have been shown in the precision of conventional and digital methods.[1]

In orthodontics and in paediatric dentistry, impressions are taken from children for diagnosis and treatment procedures. Today, a digital change is evident in dentistry in the field of impression taking. This is because with the development of the systems in this field, a complete change can be expected in the impression-taking procedure, often considered as the worst experience by patients and children.[1]

In addition to that, the comfort of impression methods and the time required are important because it is known that children are more stressed in their encounters with the dentist than the elderly, and their chairside times are shorter.

Yilmaz & Aydin[1] reported on a trial that sought to compare impression-dependent factors between digital and conventional methods (eg. gag reflex, queasiness, smell/taste, heat/cold, and so forth) and the time required to take impressions in children (7-13 years old).

The null hypothesis was that there were no significant differences between conventional and digital impression-taking methods in terms of comfort and the total time required for impression taking.

MATERIALS AND METHODS

A total of 30 children were considered for this crossover trial. The study, however, was conducted on 28 children (17 girls and 11 boys - mean age = 10.16 ± 1.77) as one patient did not come to his appointments, and one patient decided to quit the study.

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When including individuals in the study, patients who needed conventional impressions for the fabrication of a fixed or removable appliances were selected in addition to the digital impressions taken as a routine diagnostic record.

This was considered as a prerequisite. Those individuals who met the pre-requisites were included in the study. The following criteria were also considered: not to have previously experienced digital or conventional impression taking, not to have temporomandibular joint and periodontal discomfort, and not to be using psychiatric or neuropathic drugs.

The study was a crossover design and included digital and conventional impressions taken by one operator at 14- to 21-day intervals from the same patient. The operator assessed both impression-taking methods for the presence/absence of squeezing, hand/arm/foot movement, breathing difficulties, queasiness, gag reflex, vomiting, and crying in the patient and scored the procedure between 0 and 100.

Following that, the patient was asked to report his or her feeling of general discomfort, difficulty breathing, smell/taste discomfort, heat/cold disturbance, queasiness, gag reflex, and a pain spot. The patient responses were recorded by using a 100-mm VAS index, which was supported with facial emojis designed specifically for children.

Digital impressions were taken by using an up-to-date intraoral scanner (Trios 3-Cart, Color-2017, 3shape, Denmark) - adhering to the scanning pattern recommended by the company for routine diagnosis and recording.

In the upper jaw, the occlusal, buccal, and lingual surfaces of the teeth and the palate were scanned. In the lower jaw, the occlusal, lingual, and buccal surfaces of the teeth were scanned in the order given.

The intraoral scanning process was divided into the patient registration, lower jaw scan, upper jaw scan, and bite scan stages considering the progress of the process with the device.

The time was paused by the observer at each stage which was recorded separately. A follow-up appointment was arranged for the patient to visit the clinic 14-21 days later, and then the patient underwent the conventional impression-taking procedure.

Alginate was used for conventional impression taking and was hand-mixed. Similarly, as with the digital impression method, the same sequence of operations was recorded separately in the four stages: tray selection, lower jaw impression, upper jaw impression, and bite registration with wax.

In both impression methods, care was taken not to allow any missing space on all occlusal, buccal, and lingual surfaces. When these did occur, the missing areas were scanned in the digital impressions, and impressions were retaken in the conventional method.

RESULTS

The mean age of the 28 paediatric patients included in the study was 10.16 ± 1.77 (range = 7.08-12.92), and 60.7% were girls. Mean durations of patient registration/tray selection, lower jaw scan/impression, and total scan/impression did not differ between the digital and conventional impression-taking groups ($P > .05$).

The mean duration of the upper jaw scan/impression, however, was found to be significantly shorter in the digital impression group ($P = .008$), whereas the bite scan/registration took less time in the conventional impression group ($P < .001$).

When the two groups were compared in terms of patient comfort, the total discomfort score ($P < .001$) assessed by the clinician and the average VAS score ($P < .001$) provided by the patient were found to favour the digital impression group. The total discomfort score had seven different criteria, which were recorded by the clinician. When that score was compared with the average VAS score completed by the patient, the values were found to be similar in terms of assessing patient comfort ($P < .001$).

Patients' preferences, determined according to questions prepared for comparison of the two methods after the patients' impression experiences, showed that patients preferred the digital impression taking format, and reported it to be more comfortable, and less stressful than the conventional impression-taking method ($P < 0.01$)

CONCLUSION

Although digital impressions and conventional impressions each had specific superiorities at different stages of impression taking, the methods were similar in terms of the time required to take impressions. When the comfort of the impression methods was assessed using the VAS scores by the children and the observer clinician, the digital impression method was considered to be more comfortable than the conventional method in both scoring methods. According to the questionnaire investigating preference for the method of impression taking, most of the children preferred the digital method.

Implications for practice:

More comfortable digital systems are available for impression taking among children who seem to show preference for this compared with the conventional impressions which many dislike.

Reference

1. Yilmaz H, Aydin MN. Digital versus conventional impression method in children: Comfort, preference and time. Int J Paediatr Dent. 2019; 29: 728-35.

2. Should we be placing linings under composite resins?

I Blum, N Wilson. Br Dent J. 2019; 226, 749-52.

Composite resin fillings, especially in the developed world, have become the gold standard for both anterior and posterior fillings.

This increase has been attributed to various factors, including: increasing patient demand for tooth-coloured restorations; developments in composite and adhesive technologies; improvements in the handling characteristics of composites and related adhesive systems; the introduction of faster and easier composite placement techniques and facilitating devices, and reduced concerns over the longevity of posterior composites, together with encouraging data on the efficacy of composite repairs; the phase-down in the use of dental amalgam; and the progressive shift toward preventatively-orientated, minimum intervention approaches to the restoration of posterior teeth.[1]

There is now good evidence that does not support the placement of a lining (liner, base or combinations thereof) under posterior composites, irrespective of the depth of the preparation, except in situations where the lining is intended to have therapeutic pulpal effects in deep cavities,[1] makes composites quicker and easier. The consequences of the clinical approach of 'no more linings' under composites based on published evidence includes:

- **The need to review relevant teaching**

Composites have been taught in dental schools in many countries around the world and for most it remains the material of choice for restoring anterior teeth as well as occlusal and occluso-proximal defects in posterior teeth.[1] However, important variations in teaching have been reported, notably variations in the selection of liners, base materials and lining techniques.[1]

Many dental schools have recently been found to recommend the use of a glass-ionomer (GI) material to line specifically deep cavities to replace dentine and on the understanding that, in bonding to dentine, GI's hermetically seal off the floor and, when present, axial walls of the cavity. In addition, it remains a widely held view that the anti-bacterial effects of fluoride release from GI bases are clinically significant throughout the clinical service of the restoration. Such thinking is considered misguided.[1]

- **The challenge to change custom and practice in conservative (operative) dentistry**

It will be no mean feat to achieve the change to the widespread practice of no more linings under composites. Perhaps the greatest concerns to overcome are the potential damage to the pulp and an increased incidence of postoperative sensitivity, both of which may have negative effects on patient satisfaction and, in turn, diminish confidence in a practitioner and practice.[1]

There are published studies that have reported an increase in microleakage, postoperative sensitivity and secondary caries when a lining is present under a posterior composite.

- **The need to adopt new approaches to the management of caries**

Traditionally, dental schools have taught that all caries, except possibly for some residual softened, unstained dentine close to the pulp, should be removed before proceeding to restore a tooth. Evidence has now been presented that states that once isolated from their source of nutrition by a restoration of sufficient integrity, bacteria in caries either die or remain dormant and therefore pose no risk to the tooth. Thus, 'the seal is the deal'.

There is also substantial evidence that removing all caries in an asymptomatic, vital tooth is not required, especially if one is attempting to avoid pulpal exposure.[1] Indeed, there is increasing evidence that continuing to excavate until the base of the preparation is formed of hard, albeit somewhat discoloured dentine, may do more harm than good.

- **Increased reliance on adhesive bonding**

If more caries is to be left in the base of preparations, practitioners may reasonably seek new reassurances on the nature, adequacy and durability of the bond formed between dental adhesive and residual caries-affected dentine in unlined cavities.

If this bond suffers certain limitations, does it mean that the integrity of the bond along the cavosurface margin is all the more critical? And what may be the consequences of this bond failing?

Practitioners asking such questions may take comfort as there is published evidence that there is an increase in microleakage, postoperative sensitivity and potentially secondary caries when a lining is present under a posterior composite. Also evidence has showed that the sealing effect of bonding agents on different dentine substrates provides adequate protection and renders the dentine insensitive, reducing or eliminating postoperative sensitivity and the possible adverse effects of resins on the pulp.[1]

- **Reductions in the time taken to place composite restorations**

With no need to place a lining, which may be compound sub-base and base, let alone the use of deep cure composites and simplified caries management, it is anticipated that placement times for state-of-the-art posterior composites will be found to be similar, not significantly different to those for traditional direct restorations of dental amalgam.

- **Enhanced biomechanics of restored tooth units**

Studies investigating the longevity and reasons for failure of complex posterior composites placed with or without a lining, found that posterior composites placed on top of a GI lining suffered more fractures than posterior composites placed using a total-etch technique.[1] A more recent Cochrane review concluded that 'using a liner is an unnecessary step in routine composite-based restorations in adult posterior teeth'.[1]

- **Simplified repair protocols**

Repair rather than replacement of failing restorations is now widely taught.[1] From the growing body of evidence on the benefits and efficacy of repairs, it is suggested that the repair of posterior composites which have been placed without a lining, rather than lined, will be found to be quicker and simpler with the possibility of enhanced performance in clinical service.

- **Increased restoration longevity**

Posterior composites without linings may remain in clinical service longer than composites with linings. With the prospect of repairs to unlined composites being more efficacious than repairs to lined composites, it may be anticipated that the longevity of unlined composites which are well maintained in clinical service, will exceed the longevity of lined composites.

Any measure which effects an increase in restoration longevity has an important impact on 'teeth for life' through a slowing down of the 'restorative cycle' and, as such, should be adopted. Available evidence favours the adoption of 'no more lining' under composites for this very reason.

Implications for practice

The review article provides evidence of the progress that has been made in term of new approaches to restoring teeth with new generation composite materials. It requires a mind-set change from many colleagues who have been taught differently and provides further evidence of the need for practitioners to keep up to date with the latest evidence guiding clinical practice.

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Do the CPD questionnaire on page 587

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.

Online CPD in 6 Easy Steps

1 Go to the SADA website www.sada.co.za.

2 Log into the 'member only' section with your unique SADA username and password.

3 Select the CPD navigation tab.

4 Select the questionnaire that you wish to complete.

5 Enter your multiple choice answers. Please note that you have two attempts to obtain at least 70%.

6 View and print your CPD certificate.

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Ethical dilemmas when dealing with doctor Google and the importance of patient education

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LM Sykes[1], E Crafford[2], C Bradfield[3], C Johnson[4]

CASE REPORT

A 55 year old female patient presented for dental treatment. Her attending clinician immediately noted that since her first visit some days previously she had shaved her head, revealing a severe rash on her right forehead and scalp (Figure 1).

The rash extended from her right eye inferiorly to the coronal suture superiorly. It ended abruptly in the midline mesially and along a distinctly demarcated line just above her ear laterally.

The entire area of skin within these borders was fiery red with many large crusted areas. Her right iris was also reddened and the eye itself watery (Figure 2).

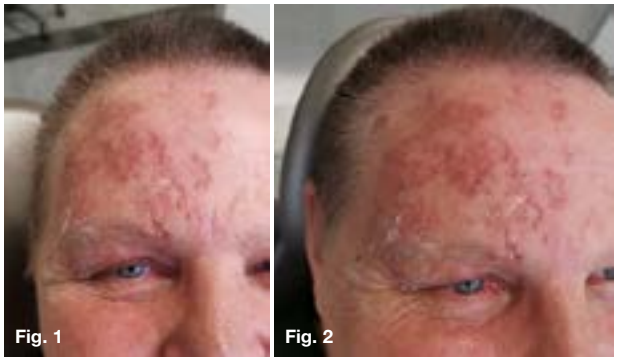

Figure 1. Unilateral spread of skin rash.

Figure 2. Ocular involvement of viral infection.
Photographs printed with kind permission of the patient.

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4. **Chalita Johnson:** Treating student - 10%

ACRONYM

VZV: Varicella-Zoster Virus

On questioning, she reported that about a week earlier she had developed a sudden and severe headache with itching of her scalp. She had taken some aspirin for the pain and rubbed Aloe Vera gel on her head to try to calm the itch. Almost immediately she noticed that her entire body started to become hot and itchy.

She rushed to her pharmacist who diagnosed a severe allergic reaction to the gel and gave her a dose of corticosteroids. This helped with the reaction and itch on her body, however the head rash persisted and worsened over the next few days.

The dentist was skeptical about this diagnosis especially in light of the persistent lesions and their distinct unilateral location. On further questioning she revealed that she had been feeling very tired that day and was sitting in the sun resting when the symptoms developed. Given the history, reported signs and symptoms, and classical appearance of her condition, the dentist suspected that she had been mis-diagnosed, and that she was suffering from an intense case of varicella-zoster virus (VZV) infection, worsened by an allergic reaction.

The patient was informed about the aetiology and pathophysiology of this viral infection. During this process of patient education, she remembered more of her own details, which all conformed to the classic picture of VZV infection. (For a brief description see ** on p584). She was advised to visit a medical practitioner, but chose to rather wait and see how she felt. Fortunately her lesions resolved slowly and uneventfully over the following five weeks.

This case scenario illustrates the commonly seen situation where patients first self-diagnose and self-medicate, and only later seek help if their symptoms don't improve. Her initial use of the Aloe gel led to an allergic reaction that the pharmacist subsequently treated with cortisone.

While this was appropriate for the allergy, he did not look deeper into the history of her complaints and failed to identify the very obvious VZV lesions on her head.

Had he done so, he should have known that cortisone is contra-indicated in viral infections as it suppresses the immune system and thus makes it harder for the body to fight the virus.[1,2] As expected, her infection worsened.

When she arrived at the dental clinic, the dentist was the first to take a thorough history including an extra-oral and intra-oral examination. She recognized all of the indicators that suggested the patient was suffering from a VZV infection, and advised her to go for further allergy tests as well as a thorough medical check up to confirm her suspicions.

Unfortunately, at this stage nobody had paid much attention to the fact that the virus had already invaded the optic nerve which could lead to scarring or even blindness. Had she been sent for special tests immediately, she could have been given antiviral medication to prevent this potentially sinister spread.

Ethical questions that need to considered

In this case the pharmacist diagnosed and prescribed medication for a condition that he was not trained to manage. In addition steroids are classified as Schedule 4 drugs and should only be dispensed with a doctor's prescription. The remedy alleviated some of her symptoms, but they also aided the progression of the far more serious viral infection.

It draws attention to the issue of patients seeking advice and being treated by non-trained persons, including themselves, family, friends, social media sites, magazines, television shows, traditional healers, "alternative medicine" practitioners, and even other medically trained person who act outside their areas of expertise.

A number of questions arise such as:

- Who can and should be allowed to make medical / dental diagnoses, and dispense medication?
- Who is accountable for the consequences of treatment where an incorrect initial diagnosis was made and the wrong medicine was prescribed?
- If a patient makes an autonomous decision to consult someone other than a doctor for medical advice and care, do they have the right to lay charges against the former if their conditions worsen? This is particularly relevant in this case where the drug prescribed for the management of the allergy was correct, however the pharmacist failed to diagnose the VZV, a condition in which the same medication is totally contra-indicated?
- What should the dentist have done at the first consultation? Treatment of VZV is generally not within their scope of practice unless there are oral symptoms, which often do not resemble classic skin VZV.
- Should the dentist attempt to aspirate the fluid in oral lesions or take swabs, or rather send directly to a medical practitioner?
- Should the dentist provide symptomatic relief by prescribing pain killers? However, this too could be risky given that the patient had a history of a recent allergic reaction.
- Can someone who posts advice on Google / social media sites be held accountable if others follow their suggestions and there are harmful consequences?
- Does and should the Consumer Protection Act cover the dispensing of services and medication?

Reasons why patient may seek alternative treatment

It is tempting to chastise patients who don't go to their doctors initially, or even after being advised to do so. However, there are many reason why they may not go for help or may seek unconventional/alternative therapy. This may be a conscious decision, or could be a choice made as a consequence of circumstances.

Patients may have time and financial constraints which prevents them from seeking and/or affording medical services; unequal access to health care; living in remote areas where there is a scarcity of doctors, limited resources and lack of medication; lack of education; fear and skepticism of modern medicine (Ahmed Bawa - anti-intellectualism and distrust in science is a growing international trend); trust in local figures who are considered to be knowledgeable; previous bad encounters with medical professionals, desperation if conventional treatment has been unsuccessful; and in some cases they do not want to know the truth or severity of their condition, and choose to self-treat or to hide their symptoms.

The onus often lies with the advice-giver to recognize their own limitations, to be modest enough to know when to refrain from treating, and to have the wisdom to detect when a patient needs to be referred to a more experienced practitioner.

Another concern is the ease with which patients can access medicine without needing a prescription. They may acquire it from friends, from a friendly pharmacist, or even through the internet. The latter is particularly dangerous as there are many counterfeit products on the market, often available at temptingly low prices which entices naive customers.

Issues for the dentist to consider?

The dentist has a number of issues to consider:

- How to deal with the pharmacist who tried to help, but at the same time acted negligently by failing to take a full history and thus not only made an incorrect diagnosis, but also missed identifying the more crucial primary condition?
- What to do about the pharmacist who wrongly providing medication that was totally contra-indicated for her condition, and more than likely exacerbated her symptoms?

- What advice to give the patient about the treatment she had received, and whether or not she should take any actions against the pharmacist, given that she was the one who sought his help?

- How to manage the patient at that first visit, for she needed to have the VZV infection definitively diagnosed and managed urgently as it had already spread to involve her right eye?

- If the dentist intervened and provided medication, but the patient did not recover, could he/she be held responsible for both the initial incorrect treatment as well as the intervention?

- Should the dentist approach the pharmacist directly or advise the patient to either report back to the pharmacist or lodge a complaint against him?

Given that the patient was reluctant to take the dentist's advice to consult a doctor, and she still maintained that her pharmacist had helped her, she probably would not approach him. She may also not want to jeopardize her future supply of easily accessible, "OTC-prescription" medication.

However, the outcomes of this sort of practice by the pharmacist may not always be favourable, and could even have dire consequences. The dentist, who is also a health care provider, has an ethical duty to promote beneficence and non-maleficence (i.e. prevent harm), and is obligated to take actions to enhance the health and safety of all patients.

Possible steps to follow

- Document the patient's present condition (including photographs) at that visit.

- Refer the patient to a more suitably trained medical person to confirm the diagnosis, and record this in the event that she chooses to not seek help.

- Inform and educate the patient about her condition, the dangers of self-diagnosing or relying on internet sites and other ill-equipped persons for information, and the risks of taking unprescribed medication.

- Follow up on the patient's condition if possible. This may be difficult if he/she does not come back for further dental treatment.

- Warn the patient about possible adverse drug interactions, especially if they take OTC medication or take a cocktail of drugs they have procured from various sources.

- Consider calling the pharmacist to discuss your concerns in a collegial manner. Remember though, the obligation to maintain patient confidentiality and anonymity.

  Thus it may be prudent to inform the patient of your intention and ensure that her identity is protected when you discuss her case.

- If the pharmacist's prescribing habits are seriously dangerous or frequent, one may consider reporting the matter to the HPCSA.

  The flip side of this is that we have very little control over similar situations where medication is provided by traditional healers, homeopaths, alternative therapists or purchased off the internet, so one could argue that at least the pharmacist has a medical background and training.

CONCLUSIONS

This case is a reminder that dentists need to be holistic in their approach to treatment and to see beyond the mouth. They have a duty to spend time taking a comprehensive history, and in conducting a thorough extra-oral and intra-oral examination.

It is also incumbent on them to be responsible for educating their patients and colleagues, and to acknowledge and embrace alternative healers. They need to also stand together as active campaigners in the fight against the illegal supply and use of all forms of medicine.

In conclusion, in ethics and in practice, there are often no clear answers as to what the practitioner should have done in this situation. In addition, their actions may not be the same in each situation or between patients. What do other practitioners think and feel?

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****Varicella Zoster Virus**

The rash is typically preceded by a prodromal stage in which the patient may experience a painful tingling, itching, hyperesthesia, or paraesthesia which is confined to one area.[1,2] This is often accompanied by fever, headache, or fatigue, and followed by the emergence of a characteristic skin rash along the affected dermatome resulting in a reddened stripe that is limited to one side of the body and does not cross the midline.[1,3,4]

Later the rash forms small vesicles filled with a serous exudate, which become cloudy and darkened as they fill with blood, and finally they crust over.[4] The rash usually heals within two to four weeks;[2] however, some people develop "ongoing nerve pain which can last for months or years, a condition called post herpetic neuralgia (PHN)".[1] Reactivation of VZV results in shingles which may become widely disseminated in the elderly or those with compromised immune function.[1]

Shingles of the head most frequently affects the trigeminal nerve.[5] When the ophthalmic division is involved it will affect the skin of the forehead, upper eyelid and

orbit of the eye.[6] Symptoms may include conjunctivitis, keratitis, uveitis, optic nerve palsy and even loss of vision.[7]

If it involves the maxillary or mandibular division of the trigeminal nerve it will manifest in the mouth as a rash on the mucous membrane of the palate, and/or gingiva or the tongue and mandibular gingiva respectively.[8] "Oral involvement may occur alone or in combination with a rash on the skin over the cutaneous distribution of the same trigeminal branch."[9]

"Once again lesions are confined to one side of the mouth, distinguishing it from other oral blistering conditions."[8] Unusual complications may occur with intraoral shingles that are not seen elsewhere. The close relationship of blood vessels to nerves allows the virus to invade the blood vessels and compromise the blood supply, resulting in ischemic necrosis,[9] osteonecrosis, tooth loss, periodontitis, pulp calcification, pulp necrosis, periapical lesions and tooth developmental anomalies.[5]

Treatment with antiviral medications such as acyclovir may reduce the severity of the infection if started within 72 hours of the appearance of the rash.[3] However neither antivirals nor steroids seem to be of much value in controlling the rates of post herpetic neuralgia.[10] Paracetamol, NSAIDs, or opioids may be used to help with the acute pain.[3]

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SADJ November 2019, Vol. 74 No. 10 p586

CJ Nortjé

Below are three very rare and unusual lesions that may present in the jaws. What are the important radiological features and what are your differential diagnoses?

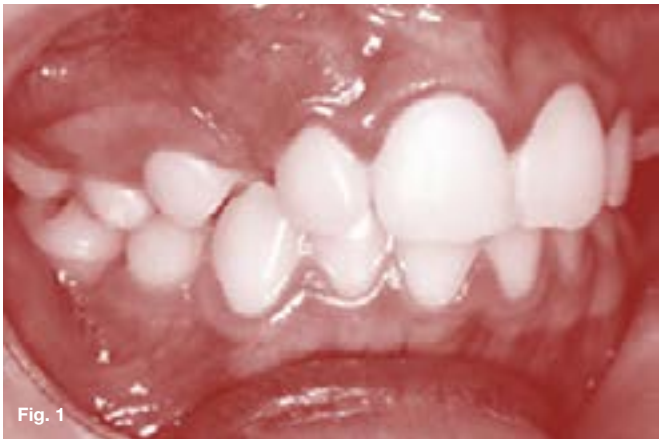
Fig. 1

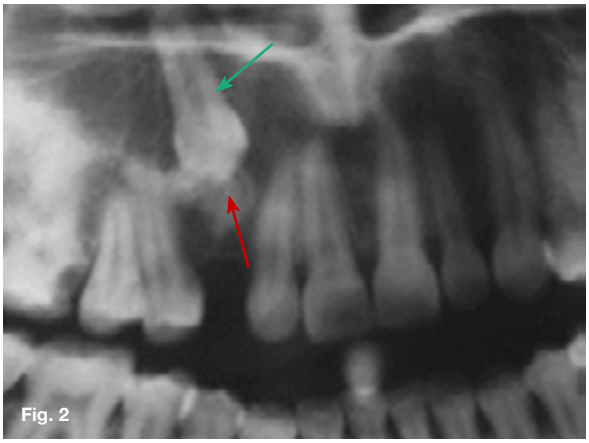
Fig. 2

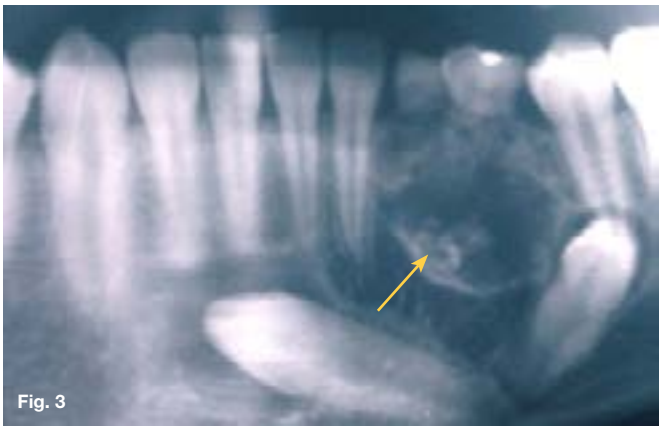
Fig. 3

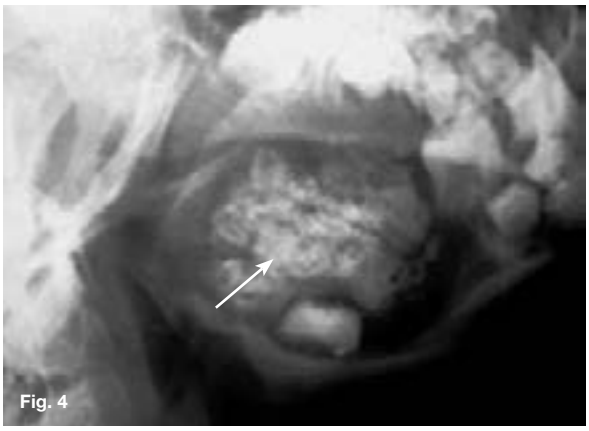
Fig. 4

INTERPRETATION

Figure 1 is of a patient with the complaint that her upper right canine has not erupted. The cropped pantomograph (Figure 2) shows an impacted canine with an irregular low density lesion at the incisal edge, (red arrow) is very similar to the dentin of the impacted canine (green arrow). A diagnosis of a dentinoma was made. This is an extremely rare tumour of odontogenic origin and occurs predominantly in the mandible and is frequently associated with an impacted tooth. The radiographic appearance is not specific, but usually there is a radiolucent area containing a large, solitary opaque mass or smaller masses of calcified material. Figure 3 is a cropped pantomograph of a fourteen year old female presenting with a swelling in the 42-35 region. A mixed radiolucent/radiopacity lesion causing displacement of left mandibular canine and first premolar is discernible. A histological diagnosis of ameloblastic fibro-dentinoma (AFD) was made. The AFD is a rare mixed odontogenic tumour composed of odontogenic epithelium, immature connective tissue and characterized by the formation of dysplastic dentin (yellow arrow). It is slow growing, is often an asymptomatic lesion with a predilection for males. Radiologically, it shows unilocular or multilocular radiolucency with or without radio-opaque areas. Histologically, it is similar to ameloblastic fibroma but also shows dentin formation. Figure 4 is an oblique lateral radiograph of a five year old male with a slow growing swelling in the premolar/molar region of the left mandible causing expansion and disturbance of eruption of the teeth in the region. Radiographically the lesion is characterized by a well-defined radiolucency containing several small, irregular fragments of tooth material (white arrow). A histological diagnosis of an ameloblastic fibro-odontoma (AFO) was made. The lesion is very similar to the AFD, and consists of soft tissue, odontogenic epithelium, enamel and dentin. Occasionally the tumour is discovered during routine dental radiographic examination.

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CPD questionnaire

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GENERAL

Remaining dentine thickness following preparation with different glide path techniques in combination with WaveOne Gold

1. In order to withstand fracture forces during post placement, Caputo and Standlee recommended a minimum dentine thickness of how many millimetres?
   A. 0.5 mm
   B. 0.6 mm
   C. 0.8 mm
   D. 1.0 mm
   E. 1.2 mm

2. Which glide path technique in combination with WaveOne Gold Primary final preparation, resulted in the poorest dentine preservation in this study?
   A. K-file group
   B. PathFile group
   C. No glide path group
   D. WaveOne Gold Glider group

3. The authors of this paper found no statistically significant difference in the remaining dentine thickness between the K-file, PathFile and WaveOne Gold Glider groups after preparation with the Primary WaveOne Gold instrument.
   A. True
   B. False

4. Which glide path technique (prior to final instrumentation with WaveOne Gold), resulted in the best (combined value) dentine preservation in this study?
   A. K-file group
   B. PathFile group
   C. No Glide path group
   D. WaveOne Gold Glider group

Comparing clinical outcomes of connective tissue grafts to platelet rich fibrin in gingival recession treatment: an extended case series

5. Identify the INCORRECT statement.
   Possible disadvantages of a second surgical site include:
   A. postsurgical oedema, increased pain and necrosis of the palatal flap during the initial healing phase
   B. increased risk of paraesthesia or permanent anaesthesia at the donor site
   C. increased risk of tongue healing to exposed palatal connective tissue
   D. repeated surgical interventions are required to correct multiple recession lesions

6. Identify the INCORRECT statement.
   Platelet rich fibrin (PRF); a natural autologous material, is the preferred graft because:
   A. allografts and xenogeneic grafts remain associated with the risk of disease transmission
   B. allografts and xenogeneic grafts remain associated with the risk of tissue rejection and may raise ethical concerns
   C. some patients may not be willing to use xenogeneic membranes for personal or religious reasons
   D. PRF material is readily available commercially

7. Identify the INCORRECT statement.
   As regards the aesthetic considerations:
   A. the study relied on the Pink Esthetic System (PES), an objective and a reproducible aesthetic scoring system
   B. the study used using a tunnel flap, previously shown to enhance aesthetic results
   C. the aesthetic outcomes with PRF were judged to be superior
   D. the study used a microsurgical approach to minimise soft tissue trauma during surgery

Outcomes of mandibular Kennedy Class I and II prosthetic rehabilitation

8. What are the categories of factors that influence success of prosthetic rehabilitation?
   A. Mechanical
   B. Biological
   C. Patient
   D. Biomechanical
   E. All of the above

9. Identify the treatment options for patients presenting with Kennedy Class I and II setup.
   A. Removable partial denture prostheses
   B. Fixed partial denture prostheses
   C. Implant-supported prostheses
   D. Shortened dental arch
   E. All of the above

10. Correctly used and applied diagnostic criteria may reduce the number of negative outcomes.
    A. True
    B. False

11. Utilising the recall system following delivery of partial dentures will improve success of this treatment.
    A. True
    B. False

The Oral Health Section of the Road to Health Chart (RtHC): how useful is it?

12. Identify the CORRECT statement.
    The Road to Health Chart:
    A. should be completed by the health professional only at every annual clinic visit
    B. records essential information on the growth of the child and any illnesses
    C. has always included an oral health section
    D. records the number of teeth present in the mouth but this has no anthropometric value

13. Identify the INCORRECT statement.
    The results of the study showed:
    A. a clear lack of understanding amongst the health-care workers of the purpose of the inclusion of the oral section in the booklet
    B. that the allied health professionals not associated with dentistry indicated it was not their job to complete the oral section
    C. that Dental professionals successfully and consistently used their own judgement in the completion of this record.
    D. incomplete recording of breast-feeding practices and health promotion messages.

The Mandibular Anterior Repositioning Appliance (MARA): a report of three cases

14. Identify the INCORRECT statement.
    The MARA is a fixed functional appliance:
    A. that eliminates the compliance factor
    B. that allows the patient to function normally
    C. that can be used in combination with full fixed appliances
    D. that relies on stimulation of the mentalis muscle

Endodontic treatment of a maxillary second premolar with three roots and three root canals

15. Identify the INCORRECT statement. The preferred restoration in these teeth is the ceramic crown requiring:
    A. that the root canal space selected to receive the post is instrumented to a sufficiently wide degree
    B. that the natural cusps remain exposed to assist proprioceptive feedback
    C. that the root has sufficient length to accommodate a fibre-reinforced composite post
    D. that adhesive techniques are applied

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16. The radiographic features of dentinoma are not specific.
    A. True
    B. False

17. Ameloblastic fibro dentinoma (AFD) is composed of dysplastic dentine.
    A. True
    B. False

Clinical Windows - What's new for the clinician

18. In the Yilmaz & Aydin trial, patients preferred the digital impression taking format, and reported it to be more comfortable than the conventional impression taking method.
    A. True
    B. False

19. Published studies have reported an increase in microleakage and postoperative sensitivity when a lining is present under a posterior composite.
    A. True
    B. False

20. Evidence has now been presented that proves that once isolated from their source of nutrition by a restoration of sufficient integrity, bacteria in caries either die or remain dormant and therefore pose no risk to the tooth.
    A. True
    B. False

ETHICS

Ethical dilemmas when dealing with doctor Google and the importance of patient education

21. Identify the INCORRECT statement. In the case described it would be ethical for the dentist to:
    A. summarily dismiss the irresponsible patient
    B. refer the patient to a more suitably trained medical person
    C. warn the patient about possible adverse drug interactions
    D. inform and educate the patient about her condition, the dangers of self-diagnosing or relying on internet sites

22. A dentist may not intervene in non-dentally related matters where a patient has already been treated by another person.
    A. True
    B. False

23. Identify the CORRECT statement. A dentist faced with the need to discuss treatment advised by a colleague must:
    A. recognise the right of the colleague to unilaterally abandon treatment with no notice given to the patient
    B. recognise the need to reassure the colleague regarding the financial ability of the patient to meet the account
    C. recognise the ethical obligation to maintain patient confidentiality and anonymity
    D. recognise the right of the Medical Aid Society to prescribe Schedule 4 drugs

24. Patient autonomy should take precedence over legislature with regards to dispensing medication.
    A. True
    B. False

25. Identify the INCORRECT statement. Dentists have an ethical duty to:
    A. perform a thorough extra-oral and intra-oral examination.
    B. educate their patients and colleague on oral health matters.
    C. be active campaigners in the fight against the illegal supply and use of all forms of medicine.
    D. restrict their management of a case to the mouth only.

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Have you submitted the Clearance Certificate number when Ethical permission has been required to undertake research or to publish data?	☐
Does the paper adhere to the format requested in Instructions to Author?	☐
Are the references quoted according to Journal policy, both in the text and in the list of references?	☐
Have all authors signed the Letter of Submission?	☐

Smalls Advertising Placement Procedure and Rules

- All smalls advertisements are restricted to a **maximum 100 words** per advertisement.
- All advertisement requests are required in writing, **submit to abayman@sada.co.za**, with full contact details of the advertiser which should include:
  - the wording of the advertisement as you require it to be published;
  - the members professional number; (will not be published);
  - the members contact details (will not be published).
- Advertisement **lifespan is two weeks** from the date of upload.
- Advertisements to be **repeated follow the same process** as the original placement request.
- All advertisements which **exceed a word count of 100** words will be forwarded to our **publishers E-Doc** for further processing as a potential advertisement to be placed in the SADJ electronically or as website advertising. E-Doc will contact you thereafter regarding your requirements.
- **SADA Members** may place advertisements at no cost providing their annual membership fees are either paid in full at the time of their request of a debit order request has been lodged.
- **Non-SADA Member** advertisers will be charged R25 per word for placement of their advertisements.
- Advertisement must be paid in full prior to uploading on the web platform.
- Invoice may be settled telephonically with the use of a credit card to prevent delay of placement.
- **Telephonically processed** payments will result in uploading of advertisement within **24 hours** of settlement.
- Advertiser remains liable for placement costs should payment be dishonoured and invoice remains unpaid.

Contact details:
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SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

www.sada.co.za