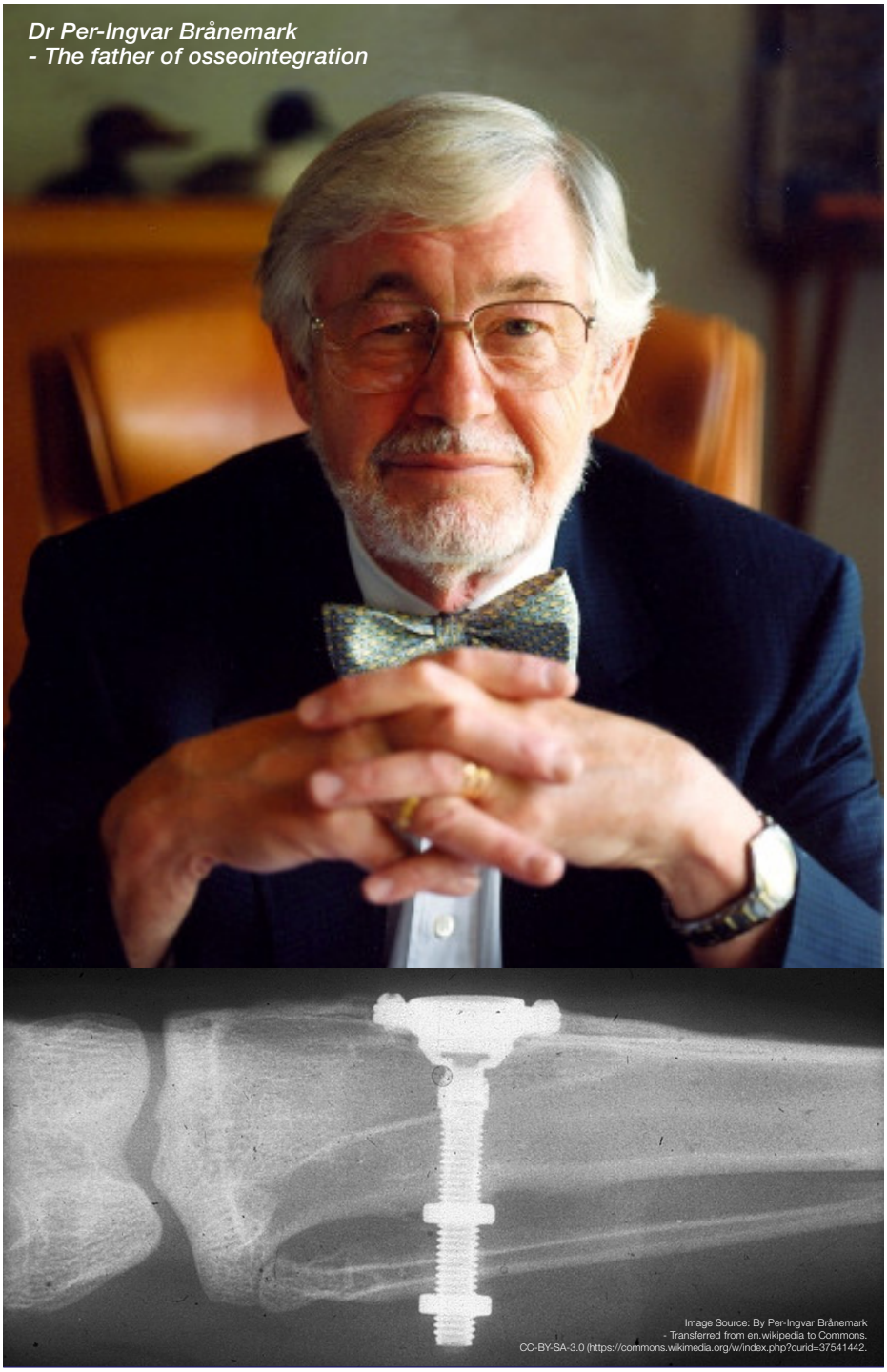
THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

JUNE 2020
Volume 75 Number 5

ISSN No. 2519-0105 – Online Edition
ISSN No. 1029-4864 – Print Edition

SADA
THE SOUTH AFRICAN
DENTAL ASSOCIATION



Dr Per-Ingvar Brånemark
- The father of osseointegration

Image Source: By Per-Ingvar Brånemark - Transferred from en.wikipedia to Commons. CC-BY-SA-3.0 (https://commons.wikimedia.org/w/index.php?curid=37541442.

Dr Per-Ingvar Brånemark

Per-Ingvar Brånemark was ultimately recognised as the "father of osseointegration"… receiving the Swedish Engineering Academy medal for technical innovation and the coveted Swedish Society of Medicine Soederberg Prize in 1992… at the time of his death in 2014, he held more than thirty honorary positions at Universities through Europe and North America… and had been declared the European Inventor of the Year in 2011 in the category Lifetime Achievement.

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ

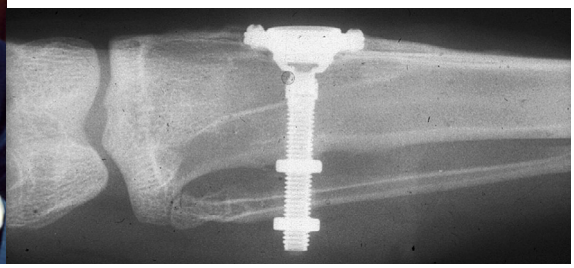
Published by:
On behalf of:
SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

CONTENTS

Our Front Cover for this Issue…

The theme for the Front Cover of the South African Dental Journal this year provides for some historical figures, some characters illuminating dental history and some important achievements in South African Dental history. The June issue draws focus to a highly distinguished South African dentist.
Read more on page 231.

Dr Per-Ingvar Brånemark
Per-Ingvar Brånemark was ultimately recognised as the "father of osseointegration"… receiving the Swedish Engineering Academy medal for technical innovation and the coveted Swedish Society of Medicine Soederberg Prize in 1992… at the time of his death in 2014, he held more than thirty honorary positions at Universities through Europe and North America… and had been declared the European Inventor of the Year in 2011 in the category Lifetime Achievement.



THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

PRODUCTION OFFICE

E-Doc CC,
a Division of Life-Long Learning Solutions CC
Tel: +27 (0)10 020 1013

Publisher and Project manager

Mr René Smulders

GENERAL AND ADVERTISING ENQUIRIES

Mr René Smulders
Email: rene@edoc.co.za

Design and Layout

Ms Reine Combrinck
Email: production@edoc.com

Website smalls advertising / CPD Enquiries and Member contact detail update

South African Dental Association
Tel: +27 (0)11 484 5288
Email: info@sada.co.za

CONTENTS

Published by:

On behalf of:

SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

Accredited by the Department of Education

SADJ is published 10 times a year by E-Doc CC, a Division of Life-Long Learning Solutions CC, on behalf of The South African Dental Association.

Dr Per-Ingvar Brånemark
- The father of osseointegration...

Dentistry and our patients had the great fortune that Dr Brånemark stumbled inadvertently on the principle of osseointegration …the stumbling may have been inadvertent but the genius was in the recognition and application of the discovery.

Per-Ingvar and his team at Gothenburg were in 1952 studying blood flow during healing and chose titanium to encase optical devices which were inserted into the tibia and fibula of rabbits. At the end of the project the researchers discovered to their surprise that the titanium had fused into the bone and could not be removed.

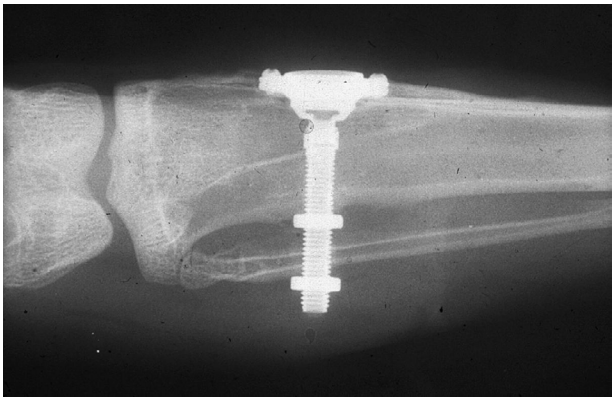
The immediate recognition of the potential of this discovery to provide an anchor for artificial teeth was followed by a protracted period of safety testing before Brånemark felt confident to introduce the technique to the world.

The dental world was, however, just not ready to accept challenges to the long-held belief that foreign bodies introduced into human tissue would always result in inflammation and probably rejection.

The tentatious Dr Brånemark endured rejection of repeated applications for research grants… but at last the Swedish National Board of Health and Welfare in the 1970's approved the implants. By then the good doctor had accumulated considerable evidence including a patient who had for decades effectively relied on four mandibular implants to support his denture.

Experiments had also been carried out on human subjects …some 20 laboratory researchers had implants inserted into their upper arms... some still bearing the scars!

It was at a meeting in Toronto in 1982 that a signal recognition was given to the discovery… osseointegration had finally arrived and of course since then millions of patients have benefitted from the technique.



Radiograph of Brånemark's initial rabbit specimen, showing the titanium optic chamber fixed to the rabbit's tibia and fibula.
Image source: By Per-Ingvar Brånemark - Transferred from en.wikipedia to Commons. CC-BY-SA-3.0 (https://commons.wikimedia.org/w/index.php?curid=37541442.

The profession acknowledged "the extensive and weighty documentation of implant efficacy" and "early replication by reliable independent researchers".

Whilst the concept became known as the Brånemark system, and was widely accepted, there have been other developers who have produced the specialised titanium or titanium-coated implants and today the option is readily available for numerous applications, for example to support external hearing aids, prosthetic ears and noses. Temporary anchorage using small titanium screws has taken over in many aspects of Orthodontics… patients happily accepting the technique in place of headgears and other cumbersome appliances.

South Africa was in fact one of the first countries to embrace osseointegration. Professors Slabbert and Lownie from Wits travelled to Sweden to be "inducted into the clan" and returned to introduce the clinical procedures to the profession here.

Per-Ingvar Brånemark was ultimately recognised as the "father of osseointegration"… receiving the Swedish Engineering Academy medal for technical innovation and the coveted Swedish Society of Medicine Soederberg Prize in 1992… at the time of his death in 2014, he held more than thirty honorary positions at Universities through Europe and North America… and had been declared the European Inventor of the Year in 2011 in the category Lifetime Achievement.

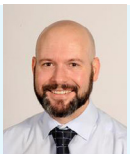
References

1. Per-Ingvar Brånemark. Wikipedia. (https://en.wikipedia.org/wiki/Per-Ingvar Brånemark).
2. https://www.nytimes.com/2014/12/28/health/per-ingvar-branemark-dental innovator-dies at 85.html.

Redundancy: when plenty is just enough

SADJ June 2020, Vol. 75 No. 5 p232

NH Wood



"Shortage" has become a central and recurring theme during the COVID-19 pandemic, whether reflected in materials or consumables that include personal protective equipment (PPE), or in human resources.

The effects that resulted from shortages of essential consumables and materials demonstrated the influence supply-and-demand has on costing, on planning, and on our service-delivery efficiency in the past three months.

In various practices and clinics, this theme has highlighted the benefits of creating redundancy in systems and in different resource types. Redundancy has benefits that extend to infection control, to materials and consumables management, to the communication between the patient and practitioner and between staff members, to time management, and to the overall management of human resources.

Redundancy in systems can be structured to benefit different dental settings. An example is the way in which some clinics use a rostering and/or rotational staffing system during the COVID-19 pandemic. Redundant and semi-redundant systems in terms of short-staffed scenarios can see an improvement of service delivery by overlapping shifts for rotating staff, thus ensuring shorter shifts for the same number of staff members, achieving the desired service levels and achieving treatment goal, but at the same time minimizing the risk for potential exposure to SARS-CoV-2.

Layering of such semi-redundant systems can compensate for staff shortages in case one or more are unavailable to perform their essential services.

Similarly, data-redundancy ensures security and accuracy in communication, in information access and in delivering outcomes. This creates efficiency in the clinical setting, whether writing a referral letter, performing a procedure, or even billing a patient.

By layering redundancy into practice systems, the consistency of service delivery is reinforced. Consistency provides both the patient and clinician with a sense of security and does not leave either vulnerable to uncertainty. The trust-relationship between clinician and patient will benefit from consistency and security, especially when the practitioner is able to focus on the service they provide and is not distracted by any shortage or unnecessary risks.

Patients will require access to oral healthcare during the pandemic. The availability of the dental practitioner to treat patients is therefore vital. Patients who present with pain and sepsis often require assessment and treatment outside of normal working hours.

Performing this essential treatment will only be possible if there are no voids in systems and resources. Layering redundancy into communication systems for example, ensures that no patient is left unattended. It additionally ensures that all staff are aware of current situation/status of the clinic or practice.

Redundancy in systems and in resources therefore increases professionalism and the ability to perform our duty with accuracy. In the time of COVID-19, we want to do so safely, knowing that the safety-net of redundancy will be there to compensate for unforeseen eventualities making it deliberate and essential.

Neil H Wood: Managing editor. Email: neil.wood@smu.ac.za

Third party funders must come to the party in response to oral health PPE, the government must address issues of lack of water and PPE price escalation

SADJ June 2020, Vol. 75 No. 5 p233 - p234

KC Makhubele

South African Oral Health Care (OHC) providers, just like all over the world, are considered essential services and are tasked with addressing the challenges of providing treatment during and after the COVID-19 pandemic.

OHC is an essential need, which, if left unattended could lead to crises that are life threatening or even fatal. Thus, continued care is vital to safeguard the (oral and systemic) health of our patients, prevent serious complications and sustain the profession.

The fights against the pandemic if further compounded by factors such as: the lack of water in rural areas and the escalation of PPE cost.

SADA has noted with great concern that life-saving protective equipment is running critically low in facilities across South Africa, and the world, due to increased demand created by the COVID-19 pandemic. The PPE stock continues to be affected in light of export restrictions, increased costs and disruptions in logistics.

Many of our OHC have not been able to procures the necessary PPE. SADA is becoming increasingly frustrated that as well as its members not being to procure PPE, suppliers are unable to give answers as to when PPE stocks would be available.

Since COVID-19 we have noted a more than 1000% increase in costs for required personal protective equipment since the deadly virus started its rampage in the South Africa. This increase continues. The increase is attributes to supply-and-demand factors, as well as the increased number of items mandated for safety, and the call for frequent changes. The government seems to be heading the call and we hope to see the escalation curtailed.

We equally also concerned about the lack of water in rural settlement and health facilities across the country. These areas are the most vulnerable and may become key centers on the spread of the coronavirus. We however remain hopeful that Minister of Human Settlements, Water and Sanitation, Lindiwe Sisulu, will fulfill her promise that that water provisions, such as tanks and stand pipes, for rural and informal areas would be drastically increased as a means to further fight the pandemic.

The case for infection control measures to be provided for by third party funders

The very close proximity of the OHC providers to their patients as well as the massive generation of aerosols during routine and emergency procedures increases the risk of COVID-19 contamination and cross infection.

For years, OHC workers have adopted, extensive precautions against numerous blood borne viral illnesses such as HIV and hepatitis, and fungal and bacterial challenges. The current trends in infection control and use of personal protective equipment (PPE) have been adequate to meet this challenge. However, the advent of COVID-19, with a different vector of infection, has made our current cross infection control strategies entirely inadequate.

The production of aerosols leads to extensive contamination of our surgeries, surgical scrubs and our PPE. This significant contamination requires that we efficiently disinfect our surgeries and appropriately disinfect or dispose of some of the PPE.

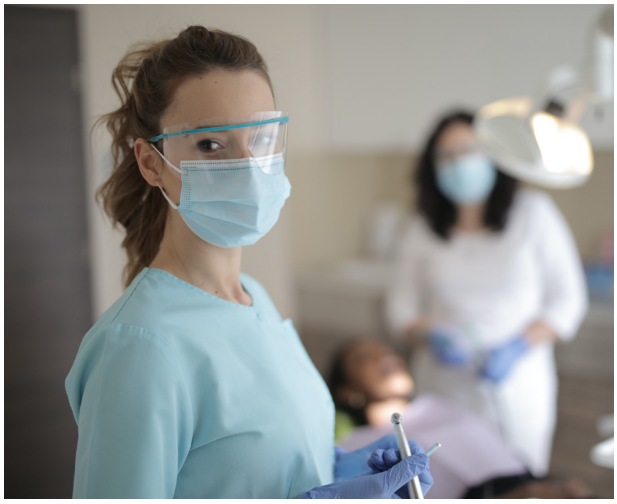
As a response to the current crisis, the SADA protocols committee developed a document that provides scientific guidelines for safe practice for all OHC workers and especially for their patients.

We refer to Dental Clinical Protocol in Response to the COVID-19 Pandemic 2020: A South African Perspective, which has been widely adopted by all OHC workers in South Africa, academia and the HPCSA.

In addition to the standard PPE required, SADA advocates for the use of Rubber Dam as an Essential Protection Measure. Not only is the use of rubber dam considered critical in the reduction of infectious pathogen transmission, but scientific reports highlight why the use of rubber dam should be considered mandatory for all routine endodontic and restorative dental procedures.

The advantages include but not limited to:

- The prevention of cross contamination.
- Protection of both operating staff as well as the patient.
- Improved effectivity and longevity of dental treatment.



The protective nature of rubber dam for both patient and operating staff in conjunction with its many clinical advantages is largely underestimated and undervalued and should therefore be classified as essential and standard protocol for dental procedures.

This requires extra-ordinary measures in the dental environment to protect patients, employees and practitioners, and they must be carried out in accordance with the latest international and SADA guidelines and protocols. The use of PPE, routine use of rubber dam (for both endodontic and restorative procedures) as well as thorough disinfection and sterilisation procedures cannot be relaxed until a vaccine or cure has been developed or herd immunity has been achieved.

These measures result in a significant increase in the costs of providing of dental services, which are not catered for in the current reimbursement system, and many practices will be unable to fund them without support. However, this cost is small compared to that of losing a life. Our priority is the safety and wellbeing of our patients and their families, our staff and their families and ourselves and our families.

SADA is currently engaged with third party funders to ensure they support the infection control measures adopted by the profession.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a1

Parents' perception of their role in the prevention of inadequate consumption of fruit and vegetables among adolescents in South Africa

SADJ June 2020, Vol. 75 No. 5 p235 - p240

TE Okagbare[1], S Naidoo[2]

ABSTRACT

Introduction
South African adolescents consume relatively low fruit and vegetables in spite of the development of food-based dietary guidelines for South Africa.

Aims and objectives
The aims and objectives of the present study were to investigate parents' perception of their role in the prevention of the health compromising behaviour of inadequate consumption of fruit and vegetables among adolescents in South Africa.

Design
The study design was qualitative and exploratory and the research strategy used was inductive, deductive and abductive.

Methods
Using a guiding question schedule data were collected from five focus group interviews. A non-probability purposive theoretical sampling method was utilized and the sample size of 37 determined by theoretical saturation. Data analysis was performed using the grounded theory approach.

Results
The findings of the study suggest that children should be introduced to fruit and vegetables as early as possible.

Conclusion
The study recommends that infants should be exposed to the taste of locally available fruit and vegetables followed by the gradual introduction of fruit and vegetables into their diet together with a variety of other nutrient-dense foods when solid foods are being introduced.

Keywords
Qualitative research, adolescents, taste buds, inadequate fruit and vegetables, interventions, oral health, South Africa.

Author affiliations:
1. **Tuweyire E Okagbare:** *BDS, PG Dip. (Odont), MSc (Odont), PhD,* Department of Dental Public Health, Faculty of Dentistry, University of the Western Cape, South Africa.
   ORCID Number: 0000-0002-8263-2866
2. **Sudeshni Naidoo:** *BDS, LDS.RCS, MDPH, DDPH.RCS, MCh D, PhD, Dip IRE., DSc,* Faculty of Dentistry, University of the Western Cape, South Africa.
   ORCID Number: 0000-0001-7424-8082

Corresponding author: Tuweyire E Okagbare
Faculty of Dentistry, University of the Western Cape, South Africa.
Private Bag X17, Bellville 7535, South Africa.
Email: teokagbare@gmail.com

Author contributions:
1. **Tuweyire E Okagbare:** Principal researcher - 60%
2. **Sudeshni Naidoo:** Co-author & advisor - 40%

INTRODUCTION

The perception that nutrient-based dietary guidelines are not effective in promoting appropriate diets and healthy lifestyles has motivated a number of countries including South Africa to develop food-based dietary guidelines (FBDGs) in accordance with the recommendation of Food and Agriculture Organisation/World Health Organization (FAO/WHO).

The South African FBDGs were satisfactorily tested for comprehension, appropriateness and applicability in consumer groups of different ethnic backgrounds in both rural and urban areas.[1] Consuming a diet high in fruit and vegetables is associated with a decreased risk of many chronic diseases, including periodontal disease because fruits and vegetables are good sources of many important nutrients such as potassium, vitamin C, folate, fiber, and numerous phytochemicals.[2]

Even though the composition of the family unit has undergone considerable change in recent decades due to a variety of socio-economic developments, it remains the first learning environment for the child. The influence of the family continues throughout adolescence and indeed throughout the life-course of the individual to varying degrees because parents are powerful role models and influence.[3] Consumption of fruit/vegetables among adolescents is a healthy behaviour consistently related to higher parental socio-economic status (SES).[4]

Foods high in fat and sugar are cheaper per unit energy when compared with foods rich in protective nutrients such as fruits and vegetables.[5] This is also the reason why social support correlates positively with fruit/vegetable intake.[6]

The most important predictor of fruit and vegetable consumption is suggested to be gender[7], and this difference is also evident in children as young as four years of age.[8] A Norwegian study involving adolescents, found that boys ate less fruit and vegetables than the girls because they like them less. However, the reasons for this are yet to be identified.[9]

Rovner et al.[10] indicate that the availability of fruits and vegetables in the school environment is positively associated with the consumption of these foods by younger learners. A Minnesota study on the other hand, indicates that snack vending machines availability in schools are associated with a decrease in the consumption of fruits among seventh graders.[11]

South African adolescents consume relatively low fruit and vegetables in spite of the development of food-based dietary guidelines.[1] There is need to understand the role of specific psycho-social factors associated with low fruit and vegetables consumption among adolescents in South Africa and to provide scientific evidence that may lead to the development of health promotion strategies, targeted interventions that are appropriate and effective from the perspective of parents.

This is because unhealthy lifestyles in adolescence including the low intake of fruit and non-starchy vegetables may predict the occurrence of adult chronic systemic conditions which may include or determine risk for poorer oral/general health status in adults.[12]

The present study was therefore, designed to provide an opportunity to generate new knowledge and improve the understanding of pathways to oral health inequalities among adolescents through the investigation of parents' perception of the psycho-social factors associated with inadequate consumption of fruit and non-starchy vegetables among adolescents in South Africa.

MATERIALS AND METHODS

Study design and sampling procedure

The study design was a Double-Layer Design, which had geographic areas as the first layer and the different audiences as the second layer. It was qualitative exploratory and the research strategy used was inductive, deductive and abductive. The sampling method utilized was the non-probability purposive theoretical sampling method.

Profile of participants

The number of participants recruited was 37; mean age 46.3 years [95% CI = 43.0-49.5]. They were homogeneous in the sense of shared experience of residing in one community but diverse in terms of their professions.

No attempt was made to achieve a provincially representative sample but in order to ensure that the data was not skewed the study endeavoured to accommodate participation from both the urban and semi-rural areas. This was also the reason why the four racial groupings in South Africa (Black, Coloured, Asian/Indian and White) were recruited and the perspectives of the two major global religious groupings (Christianity and Islam) obtained.

Data collection

Five focus group interviews of subjects who met the criteria of the study, of being a past/current parent or caregiver to an adolescent were conducted between months of March and November, 2015. The interviews were conducted in venues acceptable and accessible to all the invitees.

The researcher used the following opening question to ensure that the participants meant the inclusion criteria: *Please, has any adolescents between the ages of 10 to 19 year lived with you or living with you at the moment?"*

Consent was obtained and the participants were then requested to complete a short questionnaire on demographic characteristics.

A semi-structured interview guide developed for this study was used to ensure consistency in data collection from the focus group interviews while at the same time, allowing the interview sessions to be flexible enough to optimize the natural flow of discussion. In order to allow the participants to freely express themselves and reduce the chance of priming the discussion, the interview guide included a series of open-ended questions.

These questions were designed to stimulate discussion among the participants regarding their perception of their role in the prevention of inadequate consumption of fruit and vegetables among adolescents in South Africa. The use of the layperson's language for the benefit of all participants was encouraged so as to reduce the odds of inhibition. The participants took turns. This was to ensure that they all had equal opportunity to contribute to the discussion.

Data analysis

This study applied the grounded theory methodology in the data analysis. Data analysis of the transcripts began with Open (Substantive) and Axial Simultaneous Coding method (First and Second Cycle coding processes) which was employed right from Initial Coding up to integrated data analysis. A specialist in Community Dentistry was engaged as an independent coder to reduce bias.

Ethical considerations

This study was approved by the Senate Research Ethics Committee of the University of the Western Cape, South Africa (Ref No. 11/1/55). Details of the sample procedure of this study have earlier been published.[13,14] In brief, five focus groups interviews (minimum of six participants each) were conducted between the months of March and November, 2015.

Participants were past/current parents or caregivers to adolescents. Pseudonyms were used to ensure confidentiality was maintained throughout the study by not revealing the true identities of the participants.

The purpose of the study was explained by researcher to the understanding of the participants and were shown the ethical approval for the study before they read and signed the informed consent forms.

Permission to use the audio recorder was obtained from each participant at the commencement of every interview. The participants were informed that their participation in the interview was entirely voluntary and that anyone may decline to answer any questions.

The researcher made it clear that any of them was at liberty to withdraw from the interview at any time without consequences.

RESULTS

The sample size of 37 which was determined by theoretical saturation included 23 fathers, one grandfather, 10 mothers and three grandmothers. Thirteen of them had tertiary education while 14 had matriculated and 10 did not have matric. Overall, 25 Blacks, seven Coloured, three Indians and two Whites were recruited. Thirty of these participants were Christians while the remaining seven were Muslims.

The results of the data analysis using the grounded theory methodology were articulated in the two substantive categories below:

1. Adolescent inadequate consumption of fruit and vegetables.
2. Parents' perception regarding their roles.

Adolescent inadequate consumption of fruit and vegetables

The home environment

The study participants were unanimous regarding the important role of good upbringing of children starting at a very young age and the importance of the home environment in the formation and retention of the healthy behaviour of consuming fruit and vegetables.

There was complete agreement among the participants that a parent's healthy behaviour had a significant effect on their adolescent children's tendency towards that behaviour because parents are powerful role models that their children emulate.

Therefore, parents should be positively exemplary. The participants also, opined that different races eating differently; some consuming more vegetables than others.

Children reject foods that do not taste "nice" such as certain vegetables and they are also choosy. Below are some excerpts from the participants' discussions:

Vegetables and fruits - that's based on the way you grew up. If you grew up eating a lot of vegetables and fruits then you eat a lot.

…these kids when they growing up they …don't eat fruits or veggies… they are very choosy...

…people from certain cultures eat much more fruit or vegetables and stuff like that…

You have to be a right role model from when the child is small they look up at you as the parent. They imitate everything you do. So, if you do the right stuff the child will remember...

What I can say is with that kids eating behaviour… it depends on the home environment that they were growing up in.

Taming and training the taste buds

The participants expressed their concern regarding adolescents' preferences mainly on account of the taste of fruit and vegetables in comparison with confectionaries.

If an adolescent grew up eating fruits and vegetables, the adolescents were likely to remain so. Some excerpts below illustrate their concern:

I think with vegetables, some of these ……are not very nice…they don't taste nice. So, you can't tell a child to eat them because they are not as nice as burgers…

The wife, the mother trained that child from small, they never exposed the child to sweets and that child eats vegetables, that child eat raw food and vegetables with every meal. And for the child that is a normal thing because they don't know anything else. So, all the other cousins come and look, and, they shocked to see the child eating so much vegetables…

Influence of school environment

The study participants highlighted the significant influence of the school environment on adolescents' attitudes towards the healthy lifestyle of consuming fruit and vegetables as illustrated by the excerpts below:

Now at school they don't sell veggies. I mean the school food kiosk. They sell only sweets and chips, Doritos what do you call them. They sell coke …no fruit salad, not vegetable salad…

I don't think the schools teach children about the importance of fruits and vegetables. Even the midday meals don't have fruits and veges. They give fruit juice because it can go round when water is added…

Influence of advertisements, marketing, negative mass and social media

Advertisement and marketing of healthy behaviours and products attract adolescents to such behaviours but nobody advertises fruit and vegetables asserted the participants. Below are some contributions:

…no-one advertises fruits or vegetables like sweet things… what's advertised is what attracts people.

If you advertise a cucumber in TV and you explain the goodness of it and what I'm getting from it, may be, I will consider buying it but you don't see that. Because there is

no-one that is going to benefit from advertising cucumbers in the TV…

Affordability of fruit and vegetables

The participants lamented that fruits are not as cheap as sweet things but they also indicated that eating unhealthily is also a matter of priority not affordability only.

Some of their responses were:

May be the affordability. Fruit and vegetables are not very cheap. To buy an apple maybe is three rand. Now fifty cents can buy sweets.

There is some families which are disadvantaged but with families that can afford it, it may be all about priorities. Some people rather buy clothes and other things than buy fruit. You know, they look at fruit, they say it is expensive. But if you compare fruit and a pair of shoes, they will rather go and buy a pair shoes.

Parents' perception regarding their roles

This section is conceptualised as a multifaceted construct grounded in the interview data and it had the following components:

Parental knowledge

The participants in the present study appeared to be knowledgeable regarding the benefits of consumption of fruit and vegetables, including the nutritional/health values and the cleansing effects on the oral cavity.

If you eat vegetables and fruits you become healthy because they add vitamins, nutrients, all the carbohydrates, proteins. You grow up healthy. Your teeth will be strong and clean. You have calcium and everything. But if don't take them you are not that healthy.

For example, carrots have a cleaning effect in your mouth but if you don't know that… you will, you keep eating sweets and what not. You leave things that are healthy… so the disadvantage is that you are not eating something that is keeping you alive, that is keeping your sight functional well, that is cleaning you, that is giving you a good body, a good system. You know because some fruits, some vegetables, they help clean your body.

Challenges faced by parents of adolescents

The challenges parents face include children's general dislike for vegetables, peer pressure and outside influences so parents cannot raise their children alone.

I think we need help as parents with each other to, to raise kids. We can't raise these children alone.

Ah, yea, these days kids don't like, love vegetables. They hate it, whoa.

You see we can try to do our best by our home. Outside, they at school, the other ones, eating those sweet things, chocolates …so they will share as kids.

DISCUSSION

While the development of affordable, positive, practical, sustainable and culturally sensitive FBDGs to help South Africans, aged five years and over is commendable, South African adolescents still consume relatively low fruit and vegetables.[2] This is likely because children as young as four years of age[8], perhaps much younger have already formed their taste preferences for fruit and vegetables. The main concern of this study was adolescents' preference for sweets and confectionaries mainly on account of the perceived lack of taste of fruit and vegetables.

The important role of good upbringing of children when they are infants and also of the home environment in the formation and retention of the healthy behaviour of consuming fruit and vegetables was highlighted by the present study. There was also the opinion that different races eating differently; some consuming more vegetables than others and that if an adolescent grew up eating fruits and vegetables, the adolescents was likely to continue into their adulthood.

This opinion is supported by a recent study conducted in the United States of America, which found that older Black and White women eat differently although the dietary pattern within each racial group varied considerably depending on factors such age, socio-economic status and neighbourhood.[15] Apart from different races eating differently, the interview outcome of the present study did not perceive race has a dominant influence on adolescent's attitude towards fruit and vegetables. However, with both acculturation and globalization there are changes in preferences for certain foods and these changes may differ by ethnic groups. For example, in one study, first-generation Asian and Latino adolescents consumed higher fruit and vegetables and lower soda than the American white population. With succeeding generations, the consumption of these items by Asians remains stable. In contrast, fruit and vegetables consumption by Latinos decreased while their soda consumption increases, so that by the third generation their nutrition has become poorer than that of the American white population.[16]

Although, culture is a dynamic construct because it changes over time, it still remains a significant influence over what adolescents consume because of familiarity, and perceived healthfulness. Culture has food beliefs around certain meals and food has indeed, been both an expression of cultural identity and a means of preserving family and community unity.[17,18] The present study also identified parents' healthy behaviours to have significant effect on their adolescents' tendency towards such behaviours because parents are powerful role models, as their children emulate them. Parents should therefore, be positively exemplary.

There are two main ways parents' modelling can increase a child's consumption of fruit and vegetables. Observation could change behaviours directly or frequent provision of fruit and vegetables at meals could increase the possibility of consumption by promoting liking through increased taste exposure.[19] Parents therefore, need to be active and positive role models by eating a wide variety of foods and fruit/vegetables regularly. Parents should also ex-

pose their children to fruit and vegetables through movies, books, or gardening to stimulate their interest in them.[20] Consistent with previous studies the present study highlighted the significant influence of the school environment on adolescents' attitudes towards the healthy lifestyle of consuming fruit and vegetables.[1,10,11] Schools should not only teach the value of fruit and vegetables but should encourage their availability within the school premises in favour of snack venting machines[10] and also, include them in midday meals where such are provided.[21]

Adolescents are continuously exposed to a constant barrage of advertisements for sweetened drinks, fast foods and high-caloric snacks on television commercials.[22] The parents in this study continually referred to the pervasiveness of fast foods in today's daily life. Another area of concern is that fruits are not as cheap as sweet foods although it was also recognized that eating healthy is a matter of priority not affordability only. In situations where affordability is an issue, parents should be creative; preparing attractive and tasty meals using vegetables.[21] Vegetables are even more likely to provide optimum nutrients and protection because they are usually prepared fresh for meals preferably immediately after harvest, especially, in the rural areas; unlike fruits that are often eaten many days after harvest. Availability and lower cost of vegetables when compared with fruits that are also highly contingent on seasonal fluctuations is therefore, a great advantage.[23]

The parents in the present study appeared to be knowledgeable regarding the benefits of consuming fruit and vegetables. The perception of some of them regarding adolescent inadequate fruit and vegetables consumption was that in spite of the nutritional/health values and the cleansing effects on the oral cavity, children of this age do not like consuming fruit and vegetables because they do not taste nice when compared to the fast foods that are available.

This confirms the assertion of Vorster et al. that South African adolescents consume relatively low fruit and vegetables despite the development of food-based dietary guidelines.[2] This situation is partly dependent on how the adolescent was brought up and that it may improve if parents consumed fruit and vegetables regularly at home. Besides gender,[7] parents' fruit and vegetable consumption is one of the strongest predictor of a child's consumption of these foods because a parent's healthy behaviour has significant effect on their adolescents' tendency towards that behaviour.[3] Whereas some parents understand quite well what they should be teaching and feeding their children, they do not know how to encourage their children to eat healthily and avoid unhealthy behaviours. They lack practical strategies on how to achieve this.[24]

Infants are known to naturally have intrinsic preferences towards certain taste qualities and dislikes for others. They are also choosy and prefer sweet-tasting foods and reject foods that do not taste nice such as certain vegetables.[25] They are also reluctant to try new foods. A reluctance to try new foods is called neophobia.[20] Neophobia seems to be minimal around the age of 140-180 days, so infants may be more willing to try new foods at this age[26], making it the ideal time to help them acquire a taste for vegetables.

However, neophobia can often be overcome in children who have positive role models. Children are more likely to try unfamiliar foods if they have observed someone else eating them, parents (and sometimes siblings).[27] When parents take a bite of their children's food and show signs of delight or enjoying it, children are more likely to try the food.[19] Parents therefore, may see better results from offering their children a variety of healthy foods containing fruit and vegetables from a young age and also from repeated exposures to these foods even if the child does not like them at first.[27]

It is important to note here that fruit juice are not as healthy as solid or whole fruits and therefore should be discouraged. Solid or whole fruits not only contain less sugars (approximately 35% less sugar), the intrinsic sugars in them are healthier than the extrinsic sugars produced when cell membranes rupture during the juicing process. Solid or whole fruits also provide a lot more fibres and nutrition usually lost during the juicing process.[28]

Some of the parents reported that allergies to certain fruits and vegetables could be one of the reasons why they are not eaten. While this claim may be true, it is uncommon. A food allergy is an abnormal immune response to food. The signs and symptoms may range from mild to severe which may include itchiness, swelling of the tongue, vomiting, diarrhea, hives, trouble breathing, or low blood pressure. This typically occurs within minutes to several hours after exposure. When the symptoms are severe it is known as anaphylaxis.[29] Food intolerance (e.g. lactose intolerance) and food poisoning are different from food allergy. A type of food allergy known as oral allergic syndrome is characterize by a cluster of allergic reactions in the mouth in response to eating certain (usually fresh) fruits, nuts, and vegetables that typically develops with hay fever.[30]

It is pertinent to state here that WHO Fruit and Vegetable Promotion Initiative had concluded that up to 2.7 million lives could be saved annually with adequate fruit and vegetables consumption, and that a low intake of fruit and vegetables is among the top 10 identified risk factors for global mortality. Promoting adequate (>400 g/d) consumption of fruit and vegetables should therefore be a key dietary goal.[31] Most adolescent oral health behaviours are initiated in infancy and childhood and are likely to track into adulthood with their health implications.[32]

As previous documented[1] it takes a whole community including the schools and on-going efforts of parents to provide the enabling environment for the development and retention of the healthy behaviour of consuming fruit and vegetables. This is not a task for one parent alone and here lies the huge challenge. However, findings of the present study should be considered in the light of the following limitations. The generalizability of its findings is limited by the qualitative nature of the study because of the use of non-probability, purposive sampling strategy and also because of the small number of research participants.

CONCLUSION

Despite the limitations stated above the conclusion of the study is pertinent and weighty. It suggests that targeting South Africans five years and older has not been adequately effective in promoting appropriate consumption of fruit and vegetables. The study therefore, recommends the introduction of infants as early as possible to the taste of locally available fruit and vegetables as well as the gradual introduction of these fruit and vegetables and a variety of other nutrient-dense foods when solid foods are being introduced, in order to promote their liking through increased taste exposure.

This practice has the potential to facilitate the mitigation of the adolescent unhealthy behaviour of inadequate fruit and vegetables consumption. In addition, parents and schools should provide enabling environments that encourage consumption of fruit and vegetables. The study also suggests future investigation of the effects of the introduction of infants very early to the taste of locally available fruit and vegetables as well as the gradual introduction of these fruit and vegetables in their meals when solid foods are being introduced on adolescent healthy behaviour of fruit and vegetables consumption.

References

1. Vorster HH, Love P, Browne C. Development of food-based dietary guidelines for South Africa – the process. S Afr J Clin Nutr. 2001; 14: 3-6.
2. Centers for Disease Control and Prevention. Strategies to Prevent Obesity and Other Chronic Diseases: The CDC Guide to Strategies to Increase the Consumption of Fruits and Vegetables. Atlanta: U.S. Department of Health and Human Services; 2011.
3. Fostera MA, Lambertb R, Abbott-Shima M, Mccartya F, Franze S. A model of home learning environment and social risk factors in relation to children's emergent literacy and social outcomes. Early Child Res Q. 2005; 20: 13-36.
4. Friestad C, Klepp K. Socioeconomic status and health behaviour patterns through adolescence: results from a prospective cohort study in Norway. Eur J Public Health. 2006; 16: 41-7.
5. James WPT, Nelson M, Ralph A, Leather S. Socioeconomic determinants of health: the contribution of nutrition to inequalities in health. Br Med J. 1997; 314: 1545-8.
6. Watt RG, Sheiham A. Dietary patterns and changes in inner city adolescents. J Hum Nutr and Diet. 1996; 9: 451-61.
7. Friel S, Newell J, Kelleher C. Who eats four or more servings of fruit and vegetables per day? Multivariate classification tree analysis of data from the 1998 Survey of Lifestyle, Attitudes and Nutrition in the Republic of Ireland. Public Health Nutr. 2005; 8: 159-69.
8. Wardle J, Guthrie CA, Sanderson S, Rapoport, L. Development of the children's eating behaviour questionnaire. J Child Psychol Psychiatry. 2001; 42: 963-70.
9. Bere E, Brug J, Klepp KI. Why do boys eat less fruit and vegetables than girls? Public Health Nutr. 2008; 11: 321-5.
10. Rovner AJ, Nansel TR, Wang J, Iannotti RJ. Foods sold in school vending machines are associated with overall student dietary intake. J Adolesc Health. 2011; 48: 13-9.
11. Kubik MY, Lytle IA, Hannan PJ, Perry CL, Story M. The association of the school food environment with dietary behaviours of young adolescents. Am J Public Health. 2003; 93: 1168-73.
12. World Health Organisation. Ten facts about chronic diseases. Geneva: WHO. 2005.
13. Okagbare TE, Naidoo S. Parents' perception of psychosocial factors, health compromising behaviours and oral health among adolescents in South Africa. SADJ. 2018; 73: 221-7.
14. Okagbare TE, Naidoo S. Parental participation in the influencing of the unhealthy behaviour of adolescents in their excessive consumption of free sugars: a qualitative study. SADJ. 2018; 74: 165-70.
15. Wenjun Li, Youssef G, Procter-Gray E., et al. Racial differences in eating patterns and food purchasing behaviors among urban older women. J Nutr Health Aging. 2017; 21: 1190-9.
16. Allen ML, Elliott MN, Morales LS, Diamant AL, Hambarsoomian K, Schuster M.A. Adolescent participation in preventive health behaviours, physical activity, and nutrition: differences across immigrant generations for Asians and Latinos compared with Whites. Am J Public Health. 2007, 97: 337-43.
17. Bruss MB, Morris JR, Dannison LL, Orbe MP, Quitugua JA, Palacios RT. Food, culture, and family: exploring the coordinated management of meaning regarding childhood obesity. Health Commun. 2005; 18: 155-75.
18. Macarthur LH, Anguiano R, Gross KH. Are household factors putting immigrant Hispanic children at risk for becoming overweight: a community-based study in eastern North Carolina. J Community Health. 2004, 29: 387-404.
19. Wardle J, Cooke L. Genetic and environmental determinants of children's food preferences. Br J Nutr. 2008, 99: 15-21.
20. Gibson EL, Kreichauf S, Wildgruber A., et al. A narrative review of psychological and educational strategies applied to young children's eating behaviours aimed at reducing obesity risk. Obes Rev. 2012, 13: 85-95.
21. Krølner R, Rasmussen M, Brug J, Klepp K, Wind M, Due P. Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part II: qualitative studies. Int J Behav Nutr Phys Act. 2011; 8: 1479-5868.
22. Duijster D, De Jong-Lenters M, Verrips E, van Loveren C. Establishing oral health promoting behaviours in children - parents' views on barriers, facilitators and professional support: a qualitative study. BMC Oral Health 2015, 15: 157-70.
23. Love P, Sayed N. Eat plenty of fruit and vegetables every day. S Afr J Clin Nutr. 2001; 14: 24-32.
24. Schwartz C, Scholtens P, Lalanne A, Weenen H, Nicklaus S. Development of healthy eating habits early in life: review of recent evidence and selected guidelines. Appetite 2011; 57: 796-807.
25. EUFIC Food Today. Tastes differ – how taste preferences develop 2011; Available from: http://www.eufic.org/article/en/page/FTARCHIVE/artid/how-taste-preferences-develop/ [Accessed 25/03/2016].
26. Mennella JA, Beauchamp GK. The early development of human flavor preferences. In Capaldi ED. (ed.). Why we eat what we eat: the psychology of eating. Washington, DC: American Psychological Association, 1996.
27. EUFIC Food Today. Encouraging young children to eat different vegetables. 2010. Available from: http://www.eufic.org/article/en/page/FTARCHIVE/artid/Encouraging-young-children-eat-different-vegetables/[Accessed 25/03/2016].
28. Crowe KM, Murray E. Deconstructing a fruit serving: comparing the antioxidant density of select whole fruit and 100% fruit juices. J Acad Nutr Diet. 2013; 113: 1354-8.
29. National Institute of Allergy and Infectious Diseases. Food Allergy: an overview 2012; Available from: https://www.niaid.nih.gov/topics/foodAllergy/Documents/foodallergy.pdf [Accessed 27-03-2016].
30. Kelava N, Lugović-Mihić L, Duvančić T, Romić R. Šitum, M. Oral allergy syndrome – the need of a multidisciplinary approach. Acta Clin Croat 2014; 53:210-19.
31. WHO. Fruit and Vegetable Promotion Initiative–report of the meeting, Geneva, 25–27 August 2003 WHO Geneva. http://www.who.int/dietphysicalactivity/publications/f&v_promotion_initiative_report.pdf. [Accessed 19/09/2019].
32. Gillman, M.W., Rifas-Shiman, S.L., Frazier, A.L., et al. Family dinner and diet quality among older children and adolescents. Arch. Fam. Med. 2000; 9: 235-40.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a2

Isolation of selected possible aerobic bacterial pathogens from dental environmental surfaces after use of disinfectants - A case study at a public dental clinic, in KwaZulu-Natal

SADJ June 2020, Vol. 75 No. 5 p241 - p246

S Deulkar[1], S Singh[2], D Tiwari[3]

ABSTRACT

Introduction

Cross infection in the dental clinical environment remains a low priority in conversations around oral health care despite the high risk of exposure to blood and airborne infections.

Aim and objectives

The aim of this study was to determine the presence of selected pathogens after use of disinfectants on specific dental environmental surfaces at a public oral health facility in KwaZulu-Natal.

Methods

This was a cross-sectional descriptive case study with a non-experimental design. The dental clinical environment was divided into four zones and 9 dental units were systematically selected.

Swabs were collected from the 26 identified areas at specific time intervals (7.00, 9.00, 11.00, and 16.00) after the use of chlorine, ethanol (70% in water) and glutaraldehyde (2%) as surface disinfectants. The collected swab samples were cultured in nutrient agar media for two days at 37°C. The colony forming units were then examined and characterized using the MALDI-TOF spectrometer.

Results

Out of the 312 samples taken, 262 (84%) were shown to be bacterial culture positive. The most contaminated areas in the dental environment were around the chair area (86.53%) and the area away from the chair (92%).

Glutaraldehyde was found to be more effective than chlorine and ethanol.

Conclusion

The study suggests an association between the frequency of cleaning, the type of disinfectant used and the bacterial microbial count on the specified dental environmental surfaces at the identified oral health facility.

Keywords

Infection control, disinfectants, dental environment, bacteria, cross-infection (contamination).

Author affiliations:

1. **Swati Deulkar:** *BDS (Nagapur Nasik University), M.Sc (UKZN),* Discipline of Dentistry, School of Health Sciences, University of KwaZulu-Natal, South Africa.
   ORCID Number: 0000-0003-0842-9541
2. **Shenuka Singh:** *B.OH, M.Sc (Dent), PhD (UWC), PG Dip Heal Res Ethics (Stell),* Discipline of Dentistry, School of Health Sciences, University of KwaZulu-Natal, South Africa.
   ORCID Number: 0000-0003-4842-602X
3. **Dileep Tiwari:** *PhD (Biotechnology) (University of Delhi),* Discipline of Pharmaceutical Sciences, School of Health Sciences, University of KwaZulu-Natal, South Africa.
   ORCID Number: 0000-0002-6342-1289

Corresponding author: Shenuka Singh
Associate Professor: Discipline of Dentistry, School of Health Sciences, University of KwaZulu-Natal, Private Bag X54001, Durban, South Africa.
Email: singhshen@ukzn.ac.za

Author contributions:

1. **Swati Deulkar:** First author - 65%
2. **Shenuka Singh:** Second author - 25%
3. **Dileep Tiwari:** Third author - 10%

INTRODUCTION

Cross-contamination in the dental clinical environment should be a major public health concern given the high risk of exposure to blood and airborne infections however this remains a low priority in conversations around oral health care.[1]

The greatest potential for cross-infection is among dental operators, assistants and patients, due to the presence of a combination of blood, saliva and contaminated instruments.[1] Apart from these possible sources of cross contamination, the environmental work surfaces and water lines of dental units could pose a potential risk unless optimal infection control measures are in place.[2]

Patients have the right to access oral health care in a safe and healthy clinical environment.[3] Universal precautions in infection control include hand washing/disinfection; use of personnel protective equipment (e.g. gowns, protective eye wear, and gloves); use of disinfectants for clinic surface cleaning; and appropriate handling and disposal of contaminated sharp instruments and other clinical waste.[4,5]

Ideally all vegetative microbes should be destroyed using heat sterilization procedures, however, it is neither cost effective nor practical to sterilize dental working surfaces or instruments that are heat sensitive.[6] Disinfection provides a more practical solution for ensuring prevention of cross contamination.[1] Disinfection is characterized by killing, destroying or removal of all pathogenic microbes, except spores.[6,7]

There are various disinfection methods, which include physical disinfection, heating and chemical disinfection.[8] The disinfectants used in most hospital settings include aldehyde, alcohol, Iodophors, quaternary ammonium compounds, alcohol ammonium and peroxygenated compounds.[9] The effectiveness of a disinfection solution is dependent on factors such as the type of microbes present, the concentration of the chemical used, and its exposure time to the affected microbes.[10]

Environmental surfaces are classified as clinical (medical) contact and housekeeping surfaces.[11] Clinical contact surfaces are those that comes in contact with contaminated devices, instruments, hands, or gloves, while housekeeping surfaces are not touched directly during the delivery of dental care.[11] Damp dusting is a common disinfection procedure in the dental clinical environment.[12] This study arose of the need to investigate the effectiveness of commonly used surface disinfectants on dental environmental surfaces. There is paucity of published literature that specifically examined the efficacy or effectiveness of commonly used surface disinfectants in oral health clinical settings in South Africa.[13] The aim of this study was thus to determine the presence of selected pathogens after use of disinfectants on specific dental environmental surfaces at a public oral health facility in KwaZulu-Natal.

METHODS

This was a cross-sectional descriptive case study using a non-experimental design. Ethical clearance was obtained from the UKZN Biomedical Research Ethics Committee (BREC reference number: 068/16) and the KZN Department of Health.
(Reference number: 26/16 KZ-2015RP12-306).

Areas of sampling

Systematic random sampling was used to select 9 dental units for the study. All dental units in the oral health facility (n = 17) were considered and those numbered: 1, 3, 5, 7, 9, 11, 13, 15, 17 were selected for the study. The dental clinical environment was divided into four zones:

1. Working area around the dental operator/assistant (chair head rest, arm rest, foot rest, dental hand pieces, overhead light source, air water syringe tip, spittoon, suction hose, base of dental chair, dental chair, foot pedal/control, instrument counter and handle).
2. Area behind the dental chair (wash basin, window, wall, table top, dust bin, taps).
3. Area away from the dental chair (computer processing unit, computer monitor, telephone, floor).
4. Reception area (patient chairs, reception table top).

All of these areas added up to 26 surfaces that were sampled at each of the nine units. Swabs were collected from the identified areas at 7.00 in the morning prior to the normal infection control and cleaning procedures that are conducted in the clinic (pre-disinfection).

Disinfectants used

Disinfectants such as Chlorine, ethanol (70% in water) and Glutaraldehyde (2%) were applied respectively as indicated below.

Day 1: Chlorine:
Chair 1: 26 swabs at 7.00 am after cleaning and at 9.00 am.
Chair 3: 26 swabs at 11.00 am.
Chair 5: 26 swabs at 16.00 pm.

Day 2: Ethanol:
Chair 7: 26 swabs at 7.00 am after cleaning and at 9.00 am.
Chair 9: 26 swabs at 11.00 am.
Chair 11: 26 swabs at 16.00 pm.

Day 3: Glutaraldehyde
Chair 13: 26 swabs at 7.00 am after cleaning and at 9.00 am.
Chair 15: 26 swabs at 11.00 am.
Chair 17: 26 swabs at 16.00 pm.

This was done by using a spray method, as per the manufacturer's instructions on the 26 sites and wiped with a cloth for one minute. The procedure of obtaining the swab samples was done by dipping cotton tipped swabs in sterile water using hand-held applicators (Sterilin, England), which were pre-moistened with sterile normal saline. These applicators were gently agitated/rotated over the desired environmental surface.

A pilot study was conducted on dental units that were not a part of the identified clinical area so as to address any challenges in the data collection process.

Procedure for culture growth and assessment

The swabs were stored below 23°C, after which they were taken to the microbiology laboratory for plating on nutrient agar and incubated at 37°C for 24 hours to enable microbial growth.

Colony forming unit (C.F.U.) counts on plates were checked for the highest number of different colonies after use of the disinfectant. This resulted in 104 swabs being collected after use of one disinfectant, with a total of 312 swabs for the three disinfectants.

The microbial colonies were differentiated by observation and sub-culturing was done either in bacterial or fungal species and other criteria such as growth on the specific growth media used, in addition to the MALDI TOF (Becton Dickinson Diagnostic Instrument System, Sparks, MD). All bacterial isolates were stored at very low temperature i.e. at -80°C in Trypticase soy broth with 10% glycerol and recovered at 37°C in Nutrient Agar medium prior to use.

Primary subcultures were used for MALDI-TOF MS analysis. The mass spectra were deposited in triplicate batches for each new strain. The same experiment was repeated the following day to ensure reliability of the test. A main spectrum (MSP) of the standard control strain was created to ensure correct identification of all peaks between the genera and the recommended score of 2.9 was used as the ideal detection score for the genus and species detection.

Microbiological analysis

The first step of the analysis involved visual assessment of the colonies on the agar plates. This involved identifying the morphology of the different bacterial growths and the presence of C.F.U counts. The second step of the analysis involved sub-culturing of a specific CFU colony. The colony with the highest healthy C.F.U. count was selected for sub-culturing.

The identified colony was picked up using the tip of a toothpick. Subculture colonies were grown on selective media such as MacConkey agar for Gram-negative bacteria. S. aureus was isolated using Manitol salt agar. *Enterobacter species* was isolated using Bile salt agar. The third step of the analysis was the species identification of the unknown isolates through the use of MALDI Biotyping.

The bacterial growth in the samples was checked before the application of the disinfectant, and this became the control measurement. This data was compared with the four selected areas (chair side area, area behind chair, area away from chair and reception area).

The colonial growth on the MALDI-TOF machine was checked and compared with the experimental bacterial spectra with the regulator group spectral bacteria (*Bruker Bacterial Test Standard (BTS)* and *E. coli DH5 alpha*). The microbial count was determined and compared after use of disinfectant at a specific time interval (the 7.00 am data was compared to the 11.00 am results).

The viable colony forming unit count (C.F.U.) in the range of 10 to 100 was considered to create infection. The key quality assurance process was the identification of each colony forming unit's molecular mass which was then compared to the bio-information repositories in MALDI-TOF.

Statistical Analysis

Univariate descriptive statistics such as frequency and mean distribution were conducted for all variables. An inferential technique such as the Pearson chi-squared test was used to determine a relationship between the use of the specified disinfectants and positive bacterial growth. A level of $p<0.05$ was established as being statistically significant.

RESULTS

Types of pathogens identified in dental clinic

Altogether 312 swabs samples were collected from various sites and 262 samples (84%) were found to be culture positive. Almost ten different species of bacteria and fungi were isolated, with *Staphylococcus* and *Bacillus spp* being the most commonly isolated.

The most frequently isolated bacteria were Gram-positive cocci (*CoNS, Enterococcus spp* and *S. aureus*), and Gram-negative enteric bacilli (*Escherichia coli* and *Klebsiella pneumoniae*). Other strains such as *Bacillus megaterium, Neisseria* species and *Enterobacter cloacae* were confirmed by the MALDI-TOF.

In total, 78 samples were taken pre-disinfection and all samples (100%) showed bacterial growth. After use of chlorine 68 samples out of 78 (87%) showed bacterial growth. Six different bacterial strains were observed (*Staphylococcus, Bacillus Enterococcus spp, S. aureus, Escherichia coli* and *Klebsiella pneumoniae*).

After the use of ethanol, 61 samples out of 78 (78%) showed bacterial growth and two different bacterial strains were observed (*Bacillus* and *Staphylococcus* species). After the use of Glutaraldehyde, 53 samples out of 78 (68%) showed bacterial growth and only one bacterial strain was observed (*Staphylococcus species*).

Most contaminated areas of the dental clinic post-disinfection

The contaminated areas in the dental clinical environment included the working area around the dental operator/assistant where 135 out of 156 samples (86.5%) had positive bacterial growth. This was followed by the area behind the chair where 59 out of 84 (70.2%) had positive bacterial growth. Alarmingly, the area away from the dental chair had higher levels of positive bacterial growth (92%).

The microbial count (CF.U.) for the identified areas of the dental clinic are presented in Table 1. The microbial count in the reception area before the application of disinfectants was high, and remained high despite the application of disinfectant at different time periods in the day. All samples in the reception area (n=24; 100%) showed positive bacterial growth, which suggested that the reception area was more contaminated than the dental operating area.

Level of contamination at different time intervals

The percentages of microorganism growth after disinfection procedures at specific time intervals are indicated in Table 2. Glutaraldehyde was the most effective disinfectant at all tested times (mean=17.66, p=0.01) followed by Ethanol (mean=20.33). Chlorine was the least effective at all tested times (mean=22.66).

DISCUSSION

The results of this study indicated that the microbial count on dental environmental surfaces (pre and post disinfection) was fairly high. *Staphylococcus species* were found on various surfaces of the dental clinic.

These findings are in contrast with Umar et al. who reported that *Staphylococcus aureus* and coagulase-negative Staphylococcus (CONS) constituted only 6% and 5% respectively of their isolated bacterial strains.[14]

Although this study focused on surface microbial count, these findings are similar to those reported in studies that examined airborne microbial load within the dental operating area.[15,16] The use of high-speed dental hand pieces (including those combined with a water spray) could potentially create aerosols which could increase risk for cross infection in the dental clinic.[17,18] The presence of *Staphylococcus species* in this study could be attributed to its presence in the human body and it may suggest poor hand hygiene procedures or disinfection procedures.[19] Mehtar et al. further observed in their study that infection control practices were sub-optimal despite the availability of related information on universal precautions for dental personnel.[20]

This study findings also indicated that colonies of *Escherichia coli* and *Klebsiella pneumoniae* species were isolated. This is consistent with Umar et al. who reported that almost 40% of their study samples were contaminated by bacterial colonization and included nosocomial species such as *Staphylococcus aureus*, *Klebsiella pneumonia,* and *Enterococcus* species.[14]

The authors suggested that use of mobile phones by dental practitioners in the clinical environment could be responsible for the spread of these nosocomial pathogens.[14] The fact that these microorganisms can survive in the hospital environment increases the risk of cross infection in immuno-compromised and other patients.[21] Additionally Molepo et al. reported *Escherichia coli* as the least commonly isolated organism present in their study post dental treatment while coagulase-negative staphylococci (84%) was most predominant microorganism found on contaminated dental bib chains.[22]

Laheij et al. pointed out that more research is required to assess risks of cross infection associated with viral and bacterial infections in dental settings.[23] However Kannan

Table 1. Microbial count (C.F.U. count) present at different surfaces after use of disinfectants.

	Chlorine				Ethanol				Glutaraldehyde			
Area / Time	C.F.U. count 7 AM	C.F.U. count 9 AM	C.F.U. count 11 AM	C.F.U. count at end of day	C.F.U. count 7 AM	C.F.U. count 9 AM	C.F.U. count 11 AM	C.F.U. count at end of day	C.F.U. count 7 AM	C.F.U. count 9 AM	C.F.U. count 11 AM	C.F.U. count at end of day
Chair side area: 135 out of 156 samples (86.5%) positive for bacterial growth												
Head rest	20	60	30	60	50	20	30	50	>100	1	50	50
Arm rest	30	25	>100	25	40	10	>100	70	10	50	50	50
Foot rest	20	100	>100	>100	25	25	>100	90	20	0	50	50
Air-rotor	25	0	40	20	40	0	0	20	50	0	0	3
Light source	3	0	4	40	3	0	60	20	3	5	50	10
Air water syringe tip	1	0	>100	40	3	0	50	60	20	0	20	5
Spittoon	20	20	60	20	30	30	0	30	100	10	50	60
Counter top	20	>100	0	10	30	0	0	30	10	0	0	0
Suction hose	>100	0	0	>100	>100	0	20	>100	50	0	20	50
Chair base	30	>100	10	20	30	30	>100	50	50	50	10	20
Dental stool	30	20	15	30	30	25	20	20	50	10	0	10
Foot controller	>100	30	70	>100	>100	20	60	>100	>100	25	20	50
Handle	4	>100	10	16	4	30	30	30	40	0	0	10
Area behind chair: 59 out of 84 samples (70.23%) positive for bacterial growth												
Wash basin	25	50	50	50	30	40	20	30	10	4	10	20
Window	20	0	0	0	24	0	0	30	30	0	0	0
Wall	2	5	9	5	2	0	0	5	28	0	-	50
Table top	4	20	10	20	6	0	>100	30	50	3	-	10
Dust bin	>100	20	>100	20	>100	0	>100	90	20	-	5	50
Tap	20	5	>100	5	30	0	0	50	50	0	0	10
Area away from chair: 44 out of 48 samples (92%) positive for bacterial growth												
CPU	30	40	>100	40	36	0	10	30	>100	0	5	5
Computer Screen	50	30	>100	30	50	0	10	20	50	0	0	0
Telephone	70	15	3	5	50	10	10	20	50	-	5	50
Floor	>100	150	>100	150	>100	100	>100	>100	70	10	50	50
Reception area: All samples (24, 100%) positive for bacterial growth												
Chair	>100	40	80	>100	>100	10	60	>100	100	50	60	100
Reception table top	20	20	60	>100	20	12	50	>100	>100	60	100	60

Table 2. Bacterial growth after use of disinfectants.

Frequency of disinfection	Chlorine	70% Ethanol	2% Glutaraldehyde
7.00 am (pre-disinfection)	26 (100%)	26 (100%)	26 (100%)
9.00 am	21 (80%)	15 (56%)	13 (52%)
11.00 am	23 (88%)	21 (80%)	19 (74%)
± 16.00 pm (end of the working day)	24 (92%)	25 (96%)	21 (82%)

et al. postulate that aerobic and anaerobic spores will exist in the dental clinic despite stringent disinfection procedures.[24] Thus more research is required to isolate the various microbial strains that could contaminate the dental workplace.

Effectiveness of disinfectants

Glutaraldehyde and ethanol had more effect on the identified *in vitro* bacteria. Glutaraldehyde appeared to control most of the bacteria, except *staphylococcus* species. These findings are consistent with Almeida et al., who reported that 2% glutaraldehyde was the only efficient method in their study to control microbial growth on orthodontic pliers when compared to ethyl alcohol 70% or soap and water.[25]

Ethanol also controlled most of the bacteria, except *Bacillus* and *staphylococcus*.[26,27] Ethanol could therefore be a low-level or intermediate surface disinfectant. This finding is supported by Ribeiro et al. who reported that 'disinfection of semi-critical products (such as mouth mirrors and amalgam condensers) with alcohol 70%, or in an approximate concentration, may be reached for both products that are previously cleaned and for the ones which are not.[28:750]

Chlorine® was not active against many bacteria, since six different bacterial species were isolated, which was higher than ethanol and glutaraldehyde. Chlorine can thus be considered the weaker disinfectant for bacteria, with its possible resistance being attributed to its prolonged use in the hospital.

Although there is much debate around the efficacy of Chlorine® as a disinfectant, a recent study concluded that surface cleaning with 0.5% chlorine solutions (using a 15-min exposure time) could be effective in reducing risk of viral transmission.[29]

Thus the selection of a disinfectant must include other factors such as its toxicity, chemical content, stability, cost, degree of microbial killing required, potential damage to instrument and ability to kill microorganisms rapidly.[30] More research is required to further unpack these other considerations.

Awareness of disinfection procedures in the dental clinic

In this study, almost 87% of clinical surfaces were contaminated. It should be noted that the area around the chair had high levels of contamination levels despite the existing infection control procedures.

This finding is supported by Castalia et al. who also observed high levels of microbial load at the beginning of the working day.[31]

This study findings indicate that disinfection processes at the identified oral health facility is inadequate, suboptimal and could actually be contributing to the infection chain. There is an urgent need to review the current infection control procedures and protocols, including a review of the type of surface disinfectants used.

The frequency of disinfection (damp-dusting and housekeeping) should be reviewed, given the number of patients seen at the facility. It is also imperative that simple procedures such as awareness of hand hygiene practices are implemented and prioritized. In addition, there should be dedicated infection control monitoring and evaluation processes.

Although the study provided interesting insights into the comparative effectiveness of surface disinfectants against identified bacterial growth, some limitations were noted. The study focused only on bacteria that were identified on the MADI-TOF database.

The study did not investigate any other resistant strains of bacteria. The use of blood agar media to support *in vitro* pathogenic bacterial growth could be explored in future studies.[32] The study also focused exclusively on bacteria and did not investigate other microbes that could contribute to the cross-infection chain. More research is needed to explore this relationship further.

CONCLUSION

The study suggests an association between the frequency of cleaning, the type of disinfectant used and the bacterial microbial count on the specified dental environmental surfaces in the identified oral health facility.

Acknowledgement

Staff at the Catalysis and Peptide Research Unit (UKZN) for guidance and support in the laboratory component of this study. Adeola Shobo for his technical assistance with the MALDI-TOF machine.

Declaration

The authors declare no conflict of interest.

Funding

This paper forms part of a Masters dissertation for the first author. A scholarship of R25, 000.00 was obtained from the College of Health Sciences, UKZN.

Lessons learned

1. The protocols for infection control in the dental clinic needs to be reviewed.
2. The frequency of cleaning and the type of disinfectant used, needs to be reviewed.
3. Further research is required to identify other types of microbial activity on dental environmental surfaces.
4. Infection control procedures should be further emphasized in the undergraduate training programme.
5. Likewise, all members of the dental team (clinical and non-clinical staff) should have ongoing training in infection control.

References

1. Connor C. Cross-contamination control in prosthodontic practice. Int J Prosth. 1991; 4: 337-44.
2. Coleman DC, O'Donnell MJ, Shore AC, Russell RJ. Biofilm problems in dental unit water systems and its practical control. J Appl Microbiol. 2009; 106(5): 1424-37.
3. Petersen PE. Continuous improvement of oral health in the 21st century-the approach of the WHO Global Oral Health Programme. 2003.

4. Weinstein RA, Bridges CB, Kuehnert MJ, Hall CB. Transmission of Influenza: Implications for Control in Health Care Settings. Clin Infect Dis. 2003; 37(8): 1094-101.
5. Garner JS. Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol. 1996; 17(1): 53-80.
6. Kohn WG, Amy S, Collins AS, Cleveland JL, Harte JA., Eklund KL, Malvitz DM. Guidelines for Infection Control in Dental Health-Care Settings. 2003. December 19/52(RR17); 1-61. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm.
7. Todd ECD. Microbiological safety standards and public health goals to reduce foodborne disease. Meat Sci. 2004; 66(1): 33-43.
8. Allsopp J, Basu MK, Browne RM, Burge PS, Matthews JB. Survey of the use of personal protective equipment and prevalence of work related symptoms among dental staff. Occup Environ Med. 1997; 54(2): 125-34.
9. Kümmerer K. Drugs in the environment: Emission of drugs, diagnostic aids and disinfectants into wastewater by hospitals in relation to other sources - A review. Chemosphere. 2001; 45(6-7): 957-69.
10. Todd ECD, Michaels BS, Holah J, Smith D, Greig JD, Bartleson CA. Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 10. Alcohol-based antiseptics for hand disinfection and a comparison of their effectiveness with soaps. Journal of Food Protection, 2010; 73 (11): 2128-40.
11. Bhalla A, Pultz NJ, Gries DM, Ray AJ, Eckstein EC, Aron DC, et al. Acquisition of Nosocomial Pathogens on Hands After Contact With Environmental Surfaces Near Hospitalized Patients. Infect Control Hosp Epidemiol. 2004; 25(2): 164-7.
12. Caveney L. Infection Control: The Surgical Environment and Ancillary Areas. In: Veterinary Infection Prevention and Control. John Wiley & Sons, Inc. 2016; 245-72.
13. World Health Organization. Oral Health Surveys - Basic Methofd. 5th ed. World Health Organization. 2013; 1-137.
14. Umar D, Basheer B, Husain A, Baroudi K, Ahamed F, Kumar A. Evaluation of bacterial contamination in a clinical environment. J Int Oral Health. 2015; 7(1): 53-5.
15. Kadaifciler DG, Cotuk A. Microbial contamination of dental unit waterlines and effect on quality of indoor air. Environ Monit Assess. 2014; 186(6): 3431-44.
16. Kimmerle H, Wiedmann-Al-Ahmad M, Pelz K, Wittmer A, Hellwig E, Al-Ahmad A. Airborne microbes in different dental environments in comparison to a public area. Arch Oral Biol. 2012; 57(6): 689-96.
17. Merchant VA. Herpesviruses and other microorganisms of concern in dentistry. Vol. 35, Dental Clinics of North America. 1991; 283-98.
18. Davies KJ, Herbert AM, Westmoreland D, Bagg J. Sero-epidemiological study of respiratory virus infections among dental surgeons. Br Dent J. 1994; 176(7): 262-5.
19. Labandeira-Rey M, Couzon F, Boisset S, Brown EL, Bes M, Benito Y, et al. Staphylococcus aureus Panton-Valentine leukocidin causes necrotizing pneumonia. Science. 2007; 315(5815): 1130-3.
20. Mehtar S, Shisana O, Mosala T, Dunbar R. Infection control practices in public dental care services: findings from one South African Province. J Hosp Infect. 2007; 66(1): 65-70.
21. Weinstein RA, Gaynes R, Edwards JR. Overview of Nosocomial Infections Caused by Gram-Negative Bacilli. Clin Infect Dis. 2005; 41(6): 848-54.
22. Molepo J, M Molaudzi M, Ralephenya TRMD. Microbial contaminants on dental bib chains with attached clips. SADJ 2015; 70(3): 104-7.
23. Laheij AMGA, Kistler JO, Belibasakis GN, Välimaa H, de Soet JJ. Healthcare-associated viral and bacterial infections in dentistry. J Oral Microbiol. 2012; 4:1 17659. DOI: 10.3402/jom.v4i0.17659.
24. Kannan I, Jeevitha JY, Sambandam C, Jayalakshmi M, Premavathy RK, Shantha SInt S. Evaluation of surface contamination of bacteria in various dental clinics with special reference to obligate and facultative anaerobic spore bearing bacilli. J Med Res Health. 2014; 3: 554-9.
25. de Almeida CMF, de Carvalho AS, Duarte DA. Avaliação dos métodos de desinfecção de alicates ortodônticos. Dental Press J Orthod. 2012; 17(4): 105-9.
26. Fisher K, Phillips CA. The effect of lemon, orange and bergamot essential oils and their components on the survival of *Campylobacter jejuni, Escherichia coli O157*, *Listeria monocytogenes, Bacillus cereus* and *Staphylococcus aureus in vitro* and in food systems. J Appl Microbiol. 2006; 101(6): 1232-40.
27. Widmer AF. Replace Hand Washing with Use of a Waterless Alcohol Hand Rub? Weinstein A, editor. Clin Infect Dis. 2000; 31(1): 136-43.
28. Ribeiro MM, Neumann VA, Padoveze MC, Graziano KU. Efficacy and effectiveness of alcohol in the disinfection of semi-critical materials: a systematic review. Rev Lat Am Enfermagem. 2015; 23(4): 741-52. DOI: 10.1590/0104-1169.0266.2611.
29. Lantagne D, Wolfe M, Gallandat K, Opryszko M. Determining the Efficacy, Safety and Suitability of Disinfectants to Prevent Emerging Infectious Disease Transmission. Water 2018; 10(10): 1397.
30. Angelillo IF, Bianco A, Nobile CGA, Pavia M. Evaluation of the efficacy of glutaraldehyde and peroxygen for disinfection of dental instruments. Letters in Applied Microbiol 1998; 27: 292-6.
31. Castiglia P, Liguori G, Montagna MT, Napoli C, Pasquarella C, Bergomi M, et al. Italian multicenter study on infection hazards during dental practice: Control of environmental microbial contamination in public dental surgeries. BMC Public Health. 2008; 8.
32. Turista DDR, Puspitasari E. The growth of *Staphylococcus aureus* in the blood agar plate media of sheep blood and human blood groups A, B, AB, and O. Jurnal Teknologi Laboratorium. 2019, 8(1): 1-7. DOI: 10.29238/teknolabjournal.v8i1.155.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a3

A survey of South African Maxillofacial & Oral Surgeon opinions regarding the academic education in the field of cleft lip/palate and craniofacial deformities

SADJ June 2020, Vol. 75 No. 5 p247 - p252

E Ghabrial[1], KW Bütow[2]

ABSTRACT

Background

Maxillofacial and oral surgeons (MFOS) are trained to manage hard and soft tissue conditions affecting the orofacial region. They, therefore, play an essential role in the health care of cleft lip/palate (CLP) and craniofacial deformities (CFD) patients.

The complex and lengthy nature of CLP and CFD management requires collaboration between different disciplines. Consequently, it becomes increasingly important that the academic education available to MFOS provides in-depth knowledge, multidisciplinary participation and adequate clinical exposure provided by field experts.

Objectives

This study aimed to investigate the exposure and knowledge level of MFOS regarding the management of CLP and CFD. A second objective was to obtain an opinion from practising MFOS about the academic educational needs of those working with CLP and CFD.

Method

An online survey and telephone interviews (using a structured questionnaire) were used to investigate the level and scope of the MFOS academic education and to determine their academic needs.

Results

The questionnaire was completed by 53 (of 121) of practising MFOS on the Medpages health care provider database, 64.8% of whom had more than 10 years of professional experience.

Of the respondents, 60% showed a good general knowledge of CLP and CFD. However, 66.5% acknowledged that they had received only limited clinical training and exposure, which prevented them from providing adequate services to CLP/CFD patients. Only 41% of the respondents offered primary and/or only secondary treatment for both CLP and CFD patients, and 53.8% of them had participated in multidisciplinary teams.

All the respondents agreed on the need for a dedicated training programme(s) in CLP and CFD management, and the majority recommended a subspecialty training either by degree courses or clinical fellowship and / or certification.

Conclusion

This study demonstrates that postgraduate academic training and clinical exposure are limited in the CLP and CFD fields. All the respondents agreed that an educational strategy to meet the needs of MFOS providing CLP and CFD care should be established. Participants suggested that part-time clinical and/or degree courses should be developed.

Keywords

Maxillofacial & oral surgeon, cleft lip and palate, cleft lip, alveolus and palate, multidisciplinary, education, survey for dental professions.

Author affiliations:

1. **Emad Ghabrial:** *BDS HDD PG Dip MChD (Ortho),* Senior Lecturer, University of Pretoria, Attending orthodontist for the Cleft Lip and Palate Clinic, Pretoria, South Africa.
   ORCID Number: 0000-0002-7213-9760
2. **Kurt W Bütow:** *MChD (MFOSurg), DrMedDent PhD DSc (Odont) FCMFOS, FIBCSOMS,* Professor and Head of Department Emeritus, and former Head of the Cleft Lip and Palate Clinic, University of Pretoria, Pretoria, South Africa.

Corresponding author: Emad Ghabrial
Professor and Head of Department Emeritus, and former Head of the Cleft Lip and Palate Clinic, University of Pretoria, Pretoria, South Africa, PO Box 11654, Queenswood 0121.
Email: emad.ghabrial@up.ac.za

Author contributions:

1. **Emad Ghabrial:** First author - 70%
2. **Kurt W Bütow:** Second author - 30%

INTRODUCTION

Surgical care for cleft lip/palate and craniofacial deformities (CLP and CFD) contributes to the global cost of disease, making many patients unable to access adequate surgical care.[1] A shortage of human resources for surgical care, and inadequate surgical capacity and finance in developing countries (including South Africa), have been reported in the literature.[2]

Consequently, CLP and CFD surgery has been identified as one of the essential surgeries that need to be performed consistently around the world.[3] The maxillofacial and oral 'surgeon's (MFOS) role is essential in caring for children born with CLP and CFD deformities.[4]

These surgeons are trained to manage both hard and soft tissue conditions affecting the orofacial region in order to achieve optimal functionality and aesthetically pleasing outcomes[5] and to avoid midfacial dysgnathia as far as possible.[6] Consequently, dental professionals prefer that MFOS manage CLP and CFD deformities.[7]

For many years, researchers and practitioners have understood the need to gain educational and clinical experience of treating all segments of society in order to provide quality management and improved access to care for all patients.[8] One of the earliest attempts to assess the exposure of medical and dental students to CLP treatment was done by Lass et al.[9] using a survey questionnaire. The main finding was that students lacked clinical exposure and basic theoretic education.[9] Spriestersbach et al.[10] acknowledge the effects of limited training in CLP management and advise that a clinician with limited training should not manage individuals with CLP.

These patients normally have challenging health issues because of additional complexities related to their skeletal, soft tissue and facial problems. This makes it more difficult to handle such patients as a single discipline cannot make all treatment decisions.[11]

Close collaboration between different disciplines is an integral part of the multidisciplinary team approach for the management of patients and has been advocated by practitioners.[12] Therefore, practitioners involved in CLP and CFD should be educated not only in their own fields but also in the treatment provided by other disciplines involved in multidisciplinary care.[13]

As a result, the training and development of an efficient multidisciplinary team member should be based on a pedagogical model for successful skills transfer and cooperation within the team model.[14] Not only is academic education essential for a multidisciplinary team member, but it must be combined with research in order to monitor and improve treatment outcomes.[15]

The value of treatment management relies on the training and exposure which the student received at university and the knowledge gained throughout the practitioner's career. Subsequently, feedback on the education rceived, and further training needs is necessary to provide a foundation for the improvement of educational courses, which will lead to the provision of better health services.[16]

OBJECTIVES

1. Measure the exposure and knowledge level of MFOS in the management of CPD and CFD.

2. Obtain an opinion from MFOS about the current CLP and CFD academic educational needs.

METHOD

Ethical permission was obtained from the Humanities and Social Sciences Research Ethics Committee reference (HSS/0235/017D), of the University of KwaZulu-Natal. The research survey was completed by South African MFOS who consented to participate in the study, using an online questionnaire to investigate the academic education provided to CLP and CFD practitioners.

A quantitative research method, using a 51-item structured questionnaire, was developed. Qualtrics Research Suite survey software was used to capture and analyse the data. The questionnaire was designed to collect quantitative data using a Likert-type scale, which was explained telephonically to each practitioner.

Consent for participation was obtained from each respondent prior to their completing the questionnaire. The data was collected either online or during a telephone interview, according to the preference of the participant.

Questionnaire design

The questionnaire consisted of a statement of consent to participate, followed by four sections: the first determined whether the participants were accepted for inclusion in the study. The second section collected their level of knowledge and experience. In the third section, their needs and preferences regarding further education were determined. The last section collected demographic data, which included a title, gender, age, degree(s) and location by region.

Selection of participants

A random sample of MFOS was obtained from the Medpages active practitioners' database list.[17] The sample was randomly selected from the list using Microsoft Excel (2013). On the advice of a statistician, the number of participants selected represented all MFOS in South Africa, with a sampling error of approximately 15%.

Before distribution, the questionnaire was piloted by a convenience sample of practitioners and subsequently revised based on their responses in order to ensure appropriate capturing of data. The researcher then approached the South African Society of Maxillofacial and Oral Surgeons to distribute the survey by e-mail. Initially, the questionnaires were to be distributed by the Qualtrics online survey platform twice during the first week, then weekly afterwards. This was ultimately not necessary, as the targeted participant number was achieved by randomly contacting 56 MFOS on the Medpages database.

Data analysis

The data was captured using Excel 2013. This was later converted into Stata 15 format. The analysis undertaken was descriptive summary statistics presenting frequencies and associated percentages. No further analytical tools were used because no hypothesis was being tested.

RESULTS

The questionnaire was completed by 46.3% (n=53) of the MFOS practitioners listed in the Medpages database, representing most South Africa provinces, with the highest participation from Gauteng (44.2%), Western Cape (19.2%), KwaZulu-Natal (17.3%) and Eastern Cape (7.6%) (Fig. 1).

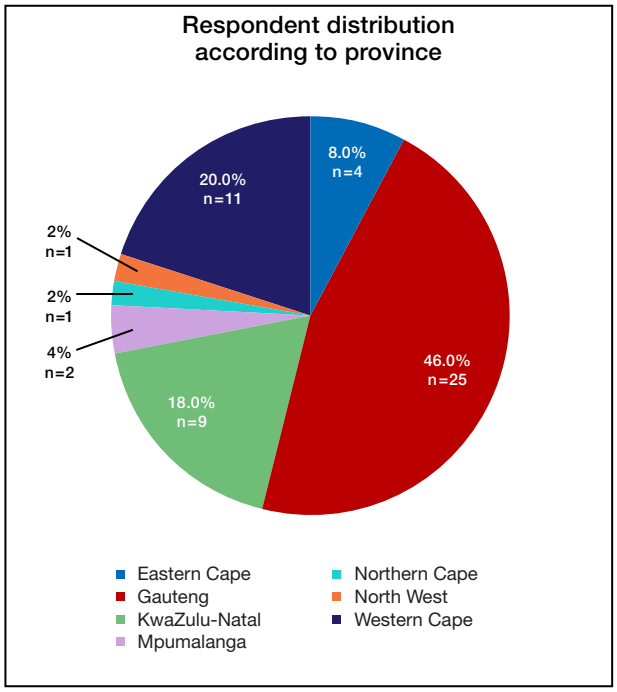


Figure 1. Respondent distribution according to province.

The distribution of participants according to years of experience showed that 64.8% had more than 10 years, 20.3% had 5-10 years and the rest had less than five years of professional experience (Fig. 2).

When asked general questions about the incidence and distribution of CLP, only 62% showed good general knowledge.

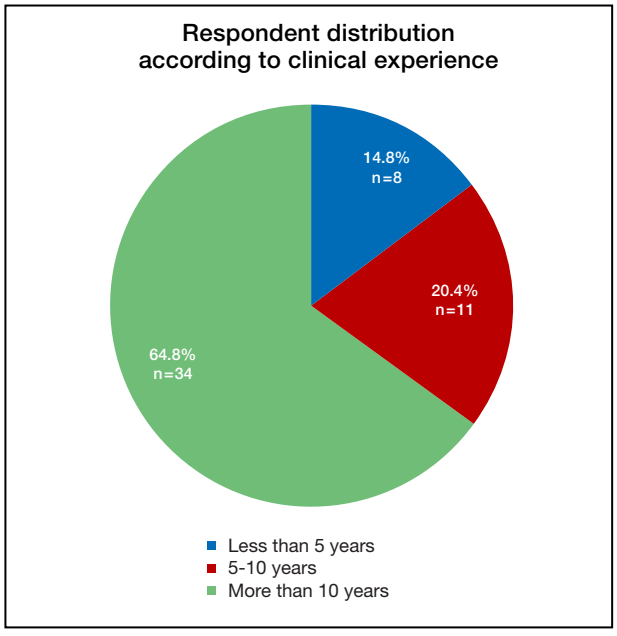


Figure 1. Respondent distribution according to clinical experience.

Regarding CLP/CFD academic education, the participants noted that, during their postgraduate studies, 38.8% had received some clinical exposure, and 40.7% had participated in CLP/CFD multidisciplinary and discussion meetings. A total of 61.1% gained their knowledge from textbooks, and 57.4% received their information by means of lectures (didactic input) (Fig. 3).

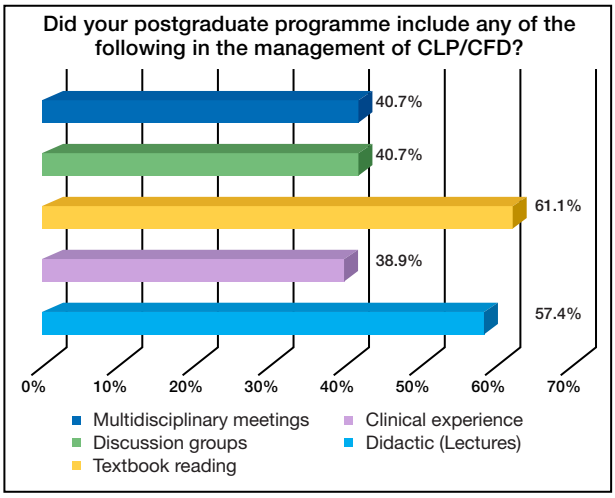


Figure 3. Did your postgraduate programme include any of the following in the management of CLP/CFD?.

Concerning services to CLP/CFD patients, 57.4% of the professionals did not offer surgical treatment for CLP or CFD patients. When asked to name the factors which prevented them from treating CLP and CFD patients, 66.7% acknowledged that it was due to their limited clinical experience and training, 12.5% mentioned the long duration of the treatment, 10.4% cited lack of interest, and 10.4% mentioned the need for multidisciplinary treatment (Fig. 4).

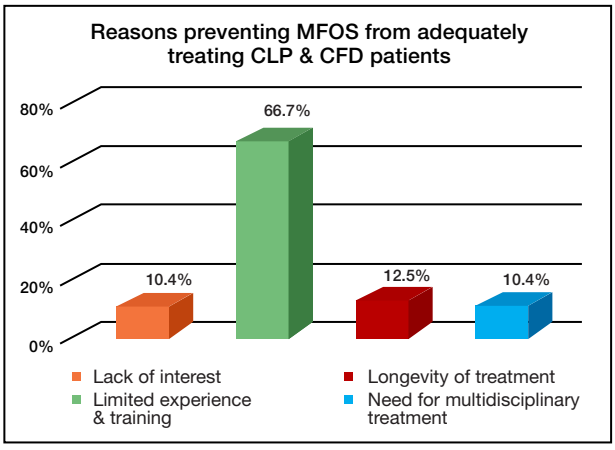


Figure 4. Reasons preventing MFOS from adequately treating CLP and CFD patients.

All the respondents agreed on the need for dedicated academic training programmes for CLP/CFD management. Of the respondents, 42.1% suggested degree (certification) courses, while 36.8% proposed non-degree clinical fellowships and the rest recommended continuing professional education (Table 1).

For degree and non-degree postgraduate CLP/CFD courses, the respondents suggested that admission requirements should include at least one professional degree.

Table 1. Type of course recommended.

Course recommended	%	N
Degree course, diploma, master's and fellowship certification	42.1%	31
Non-degree course fellowship training (only)	36.8%	28
CPD courses	21.0%	16

A total of 85.2% said that health professional full registration as a specialist was essential, whereas 44.4% placed emphasis on years of clinical experience and 22.2% suggested writing an admission examination (Fig. 5).

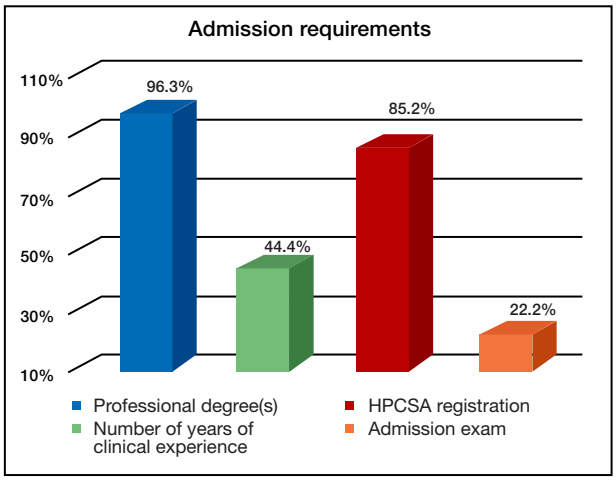


Figure 5. Admission requirements.

When the participants were asked about their motives for enrolling in such a programme, 46.2% identified interest and passion, 20.1% liked the idea of joining a multidisciplinary team, 14.8% mentioned alleviating community needs, 12.4% wished to receive a degree, and only 5.9% wished to improve their income (Fig. 6).

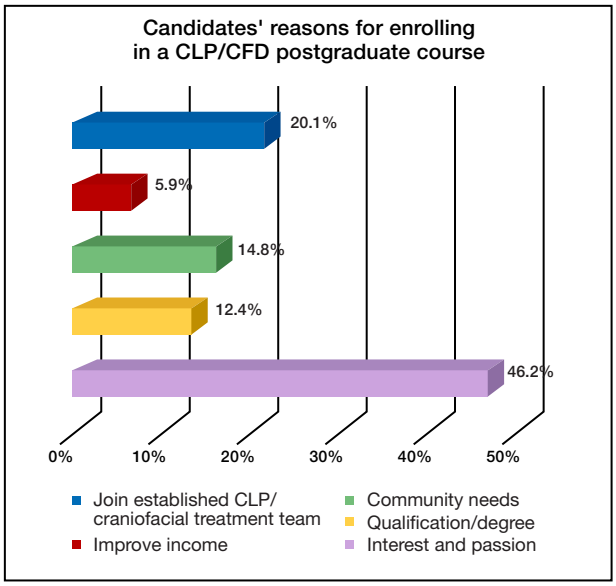


Figure 6. Candidates' reasons for enrolling in a CLP/CFD postgraduate course.

The participants had various views regarding the essential aspects of the goals and objectives of training programmes, but the majority agreed that diagnosis and treatment planning, clinical skills and multidisciplinary exposure are important.

Teamwork skills were valued by 79.6%, whereas 68.5% proposed special needs care, 44.4% recommended some research experience and 31.5% suggested participation in charity missions (Table 2).

Table 2. The goals and objectives of postgraduate training programmes.

Goal & objectives	%
In-depth knowledge	98.1%
Diagnosis and treatment planning	100.0%
Clinical skills	98.1%
Multidisciplinary approach	88.9%
Research	44.4%
Special needs care	68.5%
Teamwork skills	79.6%
Participation in charity missions	31.5%

Regarding the form of evaluation, 88.8% recommended keeping a logbook of clinical hours, 79.6% suggested a written/oral examination, 49% suggested assignments and 29.6% proposed publication in a scientific journal as an important evaluation method (Fig. 7).

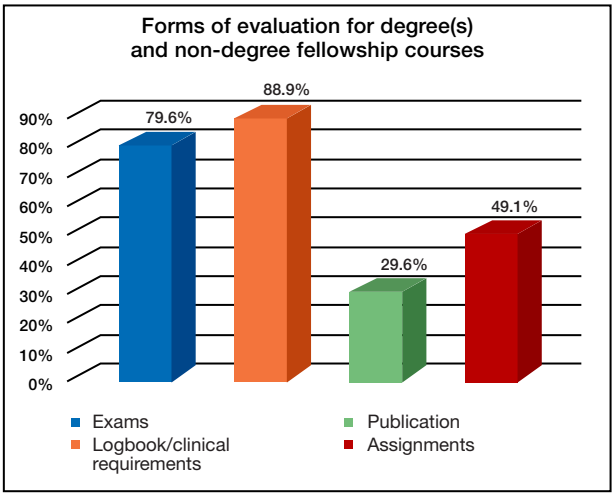


Figure 7. Forms of evaluation for degree(s) and non-degree fellowship courses.

DISCUSSION

To our knowledge, no survey has been undertaken in South Africa to investigate the opinion of MFOS about academic education in the field of CLP/CFD. However, such surveys have been conducted among other specialities in other parts of the world.[9,18]

Other surveys studies, of health professionals, used samples from the national bodies similar to the Health Professional Council of South Africa database.[19,20] In this study, participants were obtained from a list of active MFOS practitioners in a privately managed Medpages healthcare database, which is regularly updated.[17] The sample was randomly selected from the Medpages list and included practitioners from different locations and places of employment, in order to overcome limitations and to obtain general opinions from all clinicians.

It is recognised in the literature that it is difficult to receive adequate response rates in surveys of medical practitioners.[21] Some researchers have used e-mail, or postal questionnaires and others have used incentives to im-

prove the response rate.[22] In this study, the 46.3% response rate was achieved by using a mixed method of data collection using both telephone interviews and e-mail, which provided a wide distribution not limited by e-mail access, in line with recommendations by Flanigan et al.[23]

Regarding the sample size the author used the literature information as a guide for an acceptable response rate.[19,25] In agreement with the findings of other disciplines in regard to CLP/CFD academic education[26,27], this study found a limited emphasis on clinical training and multidisciplinary exposure during academic graduate programmes, meaning that graduate students may leave with limited education in the CLP and CFD fields.[27] Accordingly, this survey revealed a strong desire among South African MFOS for professional development and the need for a dedicated educational programme(s) in the CLP/CFD field.

CFD surgery programmes are available in different parts of the world as a subspecialty obtained by a clinical fellowship residency.[29] Responses in this study show that 79.9% recommended a fellowship and certificate programme. Concerning the length of such a programme, the respondents are equally divided between one or two years, which is partially in line with the minimum 12 months of fellowship residency recommended by Silvestre et al.[30]

Similar to the current recommended structure of fellowships in different parts of the world[31,32], the majority of the respondents recommended that the training should place more emphasis on discussions and clinical contact, with evaluation by means of formal examinations and a clinical hours logbook.

The respondents agreed with the findings of other studies that participation in a multidisciplinary team is vital in order to produce surgeons who are capable of providing safe, efficient and effective care for those affected with CLP/CFD.[29] Therefore, such comprehensive training can only be offered by a multidisciplinary centre where a high volume of craniofacial surgical procedures are performed by experts in the field.[33]

As stated by Egro et al.[34], candidate selection criteria should include professional degrees, the number of years qualified and possibly even an admission examination. But the respondents did not consider other requirements such as research experience and publications in candidate selection. This is in contrast with Grewal et al.[35], who state that scientific publication is a good indicator of those who will be willing to provide fellowship mentoring and education. However, the respondents in this survey recommended that the selected candidates must have interest and passion and should be planning to join an established craniofacial team. These could be important factors in building much-needed educational capacity.

CONCLUSION

There is a need to establish an educational strategy for MFOS in CLP and CFD surgery to ensure they are competent and can, therefore, provide multidisciplinary services for CLP/CFD patients. This study revealed that many practitioners are enthusiastic about and willing to enrol in training programmes to prepare them to deliver the best clinical care in CLP/CFD management.

This study also provided information about candidate selection criteria, education objectives and evaluation of such programme(s). Our findings are that, to be able to offer such education programme(s) in South Africa, MFOS, academicians, practitioners and professional societies need to collaborate in order to maintain and develop craniofacial centres where a high volume of CLP/CFD surgical procedures are performed and where enough experts are employed.

All this will provide sufficient training for the candidate not only to be able to provide ideal and comprehensive services for CLP/CFD patients but also to undertake leadership positions in a multidisciplinary team.

Acknowledgements

The authors would like to thank the Gerald Gavron Research Fund of the South African Society of Orthodontics for financial support, SAS Olorunju PhD, the Biostatistics Unit of the South African Medical Research Council for providing the statistical support, and Professor FA de Wet, Professor Emeritus for proofreading the manuscript.

Appendix 1

The dataset supporting the conclusions of this article is not currently available, as it is part of the researcher's PhD thesis. The questionnaire used to collect the data is available from the corresponding author on request.

Declaration

This article is based on a study done by the researcher in partial fulfilment of his PhD thesis.

The authors declare no conflict of interest.

Funding

The PhD project was funded by the SA Society of Orthodontics Gerald Gavron Fund. The funding sources were not involved in the design of the study, data collection analysis, interpretation of results, or writing the manuscript.

References

1. Meara JG, Hagander L, Leather AJM. Surgery and global health: A Lancet commission: Lancet, London. 2014; 383 (9911): 12-3.
2. Taro T, Yao C, Ly S, Wipfli H, Magee K, Vanderburg R, et al. The global surgery partnership: An innovative partnership for education, research, and service. Acad Med. 2016; 91(1): 75-8.
3. Poenaru D, Lin D, Corlew S. Economic valuation of the global burden of cleft disease averted by a large cleft charity. World J Surg. 2016; 40(5): 1053-9.
4. Sachs SA, Schwartz MH, Drew SJ. The oral and maxillofacial 'surgeon's role in the care of patients with cleft lip and palate deformities. NY State Dent J. 1998; 64(7): 24-9.
5. Brennan PA, Macey-Dare LV, Flood TR, Markus AF, Uppal R. Cleft lip and palate management by UK consultant oral and maxillofacial surgeons: A national survey. Cleft Palate Craniofac J. 2001; 38(1): 44-8.
6. Bütow K, Zwahlen R. Ultimate result. Cleft ultimate treatment. 2nd ed. Reach Publishers, Durban. 2016; 20, 423, 430.

7. Rocha NS, Laureano Filho JR, Silva ED, Almeida RC. Perception of oral maxillofacial surgery by healthcare professionals. Int J Oral Maxillofac Surg. 2008; 37(1): 41-6.
8. Gadbury-Amyot CC, Simmer-Beck M, McCunniff M, Williams KB. Using a multifaceted approach including community-based service-learning to enrich formal ethics instruction in a dental school setting. J Dent Ed. 2006; 70(6): 652-61.
9. Lass NJ, Gasperini RM, Overberger JE, Connolly ME. The exposure of medical and dental students to the disorder of cleft palate. Cleft Palate J. 1973; 10(56): 306-11.
10. Spriestersbach DC, Dickson DR, Fraser FC, Horowitz SL, McWilliams BJ, Paradise JL, et al. Clinical research in cleft lip and cleft palate: The state of the art. Cleft Palate J. 1973; 10: 113-65.
11. Marks M. A teamwork approach to cleft palate rehabilitation in South Africa. S Afr J Commun Disord. 1960; 7(2): 8-10.
12. Bütow KW. Treatment of cleft lip and palate. Part V: The clinic and the multidisciplinary approach to cleft lip and palate cases. J Dent Assoc S Afr. 1984; 39(8): 543-5.
13. Berkowitz S. Cleft lip and palate: Diagnosis and management: Springer-Verlag; Berlin, 2013. 885.
14. Garner HG. Teamwork models and experience in education: Allyn & Bacon; Needham Heights, MA 1995; 65.
15. McCarthy JG, editor. Development of craniofacial orthodontics as a subspecialty at New York University Medical Center. Semin Orthod. 2009; 15(4): 221-4.
16. Kern DE, Thomas PA, Hughes MT. Curriculum development for medical education: A six-step approach. 2nd ed. Johns Hopkins University Press; Baltimore, MD 2009; 5-15.
17. Medpages, South Africa: (updated 7 Sep 2016; cited 28 July 2017). Available from: https://www.medpages.info/sf/index.php?page=services.
18. Vallino LD, Lass NJ, Pannbacker M, Klaiman PG, Miller P. Medical students' knowledge of and exposure to cleft palate. Cleft Palate Craniofac J. 1992; 29(3): 275-8.
19. Modi N, Ross E. The current practices, training and concerns of a group of hospital-based speech therapists working in the area of dysphagia. S Afr J Commun Disord. 2000; 47: 3-14.
20. Snyman L, Visser J. The adoption of social media and social media marketing by dentists in South Africa. S Afr Dent J. 2014; 69(6): 258-64.
21. Kellerman SE, Herold J. Physician response to surveys. A review of the literature. Am J Prev Med. 2001; 20(1): 61-7.
22. Keating NL, Zaslavsky AM, Goldstein J, West DW, Ayanian JZ. Randomised trial of $20 versus $50 incentives to increase physician survey response rates. Med Care 2008; 46(8): 878-81.
23. Flanigan TS, McFarlane E, Cook S, editors. Conducting survey research among physicians and other medical professionals: A review of current literature. In Proceedings of the Survey Research Methods Section, American Statistical Association . May 15 2008; 1: 4136-47.
24. Modi, N, Ross E. The current practices, training and concerns of a group of hospital-based speech therapists working in the area of dysphagia. The South African Journal of communication disorders. 2000; 47: 3-14
25. Thandeka M, Penelope F, Robin J. Are South African speech-language therapists adequately equipped to assess English Additional Language (EAL) speakers who are from an indigenous linguistic and cultural background? A profile and exploration of the current situation. S Afr J Commun Disord. 2016; 63(1): e1-e5.
26. Noble J, Schroth RJ, Hechter FJ, Huminicki A, Wiltshire WA. Motivations of orthodontic residents in Canada and the United States to treat patients with craniofacial anomalies, cleft lip/palate, and special needs. Cleft Palate Craniofac J. 2012; 49(5): 596-600.
27. Bedwinek AP, Kummer AW, Rice GB, Grames LM. Current training and continuing education needs of preschool and school-based speech-language pathologists regarding children with cleft lip/palate. Lang Speech Hear Serv Sch. 2010; 41(4): 405-15.
28. Kuehn DP, Kummer AW, 'D'Antonio LL, Karnell MP. Cleft palate and speech: Three models of focused education. Perspect Speech Sci Orofac Disord. 2006; 16(2): 17-21.
29. Patel N, Dittakasem K, Fearon JA. Craniofacial fellowship training: Where are we now? Plast Reconstr Surg. 2015; 135(5): 1454-60.
30. Silvestre J, Agarwal D, Taylor JA. Craniofacial surgery fellowship websites. J Craniofac Surg. 2016; 27(4): 831-4.
31. Nissen L. The international association of oral & maxillofacial surgery: An organisation of contrasts and similarities. J Maxillofac Oral Surg. 2010; 9(4): 322.
32. Denadai R. The Sobrapar Hospital Craniofacial Surgery Fellowship: Wide craniofacial surgery training based on historical and evolving principles. J Craniofac Surg. 2018; 29(7): 1686-8.
33. Laskin DM. Learning to keep our teachers. J Oral Maxillofac Surg. 1991; 49(12): 1263.
34. Egro FM, Blecher NA, Losee JE, Nguyen VT, Goldstein J. Craniofacial surgery fellowship selection criteria: A national program director survey. J Craniofac Surg. 2017; 28(5): 1132-5.
35. Grewal NS, Spoon DB, Kawamoto HK, Jones NF, Da Lio AL, Crisera C, et al. Predictive factors in identifying subspecialty fellowship applicants who will have academic practices. Plast Reconstr Surg. 2008; 122(4): 1264-71.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a4

Conformity of removable partial denture designs to agreed principles based on materials used
- A preliminary study

SADJ June 2020, Vol. 75 No. 5 p253 - p259

W Farao[1], G Geerts[2]

ABSTRACT

Introduction
Removable partial denture (RPD) designs may differ based on types of materials used.

Aims
The aim of the study was to investigate how a sample of non-metal clasp (NMC), acrylic and metal RPD designs complied with biomechanical design principles.

Methods
This cross-sectional study examined 60 clinical designs of NMC, acrylic and metal RPDs at 3 commercial dental laboratories in the Cape Town Metropole, at the stage when the dentures were ready for transport to dentists. Retention, indirect retention, support, soft tissue cover, and cross-arch design features were recorded and compared with "ideal" control designs developed by 2 experts in the specialty of prosthodontics.

Results
Fifty five % of the clinical designs had no rests, hence were mucosa supported. None of the NMC and only 35% of acrylic RPDs had some rests. A total of 35 clinical designs required indirect retention, but it was only provided in 14 (40%) of them. Eighty five % of acrylic RPDs had no clasps; metal RPDs had more clasps than required while NMC RPDs had slightly less clasps than required. Ratio teeth covered/replaced was most favourable for metal (0.91), followed by acrylic (1.83) and NMC (1.80) RPDs. Cross – arch stabilization was absent in 22% of clinical designs, all of them from the NMC group.

Conclusion
Of the 3 types of RPDs, metal RPDs complied best with requirements in terms of tissue support (mostly tooth and mixed tooth/mucosa), retention, cross-arch stabilization and "open" design. Acrylic RPDs provided cross-arch stabilization but were lacking in all other aspects. Except for direct retention, NMC RPDs did not conform to any of the agreed biomechanical requirements for RPDs assessed in this study.

Author affiliations:
1. **Warren Farao:** *BChD, PDD, MChD,* Senior Lecturer, Specialist: Prosthodontist, Faculty of Dentistry, Tygerberg Campus, University of the Western Cape, Tygerberg Oral Health Centre, Tygerberg, South Africa.
   ORCID Number: 0000-0002-1327-8170
2. **Greta Geerts:** *BChD, PDD, MChD, PhD,* Senior lecturer, Chief specialist, Faculty of Dentistry, Tygerberg Campus, University of the Western Cape, Tygerberg Oral Health Centre, Tygerberg, South Africa.
   ORCID Number: 0000-0002-6324-4251

Corresponding author: Warren Farao
Senior Lecturer, Specialist: Prosthodontist, Faculty of Dentistry, Tygerberg Campus, University of the Western Cape, Tygerberg Oral Health Centre, Tygerberg, South Africa.
Email: wfarao@uwc.ac.za

Author contributions:
1. **Warren Farao:** Principal researcher - 75%, Writing article - 25%
2. **Greta Geerts:** Research - 25%, Writing article - 75%,

INTRODUCTION

In industrialised countries, edentulism decreased due to improved oral hygiene, patient health and dental care, with many people retaining some of their natural dentition into old age, and an increased desire by patients to retain their teeth.[1] A shift from total to partial edentulism, has led to a greater need to replace missing teeth for partially edentulous patients.[1]

One of the options for tooth replacement in partially edentulous patients is RPDs. Removable partial dentures have to comply with biomechanical aspects of support, retention and stability as well as limit damage to intraoral hard and soft tissues.[2-5]

The Academy of Prosthodontics publishes and regularly updates its principles, concepts, and practices in prosthodontics, including those for RPDs based on feedback from members and working committees of several Academies.[6] However, there appear to be variations in how these principles and concepts are applied.[7] In addition, there is little evidence that adhering to these principles leads to improved treatment outcomes or patient satisfaction.[8]

Many studies have reported on the adverse effects of RPDs on oral tissues. They may be associated with higher plaque (PI), gingival (GI) and calculus indices (CI), increased probing depth (PD), gingival recession, root caries and mobility of abutment teeth.[9-16] However, with

high level of patient cooperation and motivation, the number of teeth lost, decayed and filled due to RPD wearing, can be limited. Wilson (2009) proposed that acrylic RPDs can be considered definitive prostheses provided that proper patient selection and design principles are followed.[17] Hence, it is the clinician's responsibility to plan and design each RPD in such a way that the balance between benefits and risks of placing a RPD is in the patient's favour.[18]

Several materials may be used to fabricate RPDs. Cobalt chromium alloys and polymethyl methacrylate resin are the traditional materials. Newer materials, known as "thermoplastic" or "flexible" materials have been developed. These materials include a variety of polymers: polyethylene glycol, methyl methacrylate, aryl-ketone polymers, polyamide resins, polycarbonate resins, polyethylene terephthalate resins.[19] Dentures fabricated from these materials are referred to as non-metal clasp (NMC) dentures.[19] Physical properties vary considerably among of this group of new materials.[20,21]

It is claimed that NMC RPDs lead to improved patient comfort and satisfaction compared to acrylic RPDs, blend better with oral tissues hence are aesthetically more pleasing than some of the traditional materials and are hypo-allergenic.[22] Even though long-term evidence and guidelines for the use of NMC RPDs has been lacking, they attracted interest from practitioners.

This led to the development of a "position paper" based on "expert opinion" by the Japan Prosthodontic Society, wherein NMC RPDs were not recommended as defini tive prostheses, except in case such as metal allergy or when rigidity can be provided by incorporating a rigid framework.[19,20,23] A major disadvantage of NMC RPDs includes clasps covering the cervical area of the tooth, marginal gingiva and mucosa - as opposed to metal clasps which do not come into contact with the gingival margin - hence may cause caries and periodontal disease.[20] In addition, if NMC RPDs do not have rigid rests and frameworks, their clasps can traumatize marginal gingiva.[20]

It has been the impression of the authors that application of RPD design principles differ based on the types of materials used. Therefore, the aim of the study was to assess how a sample of clinical NMC, acrylic and metal RPDs comply with accepted biological and mechanical design principles. The null-hypothesis was that there is no difference among RPDs made from different materials in complying with biological and mechanical design principles.

MATERIALS AND METHODS

The research proposal was approved by the biomedical research ethics committee of the University of the Western Cape (BM/16/5/12). The project is a cross-sectional study using a convenience sample. Three dental laboratories in the Cape Town Metropole, known to fabricate NMC RPDs, were identified and invited to participate in the study. Their participation required of them to email photographs of completed NMC, acrylic and metal RPDs and their casts prior to sending them to practices for delivery to patients. The following views of the RPDs were requested: occlusal, left lateral, right lateral, frontal and any other view to enable the researchers to identify all RPD components on the photographs. Specimens were collected until 20 metal, 20 acrylic and 20 NMC RPDs were received. Data collection took place during 2018.

For each RPD, the actual design as well as an "ideal" design was drawn, using the image of the cast. This was done independently by two observers, who are experienced members of staff in the Department of Restorative Dentistry (Prosthetics).

The ideal designs from both observers were later compared for similarity. Differences in designs were resolved by means of discussion until agreement was reached. Each ideal design served as the control for its clinical design.

Prior to designing the ideal RPDs, for the sake of consistency, the following agreements were made:

- Mandibular lingual major connector for control design was kept the same as the clinical RPD design (plate vs. bar).
- Number of replaced teeth on ideal denture was kept the same as number of teeth replaced on the clinical RPDs.

Prior to recording data from the RPD and ideal designs, for the sake of consistency, the following agreements were made:

- The number of rests was counted and was given as a numerical value: 1, 2, 3, 4, >4. The configuration of rests was given as 0: no configuration because there were no rests or only one rest; 2: line; 3: triangle; 4: at least a quadrangle.
- Type of support for the RPD was indicated as: hard (exclusively tooth-born), soft (exclusively mucosa-born) or mixed (both tooth and mucosa support).
- Number of clasps was counted and was given as a numerical value: 1, 2, 3, 4, >4.
- Presence of indirect retention was given as: yes, no or not applicable. An indirect retainer helps to stabilize a distal extension RPD. The requirement of indirect retention for Kennedy Class III and IV were also identified where applicable. The indirect retention component is usually located on the opposite side of the retentive fulcrum line from the mucosa supported base.[24]
- Number of teeth with gingival margin cover as well as number of replaced teeth were given as a numerical value: 1, 2, 3… These values were used to match replaced/covered teeth to calculate a "coverage" score to give an indication of a biological price to tissue.
- Presence of cross-arch stability: yes or no. A 'no' was allocated to a unilateral RPD. A unilateral RPD is sometimes used to restore short-span, bounded edentulous spaces with the advantage of avoiding

extensive palatal or lingual major connectors. This design may result in easy dislodgement and other complications because it does not provide cross-arch stabilization. RPDs with cross-arch stabilization are generally preferred to prevent these complications.[25]

Compliance to the ideal design was rated as 'Acceptable' or 'Not acceptable' according to the following general rules:

- For support, for Class II, III and IV RPDs a minimum of 3 rests in a triangle configuration was considered acceptable, less than 3 rests or 3 rests not in a triangle configuration was considered not acceptable. For Class I RPDs a minimum of 2 rests was considered acceptable, less than 2 rests was considered not acceptable.

  Soft tissue support was not acceptable for any of the classifications. Mixed support was accepted for Class I, II and other classifications where long saddles covered arch bends; for all other designs, only hard support was acceptable.

- Absence of indirect retention for designs where it was indicated was scored as not acceptable.

- Absence of cross-arch stability was scored as not acceptable.

Two observers rated acceptability independently. Where differences occurred, these were debated until consensus was reached. Results are presented descriptively using frequency and ratio tables. Because of the nature of the data, statistical analysis was not indicated.

RESULTS

The features of all clinical and control designs are summarized in **Table 1**. The majority of the 60 RPDs were for the maxilla (n=42; 70%). Kennedy Class III designs occurred most frequently with a total of 44 (73%) RPDs. There was only one Class IV design, belonging to the acrylic RPD group.

Thirty-three (55%) clinical designs had no rests, 8 (13%) had only 1 rest, 8 (13%) had 2 rests, 4 (7%) had 3 rests, and 7 (12%) had 4 or more rests. All NMC RPDs (100%) had no rests at all. The control designs all had rests, with 57 (95%) designs having at least 3 rests. There were no control designs with 1 or zero rests (**Table 1**).

A total of 33 clinical designs were mucosa supported (Acrylic clinical = 13, Metal clinical = 0, NMC clinical = 20), 21 were of mixed support (Acrylic clinical = 6, Metal clinical 15, NMC clinical = 0) and 6 had hard tissue support (Acrylic clinical = 1, Metal clinical = 5, NMC clinical = 0).

All the control designs had either hard tissue (n = 45) or mixed support (n=15) (**Table 1**).

Total and mean number of clasps for each RPD group, clinical and control, are shown in **Table 2**. The clinical acrylic and NMC RPDs had fewer clasps than their controls. Seventeen (85%) of clinical acrylic RPDs had no clasps at all.

A total of 35 designs (including distal extension bases and maxillary Class IV dentures) required indirect retention and in only 14 designs indirect retention was provided (40% compliance rate). (**Figure 1**) Compliance rate per RPD materials group was as follows: metal 83.33%, acrylic 6.25%, NMC 42.86%.

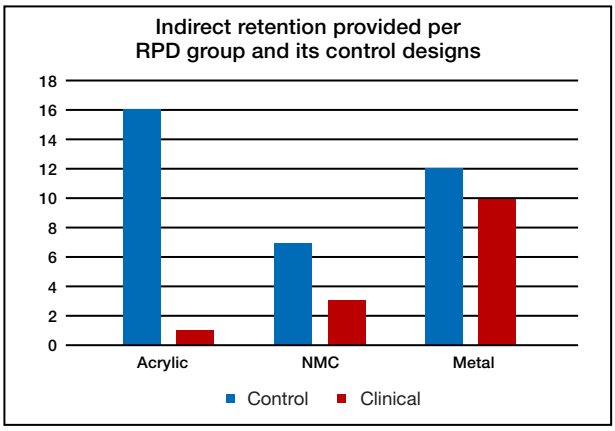


Figure 1. Indirect retention provided per RPD group and its control designs.

The number of teeth whose gingival tissue was covered versus the number of teeth replaced is shown in **Table 1** and the ratios are shown in **Table 4**.

All control designs had cross-arch stabilization, as had the acrylic and metal groups. The NMC group only had 7 out of 20 designs with cross-arch stabilization (**Table 1**). Acceptability of designs according to mechanical and biological principles is shown in **Table 4**.

DISCUSSION

Differences in compliance with biological and mechanical principles were found among designs of RPDs made from different base materials. Therefore, the null-hypothesis is rejected.

The rejection of the null-hypothesis implies that there is disparity between the teaching of generally accepted RPD design principles according to the literature and what is happening in private practice. A survey on a group of dentists that graduated at the dental school of the University of the Witwatersrand alluded to a similar situation.[26]

At the University of the Western Cape open, hygienic designs, an appropriate number of clasps and rests, and other essential RPD components to ensure adequate support, retention and stability, are taught for RPDs.

This survey showed that the disparity between design principles and clinical practice was generally smaller for metal, and larger for acrylic and NMC RPDs. This may be, to some extent, due to limitations of the material and not to a gap between knowledge and practice. In addition, NMC RPDs are not taught at the dental school of the UWC.

Table 1. Summary of different features of the RPD designs according to material groups.

	Acrylic		Metal		NMC	
	Clinical	Control	Clinical	Control	Clinical	Control
Number	20	20	20	20	20	20
Class I	3	3	2	2	1	1
Class II	2	2	4	4	3	3
Class III	14	14	14	14	16	16
Class IV	1	1	0	0	0	0
Mandibular	5	5	9	9	4	4
Maxillary	15	15	11	11	16	16
Total no. of rests	12	88	57	78	0	80
No of RPDs without rests	13	0	0	0	20	0
RPDs with 1 rest	6	0	2	0	0	0
RPDs with 2 rests	0	1	8	1	0	1
RPDs with 3 rests	0	1	4	4	0	2
RPDs with 4 or more rests	1	18	6	15	0	17
RPDs with no rest configuration	19	0	2	0	20	0
RPDs configuration in line	0	1	8	1	0	1
RPDs configuration of rests in triangle	0	1	4	4	0	2
RPDs configuration of rests in square or more	1	18	6	15	0	17
Mucosa support	13	0	0	0	20	0
Mixed tooth/mucosa support	6	5	15	6	0	4
Tooth support	1	15	5	14	0	16
Total no. of clasps	6	51	71	64	43	52
RPDs without clasps	17	0	0	0	0	0
RPDs with 1 clasp	0	0	0	0	1	0
RPDs with 2 clasps	3	11	2	4	16	9
RPDs with 3 clasps	0	7	5	8	2	10
RPDs with 4 clasps	0	2	13	8	1	1
Cross-arch stabilization present	20	20	20	20	7	20
Number of teeth covered (replaced)	159 (87)	63 (87)	85 (93)	61 (93)	81 (45)	61 (45)
No of teeth covered & (replaced) Class I	19 (21)	16 (21)	9 (10)	9 (10)	8 (5)	8 (5)
No of teeth covered & (replaced) Class II	12 (12)	5 (12)	13 (19)	13 (19)	24 (12)	20 (12)
No of teeth covered & (replaced) Class III	120 (50)	42 (50)	63 (64)	39 (64)	49 (28)	33 (28)
No of teeth covered & (replaced) Class V	8 (4)	0 (4)	-	-	-	-

RPD = Removable partial denture; NMC = Non-metal clasp; Class I, II, III, IV = Kennedy Class I, II, III, IV; No = Number.

Table 2. Number of clasps in clinical and control designs.

Denture group	Total number of designs	Clinical designs - Total number of clasps (mean)	Control designs – Total number of clasps (mean)
Acrylic	20	6 (0.30)	51 (2.55)
NMC	20	43 (2.15)	52 (2.60)
Metal	20	71 (3.55)	64 (3.20)

NMC = Non-metal clasp.

Table 4. Acceptability in % of designs according to mechanical and biological principles.

	Acrylic (Control)	Acceptability %	NMC (Control)	Acceptability %	Metal (Control)	Acceptability %
Number of dentures with rests (Min. 2 rests)	1 (20)	5%	0 (20)	0%	18 (20)	90%
Support	7 (20)	35%	0 (20)	0%	20 (20)	100%
Rest configurations	1 (20)	5%	0 (20)	0%	20 (20)	100%
Indirect retention	1 (16)	6.25%	3 (7)	42.86%	10 (12)	83.33%
Direct retention	3 (20)	15%	9 (20)	45%	20 (20)	100%
Teeth covered	159 (71)	92 extra teeth covered	81 (63)	18 extra teeth covered	85 (71)	14 extra teeth covered
Ratio teeth covered/teeth replaced	1.83 (0.72)	-	1.8 (1.36)	-	0.91 (0.66)	-
No. of RPDs with acceptable ratios	3 (20)	15%	3 (20)	15%	9 (20)	45%
Cross-arch stabilization	20 (20)	100%	7 (20)	35%	20 (20)	100%

For this study, coverage of periodontal tissues of the remaining natural teeth by RPD components was used as a benchmark for rating the biological acceptability of each denture. Mean coverage ratios were lowest for metal RPDs. With mean coverage ratios of <1 for both clinical and control designs, the metal RPDs replaced more teeth than there were teeth covered by design components.

The difference in the coverage ratio between clinical and control designs was also the lowest of the 3 denture groups. Hence, the biological price for replacing teeth in this group was least. Mean coverage ratio for the clinical acrylic RPDs was the highest.

The difference in coverage ratio between clinical and control designs was also the largest. Hence, in this study, it may be assumed that design principles were not adequately followed and the biological price paid by tissues to have teeth replaced by acrylic RPDs was the highest.

Coverage ratios for clinical and control NMC designs were both high. This may be explained by, that in this study, the NMC RPDs restored short-span edentulous areas. The difference in mean coverage ratio of clinical and control NMC RPDs was low, indicating that, in terms of biological price, the clinical design resembled optimal design conditions.

Metal RPDs scored best in terms of "open" hygienic designs. (Table 3) This was expected, since the strength of the material allows it to be used in thin sections. In terms of "open" designs, acrylic RPDs and NMCDs were rated as unacceptable (Table 4). However, due to material limitations, it may not be possible to improve their coverage ratios substantially. Hence, it may be expected that the use of acrylic or NMC RPDs will have a negative effect on PI, GI, PD and root caries unless patients are carefully selected and follow a strict maintenance routine.[9-15]

Properly placed occlusal rests on abutment teeth minimizes iatrogenic soft tissue damage.[27] Hence, a minimum number of rests in an appropriate configuration was also considered a benchmark for assessing the biologic acceptability of the designs. Optimal conditions for vertical support differ according to Kennedy classification. Each clinical design was compared with its optimal control design. Within the acrylic RPD group, only one of the clinical designs had enough rests in an appropriate configuration to be judged acceptable (Tables 1 and 4).

All the other acrylic RPDs had either one or no rests, hence, had mucosa or mixed tooth/mucosa support, where it could have been mixed tooth/mucosa or tooth support respectively. Therefore, it was decided that acrylic RPDs designs in this study sample were not acceptable regarding vertical support and they were potentially harmful to the supporting tissue of the remaining natural teeth. None of the NMC RPDs had rests.

The result is that all the NMC RPDs were considered mucosa supported and none of the 20 designs in this group was acceptable regarding support (Table 4).

In contrast with the acrylic and NMC RPDs, none of the metal-frame RPDs were mucosa supported. Fifteen clinical metal RPDs had mixed tooth/mucosa support where there should only have been 6 with mixed support according to the control designs. It was concluded that only 9 (45%) of the metal RPDs were acceptable in terms of vertical support. However, compared to the acrylic and NMC groups, the metal RPD group performed best in complying with the principle of support.

For stability and support, the selection of at least 3 rests, widely spaced, is advised.[28] For the metal RPD group, the clinical designs complied on 11 of the 20 occasions in terms of number and configuration of rests.

For the remaining 9 designs, there support and stability was not optimized. For the acrylic RPDs, there was only 1 of the 20 designs with more than 3 rests. The other designs had either no or only 1 rest. This would not allow transmission of chewing forces along the long axis of the abutment teeth.

Therefore, it was concluded that the acrylic RPD group did not conform to this bio-mechanical requirement. For the NMC group, none of the 20 designs had any rests. The clinical consequence of these findings is that for the metal and acrylic RPDs, the integrity of the abutment teeth is at risk due to inadequate transfer of occlusal forces along abutment teeth and stability of the RPDs is in the majority of cases not optimized.

Direct or active retainers or clasps are critical components of an RPD, exerting a force on abutment teeth when the prosthesis is lifted from its support in the opposite direction as its path of insertion, hence providing retention for the prosthesis.[28] More clasp assemblies lead to higher PI and TM scores, hence too many clasps are to be avoided. For the acrylic group, a total of 6 clasps were provided for the clinical designs, as compared to 51 given to the corresponding control designs.

This is a mean of 0.3 clasps per clinical design. For the control, the mean number of clasps per design was 2.6. It was concluded that the provision of direct retention was generally inadequate for acrylic RPDs hence retention would be poor. The NMC group had 43 clasps (mean 2.2 per RPD) compared to the 52 (mean 2.6 per RPD), of the control. Based on these results, it was concluded that in terms of providing retention, most NMC RPDs would be acceptable. For the metal RPDs, 71 clasps were given (mean 3.6) against their control designs of 64 clasps (mean 3.2).

This is the only group where the clinical designs were given more clasps than their control group. While this may have a positive impact on retention, it may have a negative effect on PI and GI. It should be noted that the presence of guide planes on teeth and guiding surfaces on tooth-bound saddles was not assessed in this study. These features may reduce the need for direct retention[29], and have a further positive effect on the health of soft and hard tissue. It should also be noted that the type of material, shape and position of the clasps also have an influence on their retentive force. This was not examined in this study.

Indirect retention prevents tipping of the RPD around a horizontal axis. Where applicable and needed, the presence or absence of indirect retention was recorded for the sample of RPDs in this study. Sixteen of the acrylic RPDs required the incorporation of indirect retention, with only 1 design complying (6.25%). In the NMC group, 7 needed indirect retention with only 3 complying (42.9%).

The metal group had 12 designs that needed indirect retention with 10 complying (83.33%). The metal group had the highest compliance rate. Poor compliance was noted in the acrylic group, followed by the NMC group.

It should be noted that the number of designs requiring indirect retention differed considerably among the three groups. The clinical significance of these findings is that the retention of the majority of the acrylic RPDs and half of the NMC RPDs is compromised by failing to provide acceptable indirect retention.

For cross-arch stabilization, the following findings were made: All the acrylic and metal RPDs had a bilateral design and complied with this design principle. The NMC group had only 7 bilateral designs. Hence, this group was 65% non-compliant in terms of cross-arch stability. In a unilateral RPD design with no cross-arch stabilization, the denture may tilt and dislodge causing complications such as aspiration or swallowing of the prosthesis.[30]

Biological and biomechanical criteria were identified in the methodology of this study and potential clinical translations made. However, these translations need to be confirmed by means of clinical trials. The impact of the quality of the designs of different materials group was not measured using patient based outcomes. This should be studied further.

The purpose of this study was to identify potential problems in terms of RPD design. Hence, a preliminary survey using a convenience sample was done. This sample might not be representative of the total RPDs delivered in the Western Cape.

Since issues with compliance with accepted biomechanical principles for RPD design were encountered among the different groups under investigation in this pilot study, further investigations can be launched to examine the influence of training, dentist-technician communication including presence or absence of prescriptions of designs by dentists, pricing of the different types of RPDs and third party payment schemes. Material limitations may influence design features. These design limitations may impact on oral tissue health and patient satisfaction. Not all design flaws illustrated in this survey were attributed to materials limitations.

The investigator relied on commercial laboratories to provide the designs; the sample may have been biased based on selection of designs by the laboratory technician. It is assumed that, by human nature, selection was biased towards the “better” designs. The process of designing in terms of communication and identity of the RPD designer (dentist or technician) was not requested in order to reduce selection bias by the technician.

CONCLUSION

Within the limitations of this pilot study, it may be concluded that:

- The metal RPDs scored better for support, direct and indirect retention, and open design than the acrylic and NMC RPDs. For cross-arch stabilization, metal designs scored equally with the acrylic group and better than the NMC group.
- The acrylic group scored poorly for support, direct and indirect retention and open design.
- The NMC group scored poorly for support, indirect retention, open design and cross-arch stabilization.

Acknowledgement

Dr F Kimmie for advice regarding data analysis.

Declaration

The authors have no conflict of interest in any company, product or services mentioned in the article.

References

1. Campbell SD, Cooper L, Craddock H, et al. Removable partial dentures: The clinical need for innovation. J Prosthet Dent. 2017; 118: 273-80.
2. Jacobson TE. Periodontal considerations in removable partial denture design. Compendium 1987; 8: 530-4, 536-9.
3. Budtz-Jorgensen E, Bochet G. Alternate framework designs for removable partial dentures. J Prosthet Dent. 1998; 80: 58-66.
4. Owall B, Budtz-Jörgensen E, Davenport J, et al. Removable partial denture design: a need to focus on hygienic principles? Int J Prosthodont. 2002; 15: 371-8.
5. Davenport JC, Hammond P, de Mattos MG. The acquisition and validation of removable partial denture design knowledge. II. Design rules and expert reaction. J Oral Rehabil. 1996; 23: 811-24.
6. Academy of Prosthodontics. Principles, concepts, and practices in prosthodontics. 9th ed. J Prosthet Dent. 1995; 73: 73-94.
7. Kapur KK, Deupree R, Dent RJ, et al. A randomized clinical trial of two basic removable partial denture designs. Part I: Comparisons of five-year success rates and periodontal health. J Prosthet Dent. 1994; 72: 268-82.
8. Frank RP, Brudvik JS, Leroux B, et al. Relationship between the standards of removable partial denture construction, clinical acceptability, and patient satisfaction. J Prosthet Dent. 2000; 83: 521-7.
9. Mojon P, Rentsch A, Budtz-Jørgensen E. Relationship between prosthodontic status, caries, and periodontal disease in a geriatric population. Int J Prosthodont. 1995; 8: 564-71.
10. Yeung AL, Lo EC, Chow TW, et al. Oral health status of patients 5-6 years after placement of cobalt-chromium removable partial dentures. J Oral Rehabil. 2000; 27: 183-9.
11. Zlataric DK, Celebic A, Valentic-Peruzovic M. The effect of removable partial dentures on periodontal health of abutment and non-abutment teeth. J Periodontol. 2002; 73: 137-44.
12. Akaltan F, Kaynak D. An evaluation of the effects of two distal extension removable partial denture designs on tooth stabilization and periodontal health. J Oral Rehabil. 2005; 32: 823-9.
13. Do Amaral BA, Barreto AO, Gomes Seabra E, et al. A clinical follow-up study of the periodontal conditions of RPD abutment and non-abutment teeth. J of Oral Rehabil. 2010; 37: 545-52.

14. Preshaw PM, Walls AW, Jakubovics NS, et al. Association of removable partial denture use with oral and systemic health. J Dent. 2011; 39: 711-19.
15. Orr S, Linden GJ, Newman HN. The effect of partial denture connectors on gingival health. J Clin Periodontol. 1992; 19: 589-94.
16. Bergman B, Hugoson A, Olsson CO. A 25 year longitudinal study of patients treated with removable partial dentures. J Oral Rehabil. 1995; 22: 595-9.
17. Wilson VJ. Acrylic partial dentures--interim or permanent prostheses? SADJ. 2009; 64: 434, 436-8, 440.
18. Davenport JC, Basker RM, Heath JR, et al. The removable partial denture equation. Br Dent J. 2000; 189: 414-24.
19. Fueki K, Ohkubo C, Yatabe M, et al. Clinical application of removable partial dentures using thermoplastic resin-part I: definition and indication of non-metal clasp dentures. J Prosthodont Res. 2014; 58: 3-10.
20. Fueki K, Ohkubo C, Yatabe M, et al. Clinical application of removable partial dentures using thermoplastic resin. Part II: Material properties and clinical features of non-metal clasp dentures. J Prosthodont Res. 2014; 58: 71-84.
21. Takabayashi Y. Characteristics of denture thermoplastic resins for non-metal clasp dentures. Dent Mater J. 2010; 29: 353-61.
22. Singh JP, Dhiman RK, Bedi RP, et al. Flexible denture base material: A viable alternative to conventional acrylic denture base material. Contemp Clin Dent. 2011; 2: 313-7.
23. Fueki K. Non-metal clasp dentures: More evidence is needed for optimal clinical application. J Prosthodont Res. 2016; 60: 227-8.
24. Davenport JC, Basker RM, Heath JR, et al. Indirect retention. Br Dent J. 2001; 190: 128-32.
25. Uludag B and Celik G. Technical tips for improved retention and stabilization of a unilateral removable partial denture. J Oral Impl. 2007; 33: 344-7.
26. Dullabh HD, Slabbert JC and Becker PJ. Partial denture prosthodontic procedures employed by practising graduates of the University of the Witwatersrand, Johannesburg. SADJ. 1993; 48: 129-4.
27. Owen CP. Fundamental of Removable Partial Dentures. 2nd ed. Landsdowne: Cape Town University, Cape Town Press, 2000; 25.
28. Mothopi-Peri M, Owen CP. Guide-Plane Retention in Designing Removable Partial Dentures. Int J Prosthodont 2018; 31: 145-8.
29. McCord JF, Grey NJ, Winstanley RB, Johnson A. A clinical overview of removable prostheses: 3. Principles of design for removable partial dentures. Dent Update. 2002 Dec; 29: 474-81.
30. Goodacre CJ, 1987. A dislodged and swallowed unilateral removable partial denture. J Prosthet Dent. 1987; 58: 124-5.

Do the CPD questionnaire on page 275

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.

No.1 DENTIST RECOMMENDED BRAND FOR SENSITIVE T

*GFK New expert performance tracking 2018.

For any product safety issues, please contact GSK on +27 11 745 6001 or 0800 118 27

With clinically proven Dual relief

TEETH*

4.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a5

Amelogenesis imperfecta with multiple impacted teeth and altered eruption pathways
- A radiographic case report

SADJ June 2020, Vol. 75 No. 5 p262 - p266

C Nel[1], Z Yakoob[2], T Kungoane[3], CL Davidson[4]

ABSTRACT

Amelogenesis imperfecta (AI) comprises a vast group of developmental alterations in the quantity and/or quality of enamel, unaffected by systemic disorders.

In this case report we describe the typical clinical and radiographic features of AI with multiple impacted teeth and altered eruption pathways. Patients with AI benefit from early diagnosis and treatment to prevent tooth loss and loss of vertical dimension.

Optimal management of these patients requires a multidisciplinary approach and regular dental recall appointments. Therefore it is the oral health clinician's responsibility for the timeous identification of this condition.

Author affiliations:
1. **Chané Nel:** *BChD, MSc(Rad).,* University of Pretoria, Oral and Dental Hospital, Corner of Bophelo and Steve Biko Roads, Pretoria, South Africa.
   ORCID Number: 0000-0003-4047-6356
2. **Zarah Yakoob:** *BChD, PDD (Rad), Msc (Rad),* University of Pretoria, Oral and Dental Hospital, Corner of Bophelo and Steve Biko Roads, Pretoria, South Africa.
   ORCID Number: 0000-0003-1966-5574
3. **Tsholofelo Kungoane:** *B Dent Ther, BDS, MSc (Oral Path), FC SA (PATH) ORAL, MDENT (Oral Path),* University of Pretoria, Oral and Dental Hospital, Corner of Bophelo and Steve Biko Roads, Pretoria, South Africa.
   ORCID Number: 0000-0003-4312-7418
4. **Christy L Davidson:** *BChD, PGDipDent (Endo), MSc (Oral Bio),* University of Pretoria, Oral and Dental Hospital, Corner of Bophelo and Steve Biko Roads, Pretoria.
   ORCID Number: 0000-0002-3638-6932

Corresponding author: Christy L Davidson
University of Pretoria, Oral and Dental Hospital, Corner of Bophelo and Steve Biko Roads, Pretoria.
Email: christy.davidson@up.ac.za

Author contributions:
1. **Chané Nel:** Conception and design of the manuscript. Drafted and revised the work critically for important intellectual content - 30%
2. **Zarah Yakoob:** Conception and design of the manuscript. Drafted and revised the work critically for important intellectual content - 30%
3. **Tsholofelo Kungoane:** Pathological diagnosis and tooth ground section - 10%
4. **Christy L Davidson:** Conception and design of the manuscript. Drafted and revised the work critically for important intellectual content - 30%

All authors approved of the version to be published; and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Keywords
Amelogenesis imperfecta, impactions, altered eruption pathways, gubernacular canals.

INTRODUCTION

Amelogenesis imperfecta (AI) comprises a vast group of developmental alterations in the quantity and/or quality of enamel, unaffected by systemic disorders. To date over 15 genetic mutations have been identified in cases of non-syndromic AI.[1-6] A recent publication hypothesised that gene mutations in *ENAM* and *AMELX* leads to endoplasmic reticulum stress in ameloblasts which in turn activates an unfolded protein response as a pathogenic mechanism for AI.[7]

Additionally, for reasons not yet fully understood, defects in acid phosphatase and *RELT*, have been implicated in AI.[8-11] Several other mutations have been identified in syndromic cases with AI, including DLX3 (tricho-dento-osseous syndrome) and *FAM20A* (enamel-renal syndrome, amelogenesis imperfecta-gingival fibromatosis syndrome).[12-14]

Four phenotypic subtypes of AI are recognised; hypoplastic, hypocalcified, hypomatured and mixed hypomatured/hypoplastic in combination with taurodontism.[15-17] In the hypoplastic subtype, the disruption occurs in the deposition of the enamel resulting in a thin band of fully mineralised enamel or pits and grooves dispersed in normal enamel thickness.

The hypocalcified subtype encompasses presentations where the full thickness of enamel is deposited but no mineralisation occurs. Only partial mineralisation occurs in the hypomatured subtype.[17,18] This classification is however limited, as both qualitative and quantitative enamel defects may co-present within the same patient.[18,19]

The diagnosis of AI is largely based on characteristic clinical and radiographic findings.[17,20] In normal circumstances enamel has a higher radiographic density when compared to dentine due to the higher mineral content.[21] In the hypoplastic subtype, a thin band of radiopaque enamel can be distinguished from the less radiopaque dentine. With hypomatured AI the radiographic density of enamel and dentine is alike, whereas in the hypo-

calcified subtype the enamel will have a lower density than that of the dentine and may not be evident on a radiograph.[17]

The primary clinical concerns of AI include increased dentinal sensitivity, altered aesthetics, loss of vertical dimension, malocclusion and increased caries susceptibility.[17,22] Other dental features that have been reported in association with AI include pulpal calcifications, root malformations (including taurodontism) and impactions of permanent teeth.[20,23,24] In this case report we describe a patient that presented with all the typical radiographic features of AI, and additional interesting findings.

CASE PRESENTATION

A 26-year-old male patient presented with the main complaint of small and sensitive teeth. His dental history included the recent construction a maxillary partial denture for improved functionality and composite veneers on the maxillary anterior teeth for aesthetics.

No familial history of similar conditions were reported. Extraoral examination revealed recurrent Herpes labialis on the right bottom lip. Intraorally, generalised tooth wear and numerous retained primary teeth were present. The maxillary central incisors showed veneer preparations while both maxillary lateral incisors had composite veneers. The permanent first molars displayed a rough and yellow appearance with no visible enamel (**Figure 1**). The mandibular right second incisor had a distal uncomplicated coronal fracture. The patient's oral hygiene was satisfactory with non-inflammatory gingival enlargement. The patient was referred for radiographic examination.

The panoramic radiograph (**Figure 2**) revealed a full complement of teeth however only the incisors and first permanent molars were erupted. All the remaining teeth were impacted and no supernumerary teeth were detected. Pulpal calcifications could be seen in some of the erupted and a few of the unerupted teeth. The mandibular right first molar and left second deciduous molar were carious.

The carious mandibular right deciduous molars were associated with periapical radiolucencies. A residual root was visible in the maxillary left first premolar area. Radiographically, there was no distinction between the enamel and dentine in the erupted and unerupted teeth. The impacted teeth demonstrated corticated radiolucent tubular or canal-like structures connecting the dental follicle to the alveolar ridge which resembled eruption pathways.

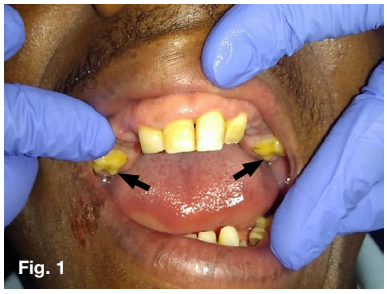
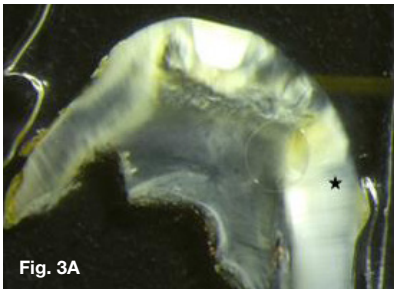


Figure 1. Intraoral photograph showing a lack of enamel and a rough and yellow appearance of the maxillary first molars (black arrows) and multiple missing teeth.



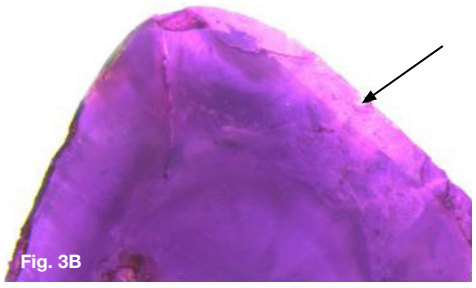


Figure 3. A: Ground section of the mandibular right second deciduous molar showing dentine with dentinal tubules, pulp with pulpal chamber and minimal representation of enamel. B: Haematoxylin and Eosin section of the crown showing the enamel (arrow head).

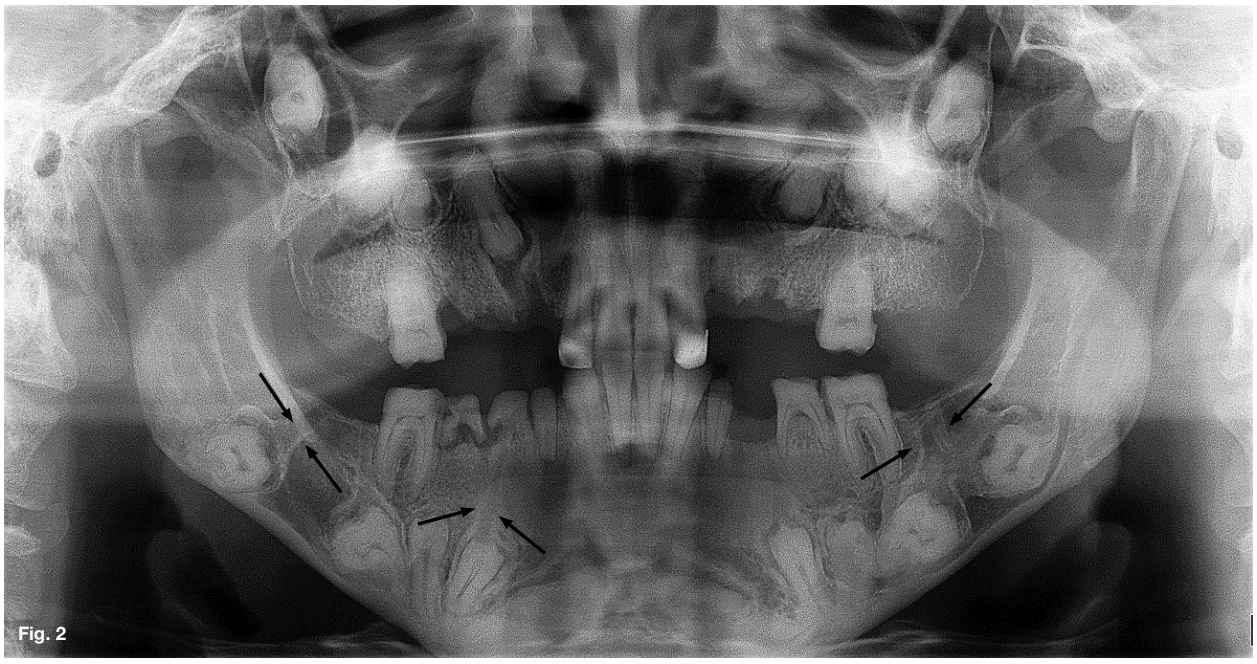


Figure 2. Panoramic radiograph. Presence of numerous impacted teeth showing no visible enamel. Corticated canal-like structures connecting the dental follicle to the alveolar ridge (black arrows).

The mandibular right deciduous molars were extracted and submitted for histological examination. The ground sections (Figure 3) showed molar teeth with minimal representation of enamel. The dentine was of normal architecture with a straight dentine-enamel junction. Both teeth showed focal external root resorption.

These features were in keeping with AI. The patient was referred to the post-graduate prosthodontics department for further management and dental rehabilitation. Genetic testing was declined by the patient. The patient was also referred to a physician for renal analysis to rule out enamel-renal syndrome.

DISCUSSION

The most apparent features observed on the panoramic radiograph were the numerous impacted teeth and the presence of canal-like eruption pathways connecting the dental follicle to the alveolar ridge. Patients with AI are six times more likely to have impactions of permanent teeth and associated anomalies such as dentigerous cysts.[19,23]

Tooth eruption is a complex developmental process influenced by genetic regulation and growth of the jaws.[25] The dental follicle orchestrates tooth eruption through the regulation of specific genes regulating bone resorption coronally and deposition apically.[26,27] Disturbances in this process can be attributed to follicular enlargements or disruptions in the molecular signals of the eruption process itself.[19,23]

Gubernacular canals are bony canals thought to occur as a result of the gubernacular cord. This cord is a fibrous strand remnant of the dental lamina that connects the reduced enamel epithelium surrounding the developing tooth, with the overlying oral epithelium. It secretes epidermal growth factor mediator that promotes osteoclastogenesis, thereby directing tooth eruption through the eruptive pathway.[28-31]

The gubernacular cord was initially only described in association with permanent teeth that have a primary predecessor but later found to also be associated with permanent molars that do not have primary predecessors.[28,32,33] However, the existence of the gubernacular cord and canal remains controversial. Nishida et al. reported the gubernacular canal as “corticated tracts of low density, contiguous with the dental follicle of an unerupted tooth”.[34]

A recent study on cone beam computed tomography investigated the presence and morphology of these canals in relation to eruption disturbances and pathologic conditions associated with impacted and unerupted permanent teeth. They found that a disturbed eruption pattern could occur with either the absence or an alteration in the shape of the gubernacular canal.[29]

These eruption pathways have also been observed in cases of primary failure of eruption disorder where a fault in the eruptive mechanism, with no mechanical obstruction, results in impaction.[27,35] The panoramic radiograph of the presented case shows evidence of altered eruption pathways, suggesting a fault in the eruptive process.

In this case report the patient had presented with non-inflammatory gingival enlargement. This finding has previously been reported in the literature as an association with AI.[36,37] From 1990 to 2014, there have been 8 AI case reports (5 of which originated from South Africa) with dental follicular-like harmatomas and generalised gingival enlargement.[24,38-44] These reported cases demonstrate a form of AI together with enlarged dental follicles associated with numerous impacted teeth.[24,36,38-44] Some of these cases with enlarged follicles were diagnosed as dentigerous cysts[36] or odontogenic fibromas.[38] However, one should consider that the latest WHO classification states that pericoronal radiolucencies with central odontogenic fibroma features associated with impacted teeth, should be considered hyperplastic follicles rather than neoplastic.[45]

In this case report, the patient presented with AI, gingival hyperplasia, multiple impactions, hyperplastic follicles and diffuse intrapulpal calcifications. These features have previously been reported in association with *FAM20A* mutation.[13,46] However to our knowledge this is the first reported case showing altered eruption pathways of impacted teeth in AI.

Patients with AI benefit from early diagnosis and treatment to prevent consequences of tooth loss and loss of vertical dimension. The increased dentinal sensitivity is caused by the exposed dentinal tubules and can be managed with fluoride application or coverage depending on the extent of enamel disruption. The patients also present with increased caries susceptibility that require preventative dental procedures and regular follow up appointments. The altered aesthetics can be managed with crowns or veneer preparations. Bond strength to the altered enamel should be evaluated on a case to case basis. Direct resin restorations have shown success in the improvement of aesthetics but long term follow-up is needed to validate the longevity of the treatment success.[47] A recent review found that indirect restorative techniques have a better prognosis in the case of AI as compared to direct restorative techniques.[48]

The optimal management of these patients requires a multidisciplinary approach and regular dental recall appointments.[49] Therefore, it is the oral health clinician’s responsibility for the timeous identification of this condition. A limitation of this study is that the true nature of the dental follicle and associated canals can only be speculated, as there was no indication for surgical removal of the impacted teeth. These lesions will be monitored going forward.

Declaration

Authors Nel, Yakoob, Kungoane and Davidson declare no conflict of interest.

Ethical considerations

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed consent was obtained from all patients for being included in the study.

This article does not contain any studies with human or animal subjects performed by the any of the authors.

References

1. Smith CEL, Poulter JA, Antanaviciute A, Kirkham J, Brookes SJ, Inglehearn CF, et al. Amelogenesis Imperfecta; Genes, Proteins, and Pathways. Front Physiol. 2017; 8: 1-22.
2. Kim YJ, Kim YJ, Kang J, Shin TJ, Hyun HK, Lee SH, et al. A novel AMELX mutation causes hypoplastic amelogenesis imperfecta. Arch Oral Biol. 2017; 76: 61-5.
3. Lu T, Li M, Xu X, Xiong J, Huang C, Zhang X, et al. Whole exome sequencing identifies an AMBN missense mutation causing severe autosomal-dominant amelogenesis imperfecta and dentin disorders. Int J Oral Sci. 2018; 10(3): 26. Available from: http://dx.doi.org/10.1038/s41368-018-0027-9.
4. Nowwarote N, Theerapanon T, Osathanon T, Pavasant P, Porntaveetus T, Shotelersuk V. Amelogenesis imperfecta: A novel FAM83H mutation and characteristics of periodontal ligament cells. Oral Dis. 2018; 24(8): 1522-31.
5. Xin W, Wenjun W, Man Q, Yuming Z. Novel FAM83H mutations in patients with amelogenesis imperfecta. Sci Rep. 2017; 7(1): 1-9. Available from: http://dx.doi.org/10.1038/s41598-017-05208-0.
6. Koruyucu M, Kang J, Kim YJ, Seymen F, Kasimoglu Y, Lee ZH, et al. Hypoplastic AI with Highly Variable Expressivity Caused by ENAM Mutations. J Dent Res. 2018; 97(9): 1064-9.
7. Brookes SJ, Barron MJ, Smith CEL, Poulter JA, Mighell AJ, Inglehearn CF, et al. Amelogenesis imperfecta caused by N-terminal enamelin point mutations in mice and men is driven by endoplasmic reticulum stress. Hum Mol Genet. 2017; 26(10): 1863-76.
8. Seymen F, Kim YJ, Lee Y, Al E. Recessive mutations in testicular acid phosphatase (ACPT) cause hypoplastic amelogenesis imperfecta. Am J Hum Genet. 2016; 99: 1199-205.
9. Smith CEL, Whitehouse LLE, Poulter JA, Brookes SJ, Day PF, Soldani F, et al. Defects in the acid phosphatase ACPT cause recessive hypoplastic amelogenesis imperfecta. Eur J Hum Genet. 2017; 25(8): 10159. Available from: http://dx.doi.org/10.1038/ejhg.2017.79.
10. Kim JW, Zhang H, Seymen F, Koruyucu M, Hu Y, Kang J, et al. Mutations in RELT cause autosomal recessive amelogenesis imperfecta. Clin Genet. 2019; 95(3): 375-83.
11. Hytönen MK, Arumilli M, Sarkiala E, Nieminen P, Lohi H. Canine models of human amelogenesis imperfecta: identification of novel recessive ENAM and ACP4 variants. Hum Genet. 2019; 138(5): 525-33. Available from: http://dx.doi.org/10.1007/s00439-019-01997-8.
12. Kim YJ, Seymen F, Koruyucu M, Kasimoglu Y, Gencay K, Shin TJ, et al. Unexpected identification of a recurrent mutation in the DLX3 gene causing amelogenesis imperfecta. Oral Dis. 2016; 22(4): 297-302.
13. Dourado MR, dos Santos CRR, Dumitriu S, Iancu D, Albanyan S, Kleta R, et al. Enamel renal syndrome: A novel homozygous FAM20A founder mutation in 5 new Brazilian families. Eur J Med Genet. 2018; (October): 1-7. Available from: https://doi.org/10.1016/j.ejmg.2018.10.013.
14. Koruyucu M, Seymen F, Gencay G, Gencay K, Tuna EB, Shin TJ, et al. Nephrocalcinosis in Amelogenesis Imperfecta Caused by the FAM20A Mutation. Nephron. 2018; 139(2): 189-96.
15. Cobourne MT, Sharpe PT. Diseases of the tooth: the genetic and molecular basis of inherited anomalies affecting the dentition. WIREs Dev Biol. 2013; 2: 183-212.
16. Witkop CJ. Amelogenesis imperfecta, dentinogenesis imperfecta and dentin dysplasia revisited: problems in classification. J Oral Pathol. 1988; 17: 547-53.
17. Sabandal MMI, Schäfer E. Amelogenesis imperfecta: review of diagnostic findings and treatment concepts. Odontology. 2016; 104: 245-56.
18. Prasad MK, Laouina S, El Alloussi M, Dollfus H, Bloch-Zupan A. Amelogenesis Imperfecta: 1 Family, 2 Phenotypes, and 2 Mutated Genes. J Dent Res. 2016; 95(13): 1457-63.
19. Reddy SS, Aarthi NV, Harish BN. Hypoplastic amelogenesis imperfecta with multiple impacted teeth - report of two cases. J Clin Exp Dent. 2010; 2(4): 207-2011.
20. Aldred MJ, Savarirayan R, Crawford PJ. Amelogenesis Imperfecta- A classification and catalogue for the 21st century. Oral Dis. 2003; 9: 19-23.
21. Pekkan G, Pekkan K, Hatipoglu M, Tuna S. Comparative radiopacity of ceramics and metals with human and bovine dental tissues. J Prosthet Dent. 2011; 106: 109-17.
22. Adorno-Farias D, Ortega-Pinto A, Gajardo P, Salazar A, Morales-Bozo I, Werlinger F, et al. Diversity of clinical, radiographic and genealogical findings in 41 families with amelogenesis imperfecta. J Appl Oral Sci. 2019; 27(0): 1-11.
23. Collins MA, Mauriello SM, Tyndall TA, Wright JT. Dental anomalies associated with Amelogenesis imperfecta - A radiographic assessment. Oral Surg Oral Med, Oral Pathol Oral Endol Radiol. 1999; 88: 358-64.
24. O'Connell S, Davies J, Smallridge J, Vaidyanathan M. Amelogenesis imperfecta associated with dental follicular-like hamartomas and generalised gingival enlargement. Eur Arch Paediatr Dent. 2014; 15: 361-8.
25. Nanci A. Ten Cate's Oral Histology: Development, Structure and Function. 9th ed. Elsevier, editor. St. Louis, Missouri; 2018.
26. Wise GE. Cellular and molecular basis of tooth eruption. Orthod Craniofac Res. 2009; 12(2): 67-73.
27. Wise GE, Frazier-Bowers S, D'Souza RN. Cellular, molecular, and genetic determinants of tooth eruption. Crit Rev Oral Biol. 2002; 13(4): 323-34.
28. Hodson J. The gubernaculum dentis. Dent Pract. 1971; 21(12): 423-8.
29. NagihanKoc HD, BernaCagirankaya L, SemaDural, van der Stelt PF. CBCT assessment of gubernacular canals in relation to eruption disturbance and pathologic condition associated with impacted/unerupted teeth. Oral Surg Oral Med Oral Pathol Oral Radiol. 2019; 127(2): 175-84.
30. Ferreira DCA, Fumes, Ana Caroline Consolaro A, Nelson-Filho P, Mussolino de Queiroz A, De Rossi A. Gubernacular cord and canal - does these anatomical structures play a role in dental eruption? RSBO. 2013; 10(2167-71).
31. Consolaro A. Orthodontic traction: possible consequences for maxillary canines and adjacent teeth. Dent Press J Orthod. 2010; 15(4): 15-23.
32. Scott J. The development and function of the dental follicle. Br Dent J. 1948; 85(9): 193-9.
33. Dos Santos Moreira F, De Almeida LY, De Oliveira Santos C, Motta ACF, Martínez Martínez M, Machado RA. Gubernacular Cord and Canal. Oral Surg Oral Med Oral Pathol Oral Radiol. 2015; 120(2): e80.
34. Nishida I, Oda M, Tanaka T, Kito S, Al E. Detection and imaging characteristics of the gubernacular tract in children on cone beam and multidetector computed tomography. Oral Maxillofac Radiol. 2015; 120(2): 109-17.
35. Proffit WR, Vig KW. Primary Failure of eruption: A possible cause for posterior open bite. Am J Orthod. 1981; 80(2): 173-90.
36. Poulsen S, Gjørup H, Haubek D, Haukali G, Hintze H, Løvschall H, et al. Amelogenesis imperfecta a systematic literature review of associated dental and oro-facial abnormalities and their impact on patients. Acta Odontol Scand. 2008; 66: 193-9.
37. Yaprak E, Subaşı MG, Avunduk M, Aykent F. Amelogenesis Imperfecta and Generalized Gingival Overgrowth Resembling Hereditary Gingival Fibromatosis in Siblings: A Case Report. Case Rep Dent. 2012; 2012: 1–6.
38. Van Heerden, W Raubenheimer EJ, Dreyer A, Benn A. Amelogenesis imperfecta: multiple impactions associated with odontogenic fibromas (WHO) type. JDASA. 1990; 45: 467-71.

39. Peters E, Cohen M, Altini M. Rough hypoplastic amelogenesis imperfecta with follicular hyperplasia. Oral Surg Oral Med Oral Pathol. 1992; 74: 87-92.
40. Raubenheimer E, Noffke C. Central odontogenic fibroma-like tumors, hypodontia, and enamel dysplasia: review of the literature and report of a case. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002; 94(74-7).
41. Paula L, Melo N, Silva Guerra E, Mestrinho D, Acevedo A. Case report of a rare syndrome associating amelogenesis imperfecta and nephrocalcinosis in a consanguineous family. Arch Oral Biol. 2005; 50: 237-42.
42. Feller L, Jadwat Y, Bouckaert M, Buskin A, Raubenheimer E. Enamel dysplasia with odontogenic fibroma-like hamartomas: review of the literature and report of a case. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006; 101: 620-4.
43. Martelli-Junior H, Bonan P, Dos Santos L, Al E. Case reports of a new syndrome associating gingival fibromatosis and dental abnormalities in a consanguineous family. J Periodontol. 2008; 79: 12870-96.
44. Roquebert D, A C, Gil del Real P, Al. E. Amelogenesis imperfecta, rough hypoplastic type, dental follicular hamartomas and gingival hyperplasia: report of a case from Central America and review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008; 106: 92-8.
45. El-Naggar A, Chan J, Rubin Grandis J, Takata T, Slootweg P. WHO classification of head and neck tumours. 4th ed. Cancer IA for R on, editor. Lyon; 2017. 228-9.
46. O'Sullivan J, Bitu CC, Daly SB, Urquhart JE, Barron MJ, Bhaskar SS, et al. Whole-exome sequencing identifies FAM-20A mutations as a cause of amelogenesis imperfecta and gingival hyperplasia syndrome. Am J Hum Genet. 2011; 88(5): 616-20.
47. Sabatini C, GuzmÁn-Armstrong S. A conservative treatment for amelogenesis imperfecta with direct resin composite restorations: A case report. J Esthet Restor Dent. 2009; 21(3): 161-70.
48. Strauch S, Hahnel S. Restorative Treatment in Patients with Amelogenesis Imperfecta: A Review. J Prosthodont. 2018; 27(7): 618-23.
49. de La Dure–Molla M, Ifi-Naulin C, Fournier BP, Berdal A, Toupenay S, Manière M-C. Amelogenesis imperfecta: therapeutic strategy from primary to permanent dentition across case reports. BMC Oral Health. 2018; 1-8.

http://dx.doi.org/10.17159/2519-0105/2019/v75no5a6

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

SADJ June 2020, Vol. 75 No. 5 p267 - p270

Compiled and edited by V Yengopal

1. 0.5% versus 3% sodium hypochlorite (NaOCl) in root canal treatment: A quasi-randomized controlled trial

C Ulin, M Magunacelaya-Barria, G Dahlén, T Kvist. Immediate clinical and microbiological evaluation of the effectiveness of 0.5% versus 3% sodium hypochlorite in root canal treatment: A quasi-randomized controlled trial. International Endodontic Journal 2020; 53(5): 591-603.

ABSTRACT

The aim of root canal treatment is to eliminate bacteria from, and prevent their further entry to the root canal system. Successful root canal therapy depends on thorough chemomechanical debridement of pulpal tissue, dentin debris, and infective microorganisms.[1]

Irrigants can augment mechanical debridement by flushing out debris, dissolving tissue, and disinfecting the root canal system. Chemical debridement is especially needed for teeth with complex internal anatomy such as fins or other irregularities that might be missed by instrumentation.

A large number of substances have been used as root canal irrigants, including acids (citric and phosphoric), chelating agents (ethylene diaminetetraacetic acid EDTA), proteolytic enzymes, alkaline solutions (sodium hypochlorite, sodium hydroxide, urea, and potassium hydroxide), oxidative agents (hydrogen peroxide), etc.

Sodium hypochlorite (NaOCl) in a variety of strengths has been used by dentists for many years, but concerns have been raised about its toxicity and the occasional report of pain when higher concentrations are used.[1]

Chlorhexidine, an antimicrobial, has also been used in a variety of concentrations as either a solution or gel. Combinations of antibiotic and a detergent (MTAD) have been recently developed and are being used increasingly.

Ulin and colleagues (2020)[1] reported on a trail that sought to test the hypothesis that in a daily routine setting, root canal preparation with irrigation using 3.0% NaOCl will result in fewer postoperative root canal samples with cultivable bacteria prior to root filling than irrigation with 0.5% buffered NaOCl but, at the same time, will not result in a higher frequency of postoperative pain.

Veerasamy Yengopal: *BChD, BScHons, MChD, PhD*, Community Dentistry Department, School of Oral Health Sciences, University of Witwatersrand, Medical School, no. 7 York Road, Parktown 2193, South Africa.
ORCID Number: 0000-0003-4284-3367
Email: veerasamy.yengopal@wits.ac.za

MATERIALS AND METHODS

The study was designed as a single-blind quasi-randomized control trial. Patients who required endodontic treatment after screening (n=298) were considered for inclusion.

Exclusion criteria were severe systemic disease, no endodontic diagnosis, the need for a language interpreter, the decision to postpone the treatment decision (wait and see), the decision to not perform any treatment, extraction or endodontic surgery treatment selected.

If a patient was referred for more than one tooth, only the first treated tooth was included in the study. After informed consent was obtained, the patient was randomly assigned to have the root canal treatment performed with 0.5% or 3% NaOCl irrigation during canal preparation.

If the patient's first visit was on an even-numbered date, the concentration was 0.5%; if the visit was on an odd-numbered date, the concentration of the irrigant was 3%.

The patients and those assessing outcomes were blinded after assignment to the intervention. After entering the study, preoperative factors such as gender, age, jaw, tooth, diagnosis and preoperative symptoms were recorded.

From the patient records, the data concerning which treatment was carried out, who made the treatment and the number of treatment sessions until the treatment was completed were retrieved.

Root canal treatment was standardized but the treatments were not restricted to a single protocol. However, the following procedures were common for all cases:

An operating microscope was available and used during all the treatment procedures. After the removal of the temporary or defective restoration or crown and, if necessary, excavation of caries, each tooth was isolated with a rubber dam, ensuring the absence of saliva leakage, and the operative field was disinfected with 30% hydrogen peroxide following by 10% tincture of iodine.

Pulp chamber access preparation was performed, and working length was established using an electronic apex locator. The working length determination was confirmed radiographically with a diagnostic file. The working length was ideally determined as equal to or slightly shorter (usually 0.5 mm shorter) than the root apex tip.

Canal shaping was performed with rotary instruments, and the technique was chosen by the operator. The instruments available for use included K-flex files, Hedström files, the rotatory ProTaper instrument system, the WaveOne instrument system and the BioRace instrument system which meant that operators could choose any system that suited the clinical case that they had to complete.

The recommended minimum apical size of canal preparation was size 25. All the operators were asked to perform the root canal treatment as they would normally.

The only variation during treatment was the concentration of the NaOCl solution for irrigation of the root canal. One group was irrigated with buffered sodium hypochlorite 0.5%, and the other group was irrigated with NaOCl 3%.

The operators were free to choose any additional irrigant as perceived necessary clinically. The irrigants available were 15% ethylenediaminetetraacetic acid (EDTA) and 5% iodine-potassium-iodide (IPI) used as a short-duration antimicrobial agent and intracanal medication for 10 minutes.

Calcium hydroxide was the standard inter-appointment medication. The inter-appointment medicament was removed prior to root filling using irrigation with 15% EDTA and 0.5% or 3% NaOCl, depending on which group the case had been allocated to.

Passive ultrasonic activation was optional. After the sampling procedures, gutta-percha and AH plus were used for root filling. The access cavity was filled with IRM after each appointment. A permanent restoration was placed by the referring dentist.

Root canal bacterial sampling was taken immediately before the root filling. The sodium hypochlorite solution and iodine-potassium-iodide were inactivated with 5% sodium thiosulfate solution for 30s. The canals were then filled with a sterile solution and dentinal shavings were produced with size 25 H-files.

The entire canal content was absorbed using sterile paper points and was transferred to sterile solution. The samples were processed at the laboratory and were transferred onto growth media and these were checked daily for 14 days or until the signs of microbial growth.

To evaluate postoperative pain and swelling, each patient was instructed to complete a questionnaire after each treatment. The questionnaire contained seven identical visual analogue scales (VAS) to assess the pain daily for seven consecutive days postoperatively.

The VAS was constructed as a 10-cm line with endpoints 0 and 10, where 0 was set to no pain and 10 the worst imaginable pain. The patients were also asked to register whether swelling had occurred during the treatment period.

RESULTS

Of the 298 patients enrolled, one hundred fifty-three patients were allocated to receive root canal treatment with 0.5% NaOCl irrigation, and 145 were allocated to receive root canal treatment with 3% NaOCl irrigation.

The patients allocated to the 3.0% NaOCl group reported preoperative symptoms more frequently than the patients in the 0.5% NaOCl group but the difference was not statically significant (P=0.067).

In the respective groups, 139 (90.8%) and 132 (91.0%) received the allocated intervention. During the follow-up and analysis, the lost to follow-up varied amongst different outcome measures.

For the microbiological samples and cultures, the analysis was available from 134 teeth (96.4%) in the 0.5% group and from 129 (97.7%) teeth in the 3% group. To evaluate postoperative pain, 106 (76.2%) patient questionnaires in the 0.5% group and 105 (79.5%) in the 3% group were available.

Regarding the analysis of postoperative swelling, the data were available from 98 (70.5%) and 101 (76.5%) of patients in each group, respectively.

Eighteen (13.4%) of the root canal samples were positive in the 0.5% NaOCl group, and 24 (18.6%) were positive in the 3% NaOCl group. The mean difference –5.2% (95% confidence interval (CI): –14.8 to 4.4) was not significant (P=0.33).

Fifty-seven (53.8%) patients reported some pain in the 0.5% NaOCl group, and 56 (53.3%) reported some pain in the 3% group. The mean difference 0.4 (95% CI: –14.0 to 14.8) was not statistically significant (P=1.0).

No significant difference was detected between the two groups when comparing the maximum postoperative pain or amount of pain over all days.

In the 0.5% NaOCl group, 5 (5.1%) patients reported swelling; in the 3% NaOCl group, the corresponding number was 18 (17.8%) of patients. The mean difference was 12.7 (95% CI: 3.1–22.4), which was significant (P=0.0084). The RR was found to be 3.49 (95% CI: 1.35–9.04).

It was found that preoperative symptoms (OR=3.73; P=0.021) and the diagnoses of symptomatic apical periodontitis (OR=2.86; P=0.021) were significantly positive predictors of postoperative swelling, whilst the pre-operative diagnosis of asymptomatic apical periodontitis tended to be a negative predictor (OR=0.42; P=0.064)

CONCLUSION

The authors concluded that replacing 0.5% NaOCl irrigation with a 3.0% NaOCl solution did not result in fewer postoperative samples with cultivable bacteria nor higher frequency or magnitude of postoperative pain. However, the number of patients reporting postoperative swelling was significantly higher in the 3% NaOCl group.

Implications for practice

This trial has provided evidence of the safety and efficacy of lower concentration 0.5% NaOCl used as a root canal irrigant compared to the stronger 5.0% NaOCl concentrate.

There were additional benefits of significantly less postoperative swelling associated with the use of the lower concentration NaOCl solution.

Reference

1. Ulin C, Magunacelaya-Barria M, Dahlén G, Kvist T. Immediate clinical and microbiological evaluation of the effectiveness of 0.5% versus 3% sodium hypochlorite in root canal treatment: A quasi-randomized controlled trial. International Endodontic Journal 2020; 53(5): 591-603.

2. The effect of an intraorifice barrier and base under coronal restorations on the healing of apical periodontitis: A randomized controlled trial

G Kumar, S Tewari, P Sangwan, J Duhan, S Mittal. The effect of an intraorifice barrier and base under coronal restorations on the healing of apical periodontitis: A randomized controlled trial. International Endodontic Journal 2020; 53 (4): 298-307.

ABSTRACT

Clinical assessment of both root canal treatment and coronal restoration is fundamental when evaluating endodontic treatment. There is a large body of published evidence that has evaluated factors that can affect the outcomes of the endodontic treatment procedure.

These include variables such as short filled (>2 mm), long filling (extruded beyond apex), flush filled root fillings, voids in the root filling materials, issues around cleaning efficacy of canals, etc. However, there is still some controversy when it comes to the level of impact of the coronal restoration on the success rate of the endodontic treatment.

Much is known about the effect of permanent coronal restoration on the treatment outcome. Some studies, including reviews have reported a link between the quality of the coronal restoration and the overall success of the endodontic procedure for that particular tooth whilst others have reported no association.

Some studies have reported that the quality of the root canal procedure (the sealing of the root system) was more important determinant of overall success than the placement of the coronal restoration.

Kumar and colleagues from India (2020)[1] reported on a trial that sought to evaluate the effects of an additional orifice barrier, the coronal extent of root filling and periodontal status on the healing of Apical periodontitis after root canal treatment. The primary objective of this study was to assess the effect of an additional coronal barrier on endodontic success. The null hypothesis was that there is no difference in periapical healing with or without additional coronal barriers.

MATERIALS AND METHODS

Patients who met the following inclusion criteria were invited to participate in this trial: permanent mandibular first or second molars with pulp necrosis and periapical radiolucency on radiographs were selected. Both occlusal and proximal cavities were included.

Exclusion criteria comprised the following: pregnant women and patients with diabetes, immunocompromising conditions, positive history of antibiotic intake in past 1 month, unrestorable teeth, teeth with apicomarginal defect, pocket depth > 6 mm, previously initiated root canal treatment, root filling or procedural errors.

The patients were randomly assigned to one of the three groups: intraorifice barrier (GIC filling placed in coronal part of root canal and at the base of the restoration), base (root canal filled and sealed off at base of pulp chamber and then GIC placed as a base for the restoration) and control (root canal filled and sealed off at base of pulp chamber and then restoration placed over this [no base]).

For randomization, equal proportion allocation ratio was followed. Opaque envelopes with concealed assignment codes were handed sequentially to all the participants. Envelopes were opened by the primary investigator only after filling of the root canals.

Endodontic procedures in all the teeth were performed by a single operator using a standardized approach. After preparation, the root canals were irrigated with 5 ml of 17% EDTA for 1 min followed by final irrigation with 5 mL 5% NaOCl. The root canals were dried using paper points and filled with laterally condensed gutta-percha and zinc oxide eugenol sealer 0-2 mm short of

the radiographic apex. The access cavity was restored with a resin-reinforced ZOE cement (Kalzinol). In the next visit after 48 h, the intermediate restoration was removed from the coronal access. The sealed envelope containing the concealed assignment code was opened by the operator, and the access cavity was restored accordingly as per group assignment.

For the Intraorifice barrier group: after removal of 3 mm of gutta-percha from the coronal portion of the root canals using a heated plugger, excess root canal sealer was removed with sterilized alcohol-wet cotton pellets.

The entire surface was conditioned using Ketac Molar liquid for 30 s, rinsed with water and air-dried. GIC (Ketac Molar) powder and liquid were dispensed in the ratio of 3:1 on the paper pad and mixed with plastic cement spatula for 45 s. GIC was then placed inside the orifice and condensed with the plugger over the root filling.

A 2-mm-thick uniform base of the same material was applied on the floor of the pulp chamber and condensed with the plastic instrument. A final composite resin (Tetric EvoCeram) restoration was placed in increments of 2 mm according to the manufacturer's instructions. Finishing was done with fine diamond points.

For the Base group, gutta-percha was left at the level of orifice. A 2-mm-thick GIC base was placed on the pulp chamber floor and the cavity restored with composite following the same procedure described above. In the Control group, only composite resin was used to seal the access cavity leaving gutta-percha up to the orifice.

The adequacy of coronal restoration and extent of canal filling was verified radiographically. Additional periodontal therapy was administered to patients with compromised periodontal health. Clinical and radiographic follow-up was done at 3, 6, 9 and 12 months. All radiographs were obtained at standard exposure parameters.

The primary treatment outcome was healing, evaluated using clinical and radiographic findings. The coronal portions of the teeth in radiograph were masked to ensure blinding of the observers. In case of disagreement, two observers sat together and discussed until a mutual consensus was achieved.

The radiographic scores at 12 months were further dichotomized into healed and nonhealed. Criteria for clinical success were the absence of pain, sinus or any swelling, tenderness to palpation/percussion, tooth mobility and increased periodontal probing depth.

A calibrated examiner masked to the treatment provided recorded probing depth (PD) and bleeding on probing (BOP) using a periodontal probe (UNC-15). Clinically, periodontal parameters were recorded at six sites in every tooth (mesial, median, and distal points at the buccal and lingual aspect per tooth).

For calculation of marginal bone height, the vertical distance between the cementoenamel junction and most coronal bone level was measured using the ImageJ® software.

RESULTS

Out of 120 patients enrolled in the study, 10 patients (2, 5 and 3 patients from the intraorifice barrier, base and control groups, respectively) were lost to follow-up. Therefore, 110 patients were included in the final analysis. There was a non-significant difference in age or gender between the groups.

There was no significant difference in radiographic scores at any interval between the groups ($P>0.05$). All the groups were associated with a significant improvement in radiographic score at all time intervals ($P<0.05$). Following dichotomization, the base group exhibited the greatest percentage of healing (97.1%) followed by the intraorifice barrier (92.1%) and control groups (83.8%); however, the differences were nonsignificant ($P=0.136$). None of the patients examined at any follow-up stage had signs or symptoms of clinical failure.

When the teeth were classified into positive (gutta-percha coronal to marginal bone) ($n=59$) and negative (gutta-percha apical to marginal bone) ($n=51$) root filling groups based on the coronal extent of the root filling, a non-significant difference in healing between both the groups was observed ($P=0.672$).

The patients were further subdivided into 2 groups based on the periodontal bone level: periodontally healthy (alveolar crest within 2 mm from the cementoenamel junction) and periodontally compromised. The average initial pocket depth of periodontally compromised patients was 3.63 mm.

Healing rate was higher in periodontally healthy patients (92.9%) than periodontally compromised patients (88.9%), but the difference was non-significant ($P=0.547$). The chi-square test was also used to compare healing between Class I (88.6%) and Class II (92.4%) cavities, and the difference was found to be nonsignificant ($P=0.498$). None of the factors (age, gender, type of cavity, type of coronal restoration, marginal bone height at baseline and radiographic score at baseline) analysed had a significant effect on outcome in the regression analysis.

CONCLUSION

The authors concluded that the use of additional barrier under permanent restorations did not significantly improve the outcome of primary root canal treatment in posterior teeth up to 12 months.

Implications for practice

The results suggest that there was no need to place a base cement on the floor of the pulp chamber before placement of permanent restoration. However, longer term follow up studies (greater than one year) will need to confirm longer term outcomes.

Reference

1. Kumar G, Tewari S, Sangwan P, Tewari S, Duhan J, Mittal S. The effect of an intraorifice barrier and base under coronal restorations on the healing of apical periodontitis: A randomized controlled trial. International Endodontic Journal 2020; 53(4): 298-307.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a7

Maxillofacial Radiology 181

SADJ June 2020, Vol. 75 No. 5 p271

CJ Nortjé

Below are images of two patients that presented at the department. The one patient was accidentally shot by a friend using a pellet gun (Fig.1 & 2), while the other patient presented with a swelling of three month duration on the left side of the mandible (Fig. 3, 4, 5, 6 & 7). Studying the images presented below what are the important lessons to learn regarding the final diagnosis of the two cases?

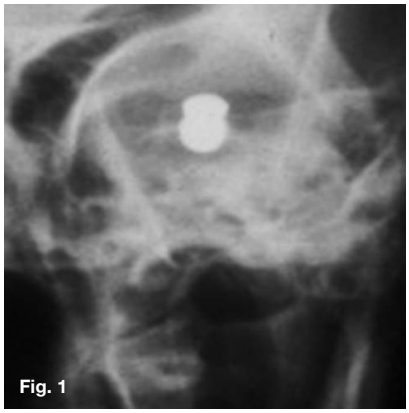


Fig. 1

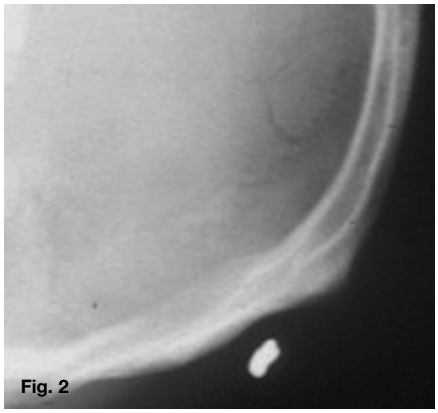


Fig. 2

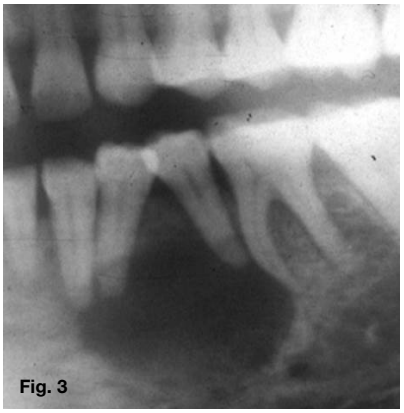


Fig. 3

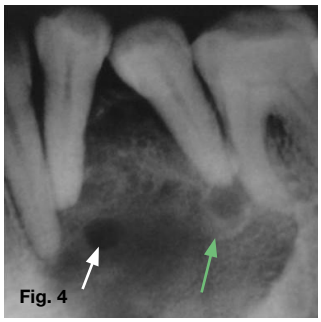


Fig. 4

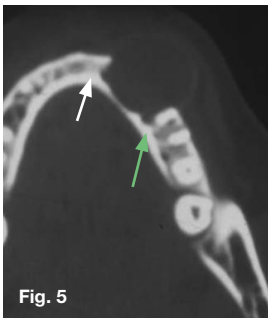


Fig. 5

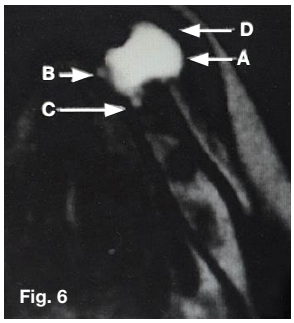


Fig. 6

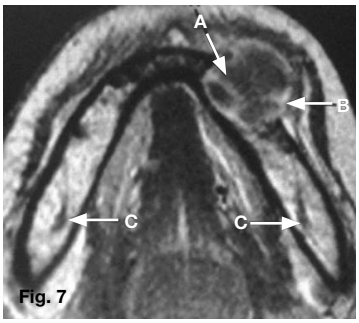


Fig. 7

INTERPRETATION

A pantomograph was taken of the patient who was accidentally shot. No sign of the presence of a pellet was discernible on the pantomograph. A posterior-anterior skull radiograph (Fig. 1) was taken and the presence of a pellet in the eyeball are clearly demonstrated. The main reason why the pellet could not be observed on the pantomograph is probably due to the fact that the pellet was not in the layer when the radiograph was taken (Review Maxillofacial Radiology Case 180). Due to the presence of the pellet in the region of the eyeball, a lateral skull radiograph (Fig. 2) was taken which clearly show the presence of the pellet in the posterior region of the skull. "One view is no view" is a common phrase amongst radiologists. When conventional radiographs are used both AP and lateral radiographs are required before an accurate diagnosis can be made. A number of radiologists over the years got themselves in serious allegations of misconception due to relying on one view only before making a diagnosis. A cropped pantomograph (Fig. 3) of the patient presenting with a swelling on the left side of the mandible showing a well demarcated radiolucency causing divergence and resorption of the roots of 34 and 35. An intraoral radiograph (Fig. 4) which shows a well demarcated radiolucency with two smaller well defined lucencies (arrows) suggestive of daughter cysts within the lesion. The reason why the daughter cysts are nicely demonstrated on the intra-oral film is because the film is very close to the lesion while on the pantomograph the cysts are not depicted because they are not present in the layer. An axial CT bone window setting (Fig. 5) shows two outward projecting daughter cysts in profile. A T2-weighted axial MR image (Fig. 6) shows the dominant cyst (A) which appears homogeneous with hyperintense fluid and the anteriorly (B) and posteriorly (C) situated daughter cysts are well depicted. A T1-weighted axial MR image (Fig. 7) confirming the lesion with buccal expansion. There are contrast enhancing soft tissue septae (A) dividing the lesion into a multilocular lesion. A small soft tissue contrast enhancing nodule is also discernible (B). The inferior alveolar nerves are also clearly depicted (C). A final histological diagnosis of a unicystic amelolastoma was made. The purpose of this communication was to emphasise the important role imaging plays in the diagnosis of lesions of the maxillofacial region.

Christoffel J Nortjé: *BChD, PhD, ABOMR, DSc.* Faculty of Dentistry, University of the Western Cape.
ORCID Number: 0000-0002-9717-5514
Email: cnortje@uwc.ac.za

Reference

1. The application of MR and CT Imaging in the Diagnosis and Management of Maxillofacial tumours. LJ van Rensburg, DSc Thesis, Maxillofacial Radiology, University of the Western Cape.

http://dx.doi.org/10.17159/2519-0105/2020/v75no5a8

Fraudulent records – Grave forensic consequences

SADJ June 2020, Vol. 75 No. 5 p272 - p274

LM Sykes[1], L Robinson[2], H Bernitz[3]

INTRODUCTION

Natural disasters, fatal accidents, and violent criminal offences are part of everyday life. All of these may result in fatalities that shatter the lives of the victim's families and friends. Their trauma is compounded by the fact that all unnatural deaths have to be investigated, and the bodies of the deceased positively identified before they can be released to the families for burial.

Bodies of victims of violent crimes, fires, drowning, motor vehicle or aviation accidents, work place fatalities or situations where some time has elapsed since death may be so disfigured that "identification by a family member is neither possible or desirable".[1]

Often the nature or degree of the injury may be so extensive that fingerprinting is also not a viable option. DNA analysis may be considered, however it takes time and is a costly procedure. There are also concerns with maintaining strict control over the chain of evidence during all additional procedures and tests. Thus, in these situations the forensic odontologist may be called in as part of the investigative team.

LITERATURE REVIEW

Dental forensics

Victim identification using forensic odontology may take one of two forms. The more common is where the forensic odontologist performs a comparative examination of ante-mortem records with a post-mortem examination.

Author affiliations:
1. **Leanne M Sykes:** *BSc, BDS, MDent, Dip Research Ethics (IRENSA); Dip ESMEA (Univ Dundee), DipOdont (Forensic Odontology),* Department of Prosthodontics, School of Dentistry, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa.
   ORCID Number: 0000-0002-2002-6238
2. **Liam Robinson:** *BChD, PDD (Maxillofacial Radiology), PDD (Forensic Odontology),* Department of Oral Pathology and Oral Biology, School of Dentistry, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa.
   ORCID Number: 0000-0002-0549-7824
3. **Herman Bernitz:** *BChD, Dip (Odont), MSc, PhD,* Department of Oral Pathology and Oral Biology, School of Dentistry, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa.
   ORCID Number: 0000-0003-1361-1225

Corresponding author: Leanne M Sykes
Department of Prosthodontics, School of Dentistry, Faculty of Health Sciences, University of Pretoria, South Africa.
Email: leanne.sykes@up.ac.za

Author contributions:
1. **Leanne M Sykes:** Primary author - 40%
2. **Liam Robinson:** Secondary author - 30%
3. **Herman Bernitz:** Tertiary author - 30%

The other is when there are no ante-mortem records available. Here dental profiling may help investigators narrow down the search to persons of a specific age, gender, and racial group. The most common reasons for dental identification are the following:

1. In criminal cases – the investigation cannot begin until the victim has been positively identified.
2. Marriage – where a remaining spouse cannot re-marry until their partner has been confirmed to be deceased.
3. Monetary – where the payment of pension, life insurance or other benefits will only happen after confirmation of death.
4. Burial – the body may not be released to the family for burial until it has been positively identified (except in cases of a pauper's burial).
5. Social – to preserve the dignity of a deceased person their identity should be known.
6. Closure – for families whose loved ones have been missing for an extended time – a positive identification will provide them with final confirmation and closure.[1,2]

A delay in identification will thus have an impact on most, if not all of the above activities, and may cause untold anguish and distress to the remaining family members and loved ones.

Comparative dental identification involves comparison of ante-mortem dental records (including patient files, written notes, radiographs, photographs and study models), with findings obtained from a thorough post-mortem clinical assessment (including visual appraisal, dental charting and radiographs). Persons with numerous and complex dental restorations, or distinctly characteristic tooth morphology will be much easier to identify than individuals with little or no restorative work or unique features. The process involves a "methodical and systematic comparison of each tooth and the surrounding structures in turn".[1]

A detailed description of this process is beyond the scope of this paper. In brief, the examination includes noting teeth present and missing, their type and position, morphology and pathology of the teeth crowns, roots, pulp chambers, and periapical regions, and all dental

restorations. In addition, the examination may involve the assessment of gingival/periodontal morphology and pathology, as well as surrounding osseous features including the alveolar process and lamina dura, maxillary sinuses, anterior nasal spine, mandibular canal, coronoid and condylar processes, and any other pathological entities.[1]

After the comparison, one of four conclusions may be reached:

1. Positive identification – where records match with sufficient details and no unexplainable discrepancies.

2. Possible identification – where there are many consistent features, but the nature or quality of the records are not good enough to justify a statement of absolute certainly.

3. Insufficient evidence available to draw any conclusions.

4. Exclusion – if there are clear inconsistencies in ante-mortem and post-mortem data.[3]

(Note: Larger/more complex or additional restorations in the post-mortem findings may be explained by disease progression, and can still result in a positive identification. However, smaller or fewer restorations are unexplainable and would warrant exclusion).

Many studies have investigated the minimum number of concordant features needed to make a positive identification. However, there is no universally accepted number required, because each case has its own individuality and as such, the final decision needs to lie with the experience, expertise, and judgement of the forensic odontologist.[4]

Dental fraud

The healthcare industry is unique in that it is both "service and product based". Vast amounts of money is spent, with many different role-players all vying for their share of the market in order to secure personal gains. Inevitably, "some will try to take advantage of the system and manipulate it to their benefit".[5]

Postma et al. (2011) conducted a study of misconduct complaints against oral health care professionals lodged with the HPCSA from 2004-2009. The results revealed that fraud accounted for 29% and 46% of the cases against dentists and dental therapists respectively.[6] The range of fraudulent complaints related to over-servicing, overcharging, claiming for services rendered to non-members, changing service dates, discrepancies between clinical records and billing records, submitting claims while being suspended from practice, incorrect tariff codes, claiming for procedures not performed, and split billing.[6]

In a later study of HPCSA misconduct records, Nortjé and Hoffmann (2014) also found that the predominant transgression was charging for services not performed and submitting these claims to medical aids, as well as for performing sub-optimal treatment.[7]

These studies only investigated HPCSA records and did not give any indication of the magnitude/scale of the fraud. Putter and Naidoo (2018) conducted an investigation that looked specifically at dental fraud, using data obtained from HPCSA, Discovery, and the Board of Health Care Funders (BHF) records. Discovery revealed that between 2007 and 2015, dental fraud reached a total of over ZAR 18.1 million. Statistics from the BHF were even more alarming as they estimated that in the same nine-year period the amount exceeded ZAR 40 million. In a separate survey conducted by KPMG from 2007-2009, they reported fraudulent cases in excess of ZAR 221 million, where more than 70% consisted of charging for services not rendered or code manipulation.[5]

Not only does fraud waste money that could be allocated to proper treatment in deserving patients, but also may have other far-reaching consequences, particularly in legal and forensic fields. The following two cases illustrate the severity and potential adverse repercussions of recording procedures not done, or charging for larger/more complex restorations than were actually carried out.

Dental forensics meets Dental fraud - "Discovering the truth after death"

In the entrance of the Pretoria medico-legal mortuary one is met with a sign which reads "This is where the dead teach the living". It often happens that in the very same mortuary the "The dead reveal secrets about the living". Unfortunately it is here, during the dental examination of deceased victims, that unethical dentistry is often discovered. This includes both poor technical procedures as well as blatent unethical practices.

Case 1

Following an aircraft accident the forensic odontology unit at the University of Pretoria were asked to identify the remains of two severely burned bodies. On arrival they were met by the pilot's wife. She was requested to locate the dental records of her deceased husband for a possible dental identification.

Fortunately, she had with her an appointment card from their regular dentist as her husband was busy undergoing dental treatment and had several follow-up sessions scheduled. The card indicated that he still required three more one-hour sessions. On dental examination of the first victim (the assumed pilot), including radiographic assessment, no carious lesions or any other dental pathology could be found. Thus, there was no evidence to justify three further dental appointments.

In light of this information, the forensic odontologist also viewed the three recently completed composite restorations (Teeth 14, 15 and 16) with suspicion (**Figure 1**). A sound amalgam restoration was noted on tooth 17.

The treating dentist was phoned to discuss the case, but no further action was taken as there was no concrete evidence to substantiate the fact that he intended to carry out more restorative work on "virgin/healthy" teeth (For full details of this case: Forensic dentistry

case book 4: Non-maleficence in dental practice, "primum non nocere" by H Bernitz in SADJ August 2015[8]).

Figure 1. Victim's maxilla showing the three recent composite restorations in the posterior first quadrant.

Case 2

In a recent mission to identify the victims of a mass disaster, one of the bodies, which had been severly carbonised, was examined for a possible dental identification. During the examination two restorations were noted, these being occlusal amalgams on teeth 18 and 48 (Figure 2). However, when the ante-mortem records arrived, they indicated that an occlusal composite restoration had also been placed on tooth 36, which was not visible during the post-mortem examination.

Under microscopic examination, a thin film of sealant was seen, which certainly did not account for the class I composite restoration that the ante-mortem records indicated and for which the patient had been charged.

Figure 2. Remains of the victim's mandible showing occlusal amalgam restorations on teeth 18 (top fragment) and 48, with no evidence of a composite restoration on tooth 36.

These findings presented the forensic odontology unit with an unexplainable discrepancy. Faced with this scenario, the unit had to decide what conclusion to draw on the victim's identity. The first option, and the only truly accurate and defensible argument, was that the post-mortem dental examination did not match the ante-mortem dental records, and thus positive identification was excluded. The second option was to presume that the dentist had placed the miniscule sealant and fraudulently charged for a larger restoration, and then confirm a positive identification. However, with no concrete proof of this fraud,the forensic odontology unit were forced to report exclusion of identity. This meant that the body could not be released to the family for burial until further tests/DNA analysis had been carried out. The victim was subsequently confirmed to be their family member, however the incident forced the family to endure a costly and stressful delay in closure due to the fraudulent activities of their "trusted" dentist.

DISCUSSION AND CONCLUSIONS

Fraud may be defined as "wrongful deception, misrepresentation or concealment with the clear intention to deceive, resulting in personal or financial gain, or as intentional theft".[9] However, the extent and repercussions can extend far beyond that of personal gratification, and may have a negative impact on many other innocent persons.

This has been illustrated in the above case scenarios where not only have the victims fallen prey to unscrupulous dentists, but their families have also been forced to endure the extended uncertainly regarding confirmation of their loved ones deaths. The difficulty of dealing with suspected fraud lies in proving intent, and there will always be those who get away with this heinous practice.

The onus lies with the remaining majority of honest practitioners to continue in their pursuits of developing a "strong anti-fraud culture, and improving the character of the nation and reputation of the profession".[5]

References

1. Pretty IA., Sweet D. A look at forensic dentistry – Part I: The role of teeth in the determination of human identity. Br Dent J. 2001; 190(7): 359-66.
2. Gosavi S, Gosavi S. Forensic odontology: A prosthodontic view. J Forensic Dent Sci. 2012; 4(1): 38-41.
3. Singal K. Dentistry as a tool for identification. J Forensic Science and Criminology. 2015; 2(5): 1043.
4. Acharya AB. Are a minimum number of concordant matches needed to establish identity in forensic odontology? J of Forensic odonto-stomatology. 2003; 21(1): 6-13
5. Putter S, Naidoo S. Dental fraud in South Africa 2007-2015. SADJ. 2018; 73(9): 546-53.
6. Postma TC, van Wyk PJ, Heymans JH, White JG, Prinsloo PM. An analysis of complaints againt oral health professionals charged with misconduct at the HPCSA: 2004-2009. SADJ. 2011; 66(9):420-5.
7. Nortjé N, Hoffmann, WA. Professional consequence for dentists involved in unethical decision-making in South Africa. J Forensic Odontostomatol. 2014; 32; 22-9.
8. Bernitz H. Forensic dentistry case book 4: Non-maleficence in dental practice, "primum non nocere". SADJ. 2015; 70(7): 312.
9. The Concise Oxford Dictionary. 10th ed. Oxford. Oxford University Press. 1999; 562.

CPD questionnaire

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

GENERAL

Parents' perception of their role in the prevention of inadequate consumption of fruit and vegetables among adolescents in South Africa

1. Identify the CORRECT statement. Why do South African adolescents consume relatively low fruit and vegetables in spite of the development of food-based dietary guidelines for South Africa?
   A. Poor implementation strategies and inadequate promotion of the dietary guidelines
   B. Most adolescent oral health behaviours are initiated in infancy and childhood
   C. Parents and schools have failed to provide enabling environment
   D. All of the above

2. Identify the CORRECT statement. How is consuming a diet high in fruit and vegetables associated with a decreased risk of many chronic diseases, including periodontal disease?
   A. Fruits and vegetables are good sources of many important nutrients such as potassium, Vitamin C, folate, fiber, and numerous phytochemicals
   B. Phytochemicals protect cells from oxidative damage
   C. Options (A) and (B)
   D. None of the above

3. Identify the CORRECT statement. Fruit juice is not as healthy as solid or whole fruits. Which of the options below is not valid?
   A. Fruit juice contains too much water
   B. Solid or whole fruits contain less free sugars
   C. The intrinsic sugars in solid or whole fruits are healthier than the extrinsic sugars produced when cell membranes rupture during the juicing process
   D. Solid or whole fruits provide a lot more fibres and nutrition usually lost during the juicing process

4. Identify the INCORRECT statement. Vegetables are more likely to provide optimum nutrients and protection than fruits. Which of the options below is not valid?
   A. They are usually prepared fresh for meals usually immediately after harvest, especially, in the rural areas
   B. Fruits are often eaten many days after harvest
   C. Vegetables are cheaper
   D. Fruits that are highly contingent on seasonal fluctuations

5. Identify the CORRECT statement. The present study recommends the introduction of infants as early as possible to the taste of locally available fruit and vegetables. Which of the options below is incorrect?
   A. In order to promote their liking through increased taste exposure
   B. Because children as young as four years of age, perhaps much younger have already formed their taste preferences for fruit and vegetables
   C. Neophobia seems to be minimal around the age of 140-180 days, so infants may be more willing to try new foods at this age, making it the ideal time to help them acquire a taste for vegetables
   D. None of the above

Academic education of South African maxillofacial and oral surgeons in the field of cleft lip/palate and craniofacial deformities

6. Identify the CORRECT statement. Maxillofacial and oral surgeons (MFOS) play an important role in left lip/palate and craniofacial deformities management because they are trained in:
   A. management of hard and soft tissue conditions affecting the orofacial region
   B. removal of wisdom teeth
   C. temporomandibular joint surgery
   D. oral pathology

7. Identify the CORRECT statement(s). Surgical care for cleft lip/palate and craniofacial deformities contributes to the healthcare burden, making many patients unable to access adequate surgical care due to:
   A. adequate surgical capacity
   B. insufficient financing
   C. shortage of human resources for surgical care
   D. travel restrictions

8. Identify the CORRECT statement. The most significant factor preventing respondents from treating CLP and CFD patients is:
   A. limited clinical experience and training
   B. long duration of the treatment
   C. lack of interest
   D. the need for multidisciplinary treatment

Conformity of removable partial denture designs to agreed principles based on materials used - A preliminary study

9. Identify the CORRECT statement.
   This survey showed that a RPD design that conforms to agreed biomechanical principles is driven by:
   A. What is taught at dental schools
   B. The material used for the framework or base
   C. The quality of the laboratory work
   D. The intra-oral condition
   E. None of the above

10. Identify the CORRECT statement. Soft tissue harm caused by RPDs can be limited by:
   A. The correct location and number of rests
   B. Using more clasps
   C. Unilateral designs
   D. Mucosa-supported RPDs
   E. None of the above

11. Identify the CORRECT statement. This survey concluded that metal-frame RPDs scored better for:
   A. Support
   B. Direct and indirect retention
   C. Open design
   D. All of the above

12. Identify the CORRECT statement. This study concluded that the NMC group scored poorly for all of the following factors, EXCEPT:
   A. Support
   B. Direct retention
   C. Open design and cross-arch stabilization
   D. Indirect retention

Amelogenesis imperfecta with multiple impacted teeth and altered eruption pathways

13. Identify the CORRECT statement.
   Amelogenesis imperfecta is best managed by:
   A. Direct restorations
   B. Indirect restorations
   C. No intervention
   D. Extractions

14. Identify the CORRECT statement. Dental complications associated with Amelogenesis imperfecta include:
   A. Decreased caries susceptibility
   B. Loss of horizontal dimension of occlusion
   C. Altered aesthetics
   D. All of the above

15. Identify the CORRECT statement. Additional oral features that can accompany Amelogenesis imperfecta include:
   A. Taurodontism
   B. Numerous impactions
   C. Pulp stones
   D. Ginigival hyperplasia
   E. All of the above

Clinical Windows - What's new for the clinician?

16. Identify the CORRECT statement. The Ulin et al. trial can be consider as "quasi-randomized" because of one of the following statements:
   A. The trail was single blinded
   B. There was a small sample size
   C. If the patient's first visit was on an even-num bered date, the concentration was 0.5%; if the visit was on an odd-numbered date, the concentration of the irrigant was 3%
   D. The trial was double-blinded

17. Identify the CORRECT statement. In the Ulin et al. trial: what were the outcomes for bacterial levels and/or postoperative pain among the groups?
   A. There was a difference in bacterial levels or and postoperative pain among the groups
   B. There was only in difference in the bacterial levels between the group
   C. There was only a difference in the postoperative pain levels between the groups
   D. There was no difference in bacterial levels or post-operative pain among the groups

18. Identify the CORRECT statement. In the Ulin et al. trial: post-operative swelling was associated with which concentration of NaOCl?
   A. Post-operative swelling was associated with 3% NaOCl
   B. Post-operative swelling was associated with 0.5% NaOCl
   C. Post-operative swelling was associated with 0.2% NaOCl
   D. Post-operative swelling was associated with 0.1% NaOCl

19. Identify the CORRECT statement. In the Kumar et al. trial: How was the 2mm GIC base applied?
   A. A 2mm GIC base was applied in all 3 groups
   B. A 2mm GIC base was applied in 2 of the 3 groups
   C. A 2mm GIC base was applied in only the control group
   D. None of the groups received a 2mm GIC base

20. Identify the CORRECT statement. In the Kumar et al. trial, which restorations had better outcomes?
   A. Restorations that had the 2mm GIC base had better outcomes than those that did not
   B. Only restorations that had been placed on single root canals had better outcomes
   C. Only restorations that had been placed on multiple root canals had better outcomes
   D. None of the above

ETHICS

Fraudulent records – Grave forensic consequences

21. Identify the CORRECT statement.
Identification using dental records:
A. Cannot be used for badly burnt bodies
B. Cannot be used in mass disaster situations
C. Cannot be used for murder victims
D. May make use of hand written notes

22. Identify the CORRECT statement. In a forensic dental investigation, many concordant features, as well as a single larger restoration in the ante-mortem records compared with the post-mortem examination would led to which conclusion:
A. Positive identification
B. Possible identification
C. Insufficient evidence
D. Exclusion

23. Identify the CORRECT answer. Performing and charging for suboptimal dental treatment is unethical and may be considered as:
A. Fraud
B. Misconduct
C. Negligence
D. Both A and B are correct
E. Both B and C are correct

24. Identify the CORRECT statement. The majority of fraud cases identified in the KPMG study (2007-2009) were for:
A. Excessive pricing
B. Split billing
C. Code manipulation
D. Charging for work done while suspended
E. Both A and B are correct

25. Identify the CORRECT statement. Over-servicing refers to:
A. Doing too much work in one session
B. Doing more work than the patient can afford
C. Doing more work than the patient requires
D. Both A and B are correct
E. Both B and C are correct

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.

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ
SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

Instructions to authors

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

The South African Dental Journal (SADJ) is a peer reviewed, Open Access Journal, published by the South African Dental Association (SADA). The Journal primarily carries research articles which reflect oral and general health issues in Africa but also publishes papers covering the widest consideration of all health sciences. In addition, items of specific relevance to members of the Association find dissemination through the Journal. The Journal is published ten times each year in electronic format. Hard copy is available by arrangement.

We shall be obliged if your submission is prepared respecting all the details listed in these Instructions. This facilitates our process and ensures more rapid responses to you. Please use and submit the Checklist for Authors suplied on page 281 for confirmation. Thank you.

Address for submission of articles

The Editorial Assistant, Mr Dumi Ngoepe,
South African Dental Journal, South African Dental Association (SADA), Private Bag 1, Houghton 2041, South Africa.
Email addresses: ngoeped@sada.co.za
bill.evans@wits.ac.za
Please submit the paper in electronic format in Word and Figures sparately in JPEG., accompanied by a covering letter signed by the author(s).

Language

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

Clinical Research

Articles should adhere to the protocols of the Helsinki Declaration (https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/.

Clinical Trials

Clinical trials should conform to the Consort Statement (Consolidated Statements of Reporting Trials) and Reviews to the PRISMA checklist (Preferred Reporting Items for Systematic Reviews and Meta Analyses) (http://www.equator-network.org).

Authors

Authors should meet the criteria for authorship as in the documents of the International Committee of Medical Journal Editors (ICMJE):

1. Substantial contributions to the conception or design of the work or the acquisition, analysis or interpretation of data for the work, AND
2. Drafting the work or revising it critically for important intellectual content, AND
3. Final approval of the version to be published, AND
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (www.icmje.org).

- The front page of the manuscript should list the title of the article, the author's(s') name(s), and their qualification(s), affiliations and positions held, telephone and fax numbers and address(es), including Email address(es), if available. It is especially important that details of the Corresponding Author should be clearly stated.
- Please submit on the front page a list of up to eight Keywords.
- In the case of multiple authors, the role played and the respective contribution made by each should be recorded. For example: "Principal Researcher- 40%, Writing Article- 30%, Tissue Analysis- 20%, Microscopic Examination- 10%", etc.
- A recent requirement is that authors should be registered with ORCID. This is a number registering you as an Open Researcher and Contributor. Go to the ORCID website home page at https://orcid.org/ and follow the Three Easy Steps indicated in green. Please submit the ORCID number with your author details.

Title

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

Abstract

The abstract shall consist of not more than 200 words.
For research articles, the summary should be structured under the following headings: Introduction, Aims and Objectives, Design, Methods, Results and Conclusions. Do not include references in the Abstract.

Text

- Articles should be clear and concise.
- Text should be typed in Times New Roman font, size 11; double-spaced with a 3 cm. margin on the sides, top and bottom. Each page must be clearly numbered.
- Please include electronic numbering of lines throughout the document.
- Tables should be clearly identified, using Roman numerals ie. Table I, Table II etc.
- Authors are requested to note and adhere to the current style of the Journal particularly with respect to paragraph settings and headings.

Length of the article

In general, papers should be between 4000 and 5000 words, although this is flexible. The Editor reserves the right to edit the length of an article in conjunction with the author(s) and SADJ reserves the right to charge for excess/additional pages. The first four pages of original research papers published in the SADJ will be free of charge after which a charge of R500 per page or part thereof will be levied.

Illustrations/graphics/photographs

- Illustrations/graphics/photographs must be appropriate to the content of the manuscript.
- Digital images with a DPI of at least 300 should be supplied. Photocopies and pdf. files of photographs are not acceptable.
- **Please note:** Figures should be included in the text **and** sent separately in jpg. format.
- The Figure numbers must be in Arabic numerals and clearly identified for each illustration, graphic or photograph.
  Please remember to record Figure numbers in the text.
- **Permission:** Where any text, tables or illustrations are used from previously published work, permission must first be

obtained from the holder of copyright and a copy of the agreement must be submitted with the article. Suitable acknowledgement must be recorded in the article.

Continuing Professional Development

Please supply **4-5 Multiple-choice Questions (MCQ's)** with 4 or 5 options per question related to your article. Questions must have only one correct answer, and indicate this correct answer clearly.

References

- References should be set out in the **Vancouver style** and only approved abbreviations of journal titles should be used (consult the *List of Journals Indexed* in *Index Medicus* for these details at: http://www.nlm.nih.gov/tsd/serials/lji.html).
- References should be inserted seriatim in the text using superscript numbers and should be listed at the end of the article in numerical order.
- A reference in the text should appear as indicated: "...as the results of a previous study showed.[23]"
- Where there are several papers referenced, the superscript numbers would appear as: "...previous studies have shown. [3,5,7,9-12,14]"
- **Do not list the references alphabetically.**
- It is the author's responsibility to verify each reference from its original source. Please note that an article may be rejected if the referencing is inaccurate.
- Names and initials of all authors should be given unless there are more than six, in which case the first three names should be given, followed by 'et al'. First and last page numbers should be given. Where it is applicable the page numbers should be abbreviated by omitting redundant numbers eg. pages 456 to 478 is recorded as 456-78, and 456 to 459 as 456-9, but 398 to 401 is recorded as 398-401.
- Notice that volume numbers are not given in bold, authors are not linked by 'and' or '&', and the year of publication appears after the name of the journal. No item should appear in italics except for foreign terms, eg *in vivo*.

Journal references should appear thus:

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

Book references should be set out as follows:

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

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

Manuscripts accepted but not yet published may be included as references followed by the words 'in press'.

'Unpublished observations' and 'personal communications' may be cited in the text but not in the reference list.

Declaration

All sources of funding, possible financial interest/s or incentives in products or services mentioned in the article must be disclosed. Authors are kindly requested to read and sign the attached declaration **on page 280**.

No articles that have been published previously, or that are currently being considered for publication elsewhere, will be accepted. Authors are kindly requested to verify that their article complies with this condition.

Ethics

Where relevant, authors should indicate whether their research has been approved by the Ethics Committee of their Institution or by other research ethics committees.

Conflict of interest

Authors must disclose their involvement with any company either owned by them or from which they have received a grant or remuneration or with which they have an association, and must declare any other personal interest they may have which would constitute a Conflict of Interest. These may include personal relationships, academic competition, or intellectual beliefs. Should there be no applicable Conflicts of Interest this should also be so stated. The statement will be included at the end of the text.

Copyright

The South African Dental Journal is a peer reviewed, Open Access Journal, adhering to the Budapest Open Access Initiative: "By 'open access' to this literature, we mean its free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited." https://access.okfn.org/definition/index.html

The Managing Editor reserves the right to decline articles, photographs or illustrations where products or services are mentioned that are not appropriate.

Submission

The paper should be submitted in one file including all Tables and Figures and their accompanying Legends Figures should also be submitted separately file in JPEG. format.
Please submit the paper in electronic format in Word along with separate Figures in JPEG. format to: ngoeped@sada.co.za and to bill.evans@wits.ac.za, accompanied by a covering letter and the Declaration **on page 280** signed by all the author(s).

Galley proofs

Changes/corrections to the proofs supplied to authors **must** be returned to the publishers by email or by fax and not over the telephone. Galley proofs must please be returned to the publishers within **four days** after receipt thereof.

Editorial Policy

Authors may also wish to refer to the Editorial Policy of the SADJ available on the SADA website.

Enquiries

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

Declaration by Author/s

Title: _____

_____

Author/s: _____

_____

I/We, the undersigned confirm and declare that:

1. This manuscript is my/our original work and I am/we are the owner/s of this manuscript and possess rights of copyright.
2. I/we confirm that this manuscript has not been published previously and it is not currently considered for publication elsewhere. Has this article been submitted to any other journal and if so, has it been rejected? **YES** ☐ **NO** ☐
3. For no consideration or royalty, I/we hereby assign, transfer and make over to SADA all the rights of copyright, which have or will come into existence in relation to this manuscript.
4. I/we waive in favour of SADA or any successors in title any moral rights which may be vested in me/us.
5. The manuscript does not constitute an infringement of any copyright and I/we indemnify SADA against all loss or damage, from any cause arising which SADA may sustain as a result of having been granted copyrights to the manuscript.
6. The research has been approved by the Ethics Committee of my/our institution/s or the Ethics Committee/s of other accredited research facilities.
7. I/we have disclosed in my/our Acknowledgments all sources of funding, possible financial interest/s or incentives in products or services mentioned in the paper.

Initial(s) and Surname	Signature	Date
Initial(s) and Surname	Signature	Date
Initial(s) and Surname	Signature	Date
Initial(s) and Surname	Signature	Date
Initial(s) and Surname	Signature	Date
Initial(s) and Surname	Signature	Date

Author's Checklist

Have you read the Instructions to Authors?	☐
Are you submitting electronically?	☐
Have you provided all author information including first names, affiliations, qualifications, positions held, Department and Institution, ORCID number, contact details?	☐
Is the first author under the age of 35 on submission of the article?	☐
Have you provided all details of the Communicating Author?	☐
Have you submitted questions for the CPD section? (four or five multiple choice, one correct answer)?	☐
Have you submitted details of the contribution of each author... can be percentage or descriptive... or both?	☐
Have you confirmed the status of your paper in terms of any Conflict of Interest?	☐
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 and placement procedure

- 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:
Ann Bayman
South African Dental Association
Tel: +27 (0)11 484 5288
Email: abayman@sada.co.za

SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

www.sada.co.za