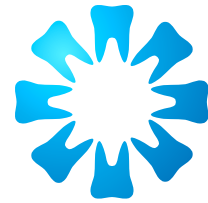


THE SOUTH AFRICAN DENTAL JOURNAL

# SADJ

MAY 2019  
Volume 74 Number 4

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



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THE SOUTH AFRICAN  
DENTAL ASSOCIATION

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1<sup>st</sup> President of the  
United States of America*



**George Washington, 1<sup>st</sup> President of the United States of America:** Gold leaf, lead plates, hippopotamus ivory, cow and horse teeth... and possibly teeth purchased from slaves... all were materials used at one time or another to construct dentures for George Washington. No wood... despite the legend!  
John Greenwood and John Baker were the dentists providing the dentures,... which were supported in the mouth with springs. No wonder George was tight lipped, seldom smiling. But the dentures are famous, just as is the wearer!



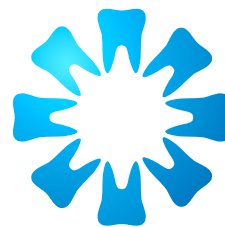
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Our Front Cover for this Issue...

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



**George Washington, 1<sup>st</sup> President of the USA:** Gold leaf, lead plates, hippopotamus ivory, cow and horse teeth... and possibly teeth purchased from slaves... all were materials used at one time or another to construct dentures for George Washington. No wood... despite the legend!

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# Prevention is better than cure

SADJ May 2019, Vol. 74 No. 4 p163

NH Wood



The news from the United States of America that Rockland County, New York banned all unvaccinated children from entering public spaces took many by surprise (Washington Post, March 27<sup>th</sup>, 2019). This was an unprecedented move to deal with something that should not have happened... an outbreak of measles.

Similarly, we saw that in Italy, children who were unable to produce evidence of being up to date on vaccination schedules were being banned from school (BBC News, March 12<sup>th</sup>, 2019). We are also faced with ever increasing reports of 'terrible' viral infections, most recently the Ebola outbreak reported from the Congo, and learn of the healthcare workers who struggle to contain the disaster.

Of course, these events have led to an increase in the fiery debate of whether or not to vaccinate, with antivaccination movements and individuals (antivaxers) spreading large volumes of misinformation on social media. The 1998 Wakefield paper<sup>1</sup> attempted to link vaccination to autism and other conditions, and caused widespread unwarranted concern. However, it is clear that the paper was scientifically and ethically flawed. It has caused a lot of damage that will take years to repair.

In the context of Dentistry, it made me realise that we do not ourselves have baseline data on whether or not our colleagues are up to date on their vaccination schedules. For the most part, our focus tends to be on the Hepatitis B vaccine and boosters, but other vaccine-preventable diseases should not be overlooked, especially when they are easily transmissible through close contact.

Vaccination is the best weapon in our arsenal against these transmissible pathogens and we should make every effort to ensure our own compliance, and educate our patients alike. This is also true for the Human papillomavirus (HPV) vaccine and HPV-associated head and neck cancer.

With the flu season upon us, and having seen the influenza virus infection arrive earlier this year than others, we would do well to ensure we get our flu shot.

We have several interesting papers to present to you this month:

Prof Noffke and her team shed some light onto several aspects of the cemento-osseous dysplasia group of conditions, and provide some guidance with regards to the diagnosis thereof.

A qualitative study from Dr Okagbare and Prof Naidoo raises some concerns with regards to the consumption of free sugars. The paper clarifies conceptual issues regarding free sugars versus naturally occurring intrinsic sugars, and emphasises the impact thereof on caries and periodontal disease. But more importantly, the authors present us with new information in two foci: Sugar consumption by adolescents, and the Influences of parental roles and perceptions and of environmental factors on sugar consumption behaviours.

Prof Motloba and co-workers present a continuation of the valuable series dealing with justice. With Part One of the series still fresh in our minds, Part Two delivers a relevant integration of Justice in oral health within the South African context.

Colleagues from the University of the Free State contribute an interesting perspective of 207 adult patients in the Mangaung Metropolitan Municipal region through an interrogation of the knowledge, attitudes and practices of oral health among these participants. This information will prove to add value by assisting the advances of the knowledge frontier with regards to integrated oral health development and promotion.

Dr Molete (Community Dentistry, WITS) provides us with insights concerning Tshwane's school oral health services, and reports on the dental status of these children. The paper also explores some of the factors that influence the reported dental status, and draws some interesting conclusions.

We also have our regular corners that include the reviews provided by Prof Yengopal and the Radiology corner from Prof Nortje, contributions which demand their continued and sincerely appreciated commitment.

## Reference

1. Wakefield AJ, Murch SH, Anthony A, Linnell, Casson DM, Malik M, et al. Ileal lymphoid nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children [retracted]. *Lancet* 1998; 351: 637-41.

## Note from the Editor

Our subeditors do a sterling job whenever they are called on to advise, assist, rewrite...or, as in this issue, serve as Guest Editor. It has been our privilege to work with Prof Neil Wood who has assembled the May issue.

**Neil H Wood:** Acting Head of Department: Periodontology and Oral Medicine, School of Oral Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa  
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# A message from the newly elected chairperson of the board

SADJ May 2019, Vol. 74 No. 4 p164

Renier Putter



A couple of minutes after having been elected as the new Chairperson of SADJ I sat down at Head Office to have a conversation with the newly elected Vice-Chairperson, Dr Nadeem Osman. We agreed that we are excited about the future of SADJ and the newly elected Board of Directors. Make no mistake, we have lots of work to do and goals to achieve but we are excited and eager to start working towards that future!

Dr Yvette Solomon, delivering her farewell message at the last National Council meeting in March, quoted Peter Drucker: "Whenever you see a successful business, someone once made a courageous decision." I want to take it even further and say then "whenever you see a successful business, someone once made courageous decisions *and made great sacrifices*".

It is now up to the newly elected Board to carry those decisions further, to make those sacrifices count towards a successful future for SADJ. A metaphor attributed to Bernard of Chartres from the 12<sup>th</sup> century was made famous by Sir Isaac Newton in 1675 when he said: "If I have seen further it is by standing on the shoulders of giants." We as a new Board are standing on the shoulders of giants who have gone before us. The work that was put in by previous Boards and the sacrifices that were made, allow us to now be able to stand solid, look further, have a clear picture of where we have come from and where we are going.

In his book, "Good to Great", Jim Collins concludes that after a five-year research project about how good companies become great, the number one underlying variable that contributed to this success was not some masterplan and a new direction, vision or strategy for the companies. It was not about getting people excited about this new vision for the companies to follow. It was about getting the right people to lead the companies, and only then figuring out where the companies should go and which direction to follow. People and relationships determine success.

The National Councillors recently attended the first meeting of a new four-year term. Whilst sitting at the meeting I looked around the boardroom and was greeted by quite a few new faces. It is good to see new and young dentists willing to sacrifice time to serve our profession. Leading on from Jim Collins's conclusion, I believe that by and large we have the right people leading our branch structures, sitting on National

Council and the Board and leading the organisation at Head Office. These are the people holding the keys to a successful future for SADJ.

I truly believe that there exists within the Board a cohesive unity and willingness to truly do what is in the best interests for SADJ and its members. During training done by the Institute of Directors Southern Africa (IoDSA), a metaphor was used depicting SADJ as a baby. We as the Board all need to work together to take care of the baby. This metaphor comes up repeatedly in conversations at Board level and I can assure you that we are all cognizant of the fact that we are here not to boost our own egos but to take care of the baby, SADJ.

I am proud, honoured and blessed to stand at the head of and to lead an amazing Board of Directors. These Directors, your friends, your colleagues, make enormous sacrifices to stand at the helm of this great organisation. Many hours are spent travelling to and from meetings. Time with family and loved ones is very often sacrificed in order to attend to SADJ's interests. This bunch of heroes do it without ever complaining.

You as SADJ members have elected us through the National Council and we stand here not serve a selfish interest, but to serve the profession, serve the membership and to serve SADJ. There is a bond of trust and camaraderie that exists at the Board. We do not always agree at Board meetings, in fact, we very often have great debates, but we never ever play the man, to use a sport metaphor. We debate issues and argue over certain viewpoints but always without attacking on a personal level.

SADJ is a membership organisation. We do not sell a product. SADJ's business revolves around people and relationships. Relationships with our members, relationships with all our stakeholders and relationships between SADJ and the different levels of governance structures.

The giants on whose shoulders we stand gave us the foundation which now allows us to foster and to encourage the development of our relationships with our stakeholders and members. I am confident that the Branch structures, National Council, Board and Head Office staff are the right people to lead this organisation and to determine our strategic direction. Lastly, I am grateful to my fellow Board members who are willing to have debates and to take those difficult decisions. I am looking forward to my first term as Board Chairperson, knowing that these are the people alongside whom I shall be working. I am honoured to call you my Colleagues.

Renier Putter: Chairperson of the board, SADJ

# Parental participation in influencing the unhealthy behaviour of adolescents in their excessive consumption of free sugars: a qualitative study

SADJ May 2019, Vol. 74 No. 4 p165 - p170

TE Okagbare<sup>1</sup>, S Naidoo<sup>2</sup>

## SUMMARY

### Introduction

The amount, and more importantly, the frequency, of free sugars consumed are strongly associated with the rate of caries formation and of periodontal diseases.

### Aims and objectives

The aims and objectives of this qualitative study were to investigate the perceptions of parents regarding their influence of the unhealthy behaviour of South African adolescents in their excessive consumption of free sugars.

### Design

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

### Methods

Data were collected from five focus group interviews using the non-probability purposive theoretical sampling method and the data were analysed using the grounded theory approach.

### Results

The parents contended that while natural sugars are acceptable, refined (free) sugars cause dental caries and gum diseases.

### Conclusion

Parents attributed the excessive consumption of free sugars among adolescents to their availability both at home and in the stores as well as their affordability.

The present study recommends that babies be weaned off exclusive breastfeeding after six months with meals not sweeter than maternal breast milk and parents and schools should provide enabling environments that do not encourage excessive consumption of free sugars.

### Keywords

Qualitative research, adolescents, taste buds, excessive free sugars, interventions, oral health, South Africa.

## INTRODUCTION

The World Health Organization's (WHO) oral health promotion framework highlighted the need to integrate oral health into general health promotion.<sup>1</sup> This was later reiterated by Watt and Sheiham, emphasising the New Public Health approach to public health promotion using the common risk factor model to improve dental and oral health, rather than the biomedical approach to health.<sup>2</sup> This is because caries and periodontal disease are chronic diseases that share risk factors with other major chronic systemic conditions.<sup>3</sup>

Although the efficacy of fluorides and fissure sealants as caries preventive measures have been shown in systematic reviews,<sup>4</sup> they do not sufficiently combat its progression.<sup>3</sup>

There was therefore a need to expand interventions to target the major risk factor of the disease, free or fermentable sugars which are also implicated in other systemic conditions such as diabetes and obesity, in order to prevent the occurrence of caries in the first instance.<sup>3</sup> This premise informed the recently updated WHO guidelines on sugar consumption.<sup>5</sup>

The amount and more importantly the frequency of consumption of free sugars found in table sugar, confectionery, soft drinks, biscuits, honey, cakes, sweets, chocolate and fruit juice are strongly associated with the rate of caries formation and periodontal diseases.<sup>6,7</sup> Free sugars are not as healthy as the naturally occurring intrinsic sugars which include breast milk sugars<sup>8</sup> and those naturally present in honey, syrups and unsweetened fruit juices. Free sugars are comprised of monosaccharides and disaccharides which are added to foods by the manufacturer, cook or consumer.

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1. **Tuweyire E Okagbare:** Principal Researcher - 60%
2. **Sudeshni Naidoo:** Co-Author & Advisor - 40%

In general, the cheapest foods are high in fat and sugar.<sup>9</sup> This is partly responsible for the high consumption rate of soft drinks and sweets among adolescents in preference to the more nutritionally advantageous meals of fruits and vegetables.<sup>10</sup> The implications for caries formation and periodontal disease are well documented.<sup>6,11</sup>

Poor oral hygiene and inadequate/infrequent tooth brushing together with the inappropriate consumption of free or fermentable sugars (both visible or table sugar and hidden sugars consumed in processed or manufactured foods and drinks) lead inexorably to the accumulation of thick destructive bacterial plaque that produces lactic acid.<sup>6</sup> It has been suggested that the brushing of teeth immediately after eating sugary foods may not adequately prevent the harmful effects, but rather it may be better to brush before a sugary meal or snack as this helps to remove plaque, reducing the bacterial population and hence the quantity of acid produced. This is because plaque bacteria will start producing acid as soon as fermentable sugar enters the mouth.<sup>6</sup>

In addition to sugars being cheaper when compared with more nutritional products, their easy availability at homes, in schools and in the shops also contributes to their high consumption among adolescents.<sup>9</sup>

A Minnesota study reported that the association between the availability and consumption in schools was stronger for chocolates and other candies among seventh graders but was not significantly associated with older learners (grades 9-10).<sup>12</sup> In South Africa, it was found that just over half of adolescent learners drink sugar-sweetened beverages and 42.6% eat cakes and/or biscuits often, with no significant variation in gender.<sup>13</sup> Inappropriate consumption of free sugars is therefore a major public health concern in South Africa with implications for reduced oral/general health-related quality of life and escalated costs of health care.

Our understanding of the perception of parents of the psychosocial factors associated with excessive and inappropriate consumption of free sugars among adolescents in South Africa is very important because they are key role players and role models who influence the behaviours of their children. The present study explored these perceptions of parents and the challenges they face trying to overcome the problem.

## METHODS

Approval for this study was obtained from the Senate Research Ethics Committee of the University of the Western Cape, South Africa (Ref No. 11/1/55).

The details of the sampling procedure have previously been published.<sup>14</sup> Briefly, five focus groups (minimum of six participants each) interviews took place between the months of March and November, 2015.

The qualitative nature of the study required that saturation governed the sample size.<sup>15</sup> Theoretical saturation was achieved at the fourth focus group interview which was in line with Krueger and Casey's assertion that most focus group interviews saturate at the third or fourth instance.<sup>16</sup> The sample size of the first four focus group interviews was 31.

The fifth focus group interviews were conducted not only to enhance saturation but also to bring the sample size to over 31, in line with other studies worldwide that used qualitative approaches and qualitative interviews as the method of data collection.<sup>17</sup> According to Gill et al. the optimum size for a focus group is six to eight participants (excluding researchers).<sup>18</sup> Participation was based on the criterion of being a past/current parent or caregiver to an adolescent.

Confidentiality was maintained throughout the study by the use of pseudonyms to ensure that the identities of the participants were not revealed. The researcher explained to participants the purpose of the study, ensuring their understanding, and presented the ethical approval for the study. Further, the parents read and signed the informed consent forms. At the beginning of every interview the researcher obtained permission from the participants to use the audio recorder. They were also informed that their participation in the interview was completely voluntary, confirming that any may refuse to answer any questions and that anyone was free to withdraw from the interview at any time without consequences.

## Profile of participants

A total of 37 participants who were homogeneous in the sense of shared experience of living in the same neighbourhood (but diverse in terms of professions) were recruited. Their mean age was 46.3 years [95% CI = 43.0 - 49.5]. Although no attempt was made to achieve a provincially representative sample, the study endeavoured to ensure that the data was not skewed by accommodating participation from both the urban areas (Alberton in East Rand/Ekurhuleni Municipality, Hillbrow in Johannesburg Municipality and Gezina in Tshwane Municipality) and semi-rural areas (Katlehong in East Rand/Ekurhuleni Municipality and Soweto in Johannesburg Municipality). Representation from amongst the four racial groupings in South Africa (Black, Coloured, Asian/Indian and White) was achieved and the views of the two largest global religious movements (Christianity and Islam) were obtained.

## Study design and sampling procedure

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

## Data collection

The interviews of the five focus group participants took place in venues acceptable and accessible to all the interviewees. To ensure that the participants met the inclusion criterion the researchers used as the opening question: *"Please tell me, have any adolescents between the ages of 10 to 19 years lived with you or are living with you at the moment?"*. Each qualifying participant was requested, after consent had been obtained, to complete a short questionnaire on their demographic characteristics. A semi-structured interview guide was used, which had been developed to ensure consistency in data collection from the focus group interviews, yet allowing the



sessions to be sufficiently flexible to encourage the natural flow of conversation in the groups. The interview guide included a series of open-ended questions in order to reduce the chances of priming the discussion, allowing the participants to freely express themselves. The questions were designed to stimulate discussion among parents regarding factors they perceived to be associated with the health-compromising behaviour of inappropriate consumption of refined sugars among adolescents in South Africa. Professionals were implored to use lay-person's language for the benefit of others and also to reduce any likelihood of inhibition. To ensure that all participants had equal opportunity to contribute, the respondents took turns to enter the debate. The average time span of the five focus group interviews in this study was 1 hr 45 mins.

### Data analysis

The data analysis used in this study followed the grounded theory approach. 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 to integrated data analysis. In order to reduce bias, an independent coder, a specialist in Community Dentistry was also engaged.

## RESULTS

The sample size of 37 determined by theoretical saturation, included a mixed group: 23 fathers, one grandfather; 10 mothers and three grandmothers. Thirteen had received a tertiary education while 14 had matriculated. Ten had not reached matric level. Altogether, the recruitment yielded 25 Blacks, seven Coloured, three Indians and two Whites. Thirty were church attendees and seven were Muslims.

The results of the data analysis were articulated in the following excerpts from the transcripts of the interviews and are presented in two sections:

1. Adolescent unhealthy behaviour of inappropriate consumption of sugars.
2. Parental participation.

### Adolescent unhealthy behaviour of inappropriate consumption of sugars

#### Adolescent upbringing

Study participants were unanimous regarding the importance of the home environment and the role of a good upbringing in the formation and retention of healthy behaviours.

There was a total agreement among the participants that unhealthy behaviours of parents have a significant effect on the tendency of their adolescent offspring towards unhealthy behaviours.

Parents are powerful role models and their children emulate their characters and characteristics as they in turn grow up to be adults and therefore, the behaviour of parents should be positively exemplary. Children learn by what they see, more than what they hear and are told. A few participants disclosed that they did indeed practice some unhealthy behaviours such as excessive

sugar consumption. Some parents are aloof, one parent even asserted that his adolescent children will outgrow their currently excessive consumption of sugars but another countered that assertion. Below are excerpts from the contributions of some participants:

*"I also wanted to add about parents being a good role model to their child... you have to practice what you preach."*

*"They will outgrow eating sugar and chocolate..."*

*"Some of the things adolescents do... depends on the behaviour of the parents at home."*

*"I've got a problem with sugar and was in hospital 2010 because I was consuming too much Coca-Cola. I was drinking three to four litres of Coca-Cola a day... this is not a good example..."*

*"I'm concerned with excessive intake of sugar because I know that my kids like sweets and chocolates..."*

#### Adolescent preferences and taste buds

The study participants expressed their concern regarding adolescents' preference and craving for refined sugars, as illustrated by the excerpts below.

*"So you see it is now also about our taste buds not about the, the natural goodness..."*

*"...put a cucumber and a lunch bar and ask the child to pick. It is a simple thing - the lunch bar, obvious choice."*

*"You cannot drink the tea my daughter drinks. There is too much sugar."*

*"The sugar content is all about craving... for sweets, chocolate, and if you have self-esteem, you have confidence,... discipline... to abstain from it."*

#### Influence of school environment, friends and peers

All the participants highlighted the significant influence of friends, peers and school environment on the acceptance and practice by adolescents of the unhealthy lifestyle of inappropriate consumption of sugars. Some of their responses were:

*"Even then if you can say to the child don't eat sweets there will be a friend there at the street to give him sweets".*

*"Even in most nursery schools they have packets of sweets they give to the children and I think that it definitely affects their emotions so children become very hyperactive and that can affect their concentration".*

#### Influence of advertisements, marketing, negative mass and social media

Advertising and marketing on television of unhealthy behaviours and products attract adolescents. The negative influences of mass and social media especially via the Internet was also reported by study participants as a significant factor driving adolescents to excessive consumption of sugars. Some excerpts from the participants:

*"And marketing. Coke looks good until..."*

*"The only things that are being advertised are the sweets, the good things that taste nice..."*

*"Like on TV, in the movies... mostly what you see is what is what you do..."*

### Availability, affordability of sugars

Many of the participants lamented that some parents spoil their adolescents with too much spending money and that ready availability of unhealthy products at home and in the shops and their affordability attract adolescents to indulge, as shown by the excerpts below:

*"It's because there are sugars and sweets everywhere, at home, the tuck shops are everywhere, always selling sweets..."*

*"Parents, they really spoil their children by giving kids spending money to get what they want..."*

### Parental participation

This section is conceptualised as a multifaceted construct grounded in the interview data, having the following components: Parental knowledge and the Challenges faced by parents of adolescents.

#### Parental knowledge

The participants in the present study indicated that parents need to be knowledgeable regarding the effects of unhealthy consumption of sugars on the teeth and gums if they are to be able to provide reasons to support what they say to their adolescent children. While most appeared to be knowledgeable, some also disclosed consuming large amounts of sugar and sugary drinks themselves. The Muslim participants claimed that they depend solely on their religion as their guide. Some of the responses of the participants:

*"What I think, is that there are natural sugars and there are sugars coming from companies. So for the natural sugar you can eat as much as you want, but processed sugar from the companies have chemicals in them which are not good for your body."*

*"Too much sugar is very bad for the teeth and health and your chances of getting tooth decay are worse than one who takes little or no sugar."*

*"Everything, in our religion teaches us balance... excess sugars leads to negative effects. But even sugars, you need a bit of sugar in your diet but everything needs a balance. Vegetable, fruit, natural, anything natural is encouraged."*

#### Challenges faced by parents of adolescents

The participants declared the challenges they face included the influence of the school environments, peer pressure, mass and social media. Parents are unable to protect their children from bad influences once outside the home, asserted an elderly parent.

*"At the end of the day the child learns all these things through TV, you know, from the media, at school, peer pressure, all of them".*

## DISCUSSION

Inappropriate consumption of free sugars by adolescents was found to be a major concern of parents in this study. This concern is substantiated by the findings of Reddy et al., who found that in South Africa 50.3% of adolescent learners drink sweet cool drinks and 42.6% often eat cakes and/or biscuits.<sup>13</sup> Similarly, Currie et al.,

reported that among European school-aged children there was an increased consumption of soft drinks and sweets in preference to the more nutritional advantageous meals of fruits and vegetables<sup>10</sup> with potentially serious implications for caries formation.

The importance of the home environment and the role of a good upbringing in the formation and retention of healthy behaviours was acknowledged during the interviews. There was also a total agreement that unhealthy behaviours of parents have significant effects on their adolescents' tendency towards similar unhealthy behaviours.

Therefore, parents behaviours should be positively exemplary - *"they should practice what they preach"*. However, children learn more by what they see than what they hear and are told. This notion concurs with the suggestion of a study that examined who 679 African American ninth-graders who were themselves admired and looked up to in their own environments; that role model effects are separate from parenting effects and indeed are more critical.<sup>19</sup> On the contrary, few of the parents disclosed that they indulged in the unhealthy behaviour of excessive sugar consumption.

One parent even asserted that he believed his adolescent children will outgrow the excessive consumption of sugars... but he was promptly reminded by another parent of his own inability to outgrow his love for Coke.

Even though some of these parents admitted their own susceptibility, they also confessed that they were not setting a good example. These views were in agreement with the argument of Gibson et al.<sup>20</sup> that parental' positive influences are vital for establishing healthy lifestyle behaviours in their adolescent children.

Concerns regarding the spoiling of adolescents by parents giving them too much spending money may be increased by the report that some parents hand their children sweets to pacify them, thereby encouraging the inappropriate consumption of sugars. According to Schwartz et al., the practice is due to their lack of practical strategies on how to properly train their children.<sup>21</sup>

A positive consideration is that adolescents with high self-esteem are likely to be more concerned with their health and wellbeing, effectively associated with eating healthily.<sup>22</sup> Parents should therefore, appreciate and cherish their adolescents in order to help to build and enhance their self-esteem.

This study confirmed the significant influence of the friends, peers and school environment on the lifestyle attitudes of children. Nursery schools who give sweets to the children to pacify them, and the sharing of chocolates and sweets among adolescents at schools and neighbourhoods, override the efforts of those parents who try to keep their offspring on natural diets including fruit and vegetables. Children from immigrant Mexican households in the United States have been seen to abandon traditional foods prepared at home in favour of the higher-calorie foods, beverages, and snacks they consume at school.<sup>23</sup>

Globalization has also been found to be contributory in increasing the availability of fast foods and sweets in schools.<sup>24</sup> School snack lines, vending machines, and in-school stores typically offer less-than-optimal food choices, including sweetened soft drinks, fried chips, candies and other confectionaries.<sup>25</sup> This is also the inference of the report of a workshop organised by the Institute of Medicine (US) and National Research Council (US) Committee on the Science of Adolescence that analysed many studies investigating the influence of environment on adolescents.<sup>26</sup>

Adolescents are exposed to many advertisements for sweetened drinks, fast food restaurants and high-caloric snacks on television commercials, such as Coca-Cola drinks, Red Bull energy drink and Doritos snacks, some of the favourites among South African youth.<sup>27,28</sup> The influences of mass and social media especially via the internet are significant factors driving the consumption of free sugars.

The present study acknowledged that parents need to be aware of the effects of the unhealthy consumption of free sugars on the teeth and gums and should be able to provide reasons to support whatever information they give to their children. Paradoxically, some disclosed consuming large amounts of sugar and sugary drinks themselves, despite their understanding of the dangers. However, they all agreed that while natural sugars were acceptable, free sugars cause caries and gum diseases. This consensus is in line with the findings of Frances et al., who reported that the amount, and more importantly the frequency, of consumption of free sugars found in table sugar, confectionery, soft drinks, biscuits, cakes, sweets, chocolate, honey and fruit juice is strongly associated with caries formation and periodontal diseases.<sup>7,11</sup>

This inappropriate consumption of free sugars is likely to lead to high prevalences of caries and of obesity among adolescents.<sup>29</sup> It is recognized, however, that there is little strong evidence to support this contention in South Africa but that may be due to the lack of updated epidemiological data at the national level for the adolescent subgroup, even from the National Children's Oral Health Survey conducted by the Department of Health.

Substituting fruit juice for solid or whole fruits is not recommended because the fruits themselves not only contain less sugars (approximately 35% less), but their intracellular sugars are healthier than the extracellular sugars produced when cell membranes rupture during the juicing process. Solid or whole fruits also provide lot more nutrition and fibres that are usually lost in the juicing process.<sup>30</sup>

Infants have innate preferences towards certain taste qualities and dislikes of other tastes.<sup>31</sup> Infants prefer sweet-tasting foods and reject foods that do not taste as good, such as certain vegetables. This reflects an evolutionary response that was historically useful because the sweet taste signaled sources of energy (e.g. the breastmilk, their first source of calories), while bitter tastes signaled foods that might be toxic. However, some

researchers suggest that infants begin to accept bitter tastes around the age of 14–180 days.<sup>32</sup> As they grow up, they may refuse certain foods and become picky about their intake. This presents many challenges for parents, who respond in a variety of ways. Some give their children what they want to pacify them and end up encouraging inappropriate consumption of sugars.

As commonly reported in adolescent literature,<sup>33</sup> the parents in the present study stated that the challenges they faced with regard to educating their children about their diet included the influence of school environment, peer pressure, and the negative influences of mass and social media. Once adolescents left home, parents were unable to protect them from the bad influences outside of the home environment. However, Muslims claimed that they depend solely on their religion as their guide and the consensus was it takes the whole community to provide the enabling environment needed to reduce the excessive consumption of free sugars among adolescents.

### Limitations

The findings of this study should be interpreted in the context of the limitations imposed by the methodology. First, the limitations of qualitative research include the fact that the results are not generalisable to the larger population of parents because of the use of non-probability, purposive sampling strategy and the small number of research participants.

In addition, not all views may have been adequately represented due to selection bias. It is also plausible that some parents may have provided socially desirable responses and the responses of some parents may have been influenced by the opinions and comments of more vocal parents.

### CONCLUSION

It was hoped that the findings of this study would provide a scientific evidence-base to inform the planning of priority public health programmes to improve parental participation in the prevention and control of excessive consumption of free sugars among adolescents. In spite of the limitations described above, the findings of the study are relevant and profound.

This qualitative study highlighted the need for parents to be cognisant of the important role they play in the prevention, initiation and control of the unhealthy behaviour of excessive sugar consumption among adolescents. Efforts should be made by parents to properly nurture and train their children from infancy through preadolescence against inappropriate consumption of sugars.

Consequently, the present study recommends that, in addition to the updated WHO guidelines on sugar consumption, babies be weaned after six months exclusive breastfeeding with meals not sweeter than the maternal breast milk the baby is already used to and that further research be initiated into this option. Parents and schools should provide enabling environments that do not encourage excessive consumption of free sugars.

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# Dental status of children receiving school oral health services in Tshwane

SADJ May 2019, Vol. 74 No. 4 p171 - p177

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## SUMMARY

### Background and purpose

School health services and baseline oral health information are central to monitoring the progress of ongoing reforms, addressing areas requiring improvement and revitalization of South African primary health care.

The study described the dental status of learners receiving oral health services in Tshwane, and assessed the influence of factors such as age, gender, location, and services received.

### Methods

A cross-sectional analytical study design with a multistage sampling technique was employed to randomly select ten schools. Oral health examinations were conducted on all learners in two selected grades in each school.

### Results

There were 736 participants, ages 6 to 16 years, 50.9% were girls. Dental caries prevalence in the permanent dentition was 25.9% and in the primary dentition, 30.2%. Mean DMFT/dmft scores were [(0.90; SD:1.7; SiC:2.7); (1.2; SD:2.3; SiC:3.7)] respectively.

PUFA/pufa prevalence mostly affected the primary dentition (pufa 5.2% vs PUFA 2.2%). The unmet treatment need (UTN) was 89.6% and associated factors included gender, location and type of services received.

### Conclusion

The prevalence of dental caries was relatively low in comparison with similar South African studies, but untreated disease levels were high. Most affected were females, primary school learners, urban learners and those not participating in a supervised tooth brushing programme.

### Keywords

Dental epidemiology, school oral health, health programmes, oral health services.

## ACRONYMS

<b>DMFT/dmft:</b>	Decayed Missing Filled Teeth Index
<b>PUFA/pufa:</b>	Pulpal Ulceration Fistula Abscess Index
<b>SiC:</b>	Significant Caries Index
<b>UTN:</b>	Unmet Treatment Need Index

## INTRODUCTION & BACKGROUND

Dental caries is a neglected public health problem globally and the incidence in developing countries is increasing at an alarming rate.<sup>1-3</sup> In South Africa, the high curative need of the condition is of concern, as over 90% of children in the country go untreated for dental caries.<sup>4,5</sup>

Though the disease is amenable to prevention and existing mechanisms of prevention are available, the multifactorial aetiology is affected by the type of diet intake, socio-economic standing, environmental factors such as water fluoridation, availability of dental services and utilisation of care.<sup>6-8</sup>

These factors influence the pattern of the disease and experiences across and within populations as a result of the varying risk profiles,<sup>9</sup> hence planning for oral health preventative programmes becomes a complex task.

School based settings around the world have been identified as platforms ideal for delivering oral health promotion and care to children as they are more likely to adopt healthy habits earlier and it is easier at these stages to equip them with personal skills such as maintaining personal hygiene, brushing teeth and adopting a healthy diet.<sup>10,11</sup> These foundational skills when re-enforced over years subsequently contribute to better oral health experiences over the growing years.<sup>12</sup> The success of such programmes in reducing the incidence of caries has been reported in some studies.<sup>13,14</sup> However, implementation of the programmes has been shown to come with a variety of contextual challenges.<sup>15-17</sup>

South Africa is embarking on health reforms by introducing a National Health Insurance financing policy aimed at redressing health inequities and ensuring universal health coverage for all citizens.<sup>18</sup>

Primary health care revitalization will be key to the transformation process as it will be central to service delivery, facilitating health promotion, prevention of illness and a first point of entry into the healthcare sector.<sup>19</sup>

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One of the revitalization streams include school health services which are currently being piloted across 11 provincial sites in the country.<sup>19,20</sup> Oral health is included in the school health services and this provides a valuable platform for introducing early oral health care interventions in order to delay the onset and control the severity of dental caries.<sup>21</sup>

The City of Tshwane health district has been piloting the School Health Service Programme since 2011 and Oral Health has been incorporated since 2013. Tracking the success of these new reforms needs periodic data at baseline,<sup>22</sup> however, such information is lacking from school health programmes where health reforms are being tested. The dearth of baseline data makes it imperative to conduct a survey against which progress of the programmes can be measured in the future.

This study is part of a larger study that is assessing the scope, implementation and outcomes of school oral health programmes in Tshwane. The aim of this paper is to describe the dental status of school learners and to assess the influence of contextual factors on the dental status of the learners at schools in Tshwane. Subsequent papers will focus on implementation processes and how these processes influence different outcomes.

## METHODS

This cross-sectional analytical study was undertaken in the Tshwane Health District of Gauteng. Tshwane is a large metropolitan municipality situated in the northern part of the Gauteng Province in South Africa. It has a population of 2,9 million with an unemployment rate of 24.2%.<sup>23</sup> It is demarcated by seven regions with a mix of urban and peri-urban components and the economic situation of residents is mostly dependent on the area in which they are located.<sup>24</sup> There are therefore socio-economic differences between the urban and peri-urban schools as more working parents are located in urban settings.<sup>23,24</sup>

The oral health services in the area have ten oral hygienists who manage school oral health programmes at various locations in the District and each oral hygienist is responsible for a number of the programmes in a specific locality. The activities at the school are planned to include oral health education, supervised tooth brushing and fissure sealant programmes. All the schools received some oral health education but due to a variety of factors, not all received a combination of a supervised toothbrush programme and fissure sealants.

All ten oral hygienists were recruited to participate in this study. Schools included had to have been receiving the services for more than a year. A multistage sampling technique was employed. In the first stage one school that met the inclusion requirements was randomly selected from the portfolio of each oral hygienist. The second stage included a random selection of one class of grade 1 and one class of grade 7 learners at each participating school. Grades 1 & 7 learners were selected as they generally had ages ranging between 6/7

and 12/13 years, which are the ages recommended for dental surveys.<sup>25</sup> A sample of approximately 700 learners was required to enable the estimation of the mean DMFT with a precision of  $\pm 0.3$ ,<sup>26</sup> assuming the standard deviation was 2.0 with a design effect of 2, which took into account the clustering effect of pupils within schools (Statcalc, version 14).

The oral health examinations were undertaken using the Decayed Missing Filled Teeth Index (DMFT/dmft) and the Pulpal Ulceration Fistula Abscess Index (PUFA/pufa).<sup>27</sup> All procedures in the survey were followed according to the WHO guidelines.<sup>25</sup> Two examiners conducted the examinations, having been trained and calibrated. Inter-rater reliability was established by conducting repeat examinations of images until Cohen's Kappa score was greater than 0.80.

During the study, the participants were seated and the oral cavity was examined in a well-lit room using a light, mouth mirror and a community periodontal index probe.<sup>25</sup> Information on the programme activities was derived from the Oral Hygienists.

Descriptive summary statistics were used to calculate the dental health status and the results were initially categorised into four age groups (6-7); (8-10); (11-12); (13-16) in order to provide a broad overview of the dental scores across the ages. As the numbers were not well distributed across the four groups, the age groups had to be stratified into two groups (6-7) and (8-16) in order to obtain sufficient numbers and power for further analyses assessing dental status according to gender, setting & services received.

A multiple linear regression was then undertaken to determine the size of effect of the dependent variables (gender, location, services) on the independent variables (DMFT, dmft, PUFA, pufa). For the 8-16 age stratum, analysis of the dmft and pufa were excluded from the regression models, as the scores were shown to be decreasing with age - as was expected because exfoliation was still occurring during those age ranges. All the data were analysed using STATA software version 14.

The proportion of unmet treatment need index (UTN) was calculated by dividing the percentage of untreated caries over the caries prevalence (% UTN = % untreated caries/caries prevalence).<sup>28</sup> The significant caries index (SiC) was also calculated in order to determine the one third of the population carrying the highest caries score. Individual DMFT/dmft scores were sorted in a descending order, one third of the population with the highest scores was then selected and the mean DMFT/dmft for the subgroup was calculated in order to determine the SiC. The calculations were performed on Excel software.<sup>29</sup>

The study obtained ethical clearance from the University of the Witwatersrand Human Research Ethics Committee (M170115), and written approval was obtained from the Gauteng Department of Education. All learners participating had written consent from their parents and they assented to participation.

## RESULTS

### Demographic characteristics

Of the 736 learners who participated in the study, 49.7% ( $n=366$ ) were grade 1 primary school learners; with ages ranging between 6-12 years. The secondary school learners (50.1%;  $n=370$ ) had ages ranging between 11-16 in grade 7. The participants consisted of 50.9% girls and 49.0% boys. Seven of the schools were located in an urban setting and three were located in a peri-urban setting.

### Dental status

The prevalence of dental caries in the permanent dentition was 25.9% and in the primary dentition, 30.2%. **Table 1** demonstrates that the largest age group ( $n=331$ ) among the participants was that of 6-7 year learners and the least ( $n=35$ ) were the 8-10 year olds. The mean dmft was highest 2.5 [2.8] among the 6-7 year olds and mean DMFT was highest 1.8 [2.3] among the 11-12 year olds. Similarly pufa most affected the 6-7 and 8-10 year groups, while the PUFA was high among the 11-12 year old learners.

**Table 1.** Dental status according to age ( $n=736$ ).

Age Groups	N (%)	dmft (sd)	DMFT (SD)	pufa (sd)	PUFA (SD)
6-7	331 (44.9)	2.5 (2.8)	0.4 (0.9)	0.2 (0.6)	0.0
8-10	35 (4.7)	1.8 (2.3)	0.5 (1.1)	0.3 (0.9)	0.0
11-12	181 (24.5)	0.01 (0.1)	1.8 (2.3)	0.01 (0.1)	0.1 (0.4)
13-16	189 (25.6)	0.0	1.1 (1.7)	0.0	0.01 (0.1)
Total mean scores	736 (100)	1.1 (2.3)	0.9 (1.7)	0.1 (0.4)	0.03 (0.2)

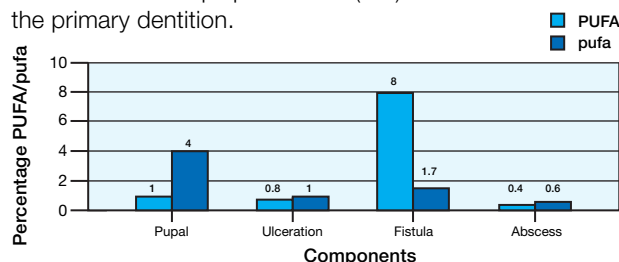
The DMFT/dmft results indicated that the “decayed” component was the major contributor to the DMFT/dmft scores, as displayed in **Table 2**. The SiC index was significantly higher ( $p<0.001$ ) than the mean DMFT/dmft in both the primary (3.7) and secondary dentitions (2.7).

**Table 2.** DMFT/dmft components ( $n=736$ ).

Permanent Dentition				
Mean DMFT (SD)	Decayed	Missing	Filled	SiC
0.90 (1.7)	0.54 (1.2)	0.05 (0.3)	0.30 (1.2)	2.7 (1.9)
Primary Dentition				
Mean DMFT (SD)	Decayed	Missing	Filled	SiC
1.1 (2.3)	1.0 (2.1)	0.12 (0.7)	0.03 (0.3)	3.7 (2.7)

### The PUFA/pufa components

The prevalence of PUFA/pufa mostly affected the primary dentition (pufa 5.2% vs PUFA 2.2%). **Figure 1** shows that fistula lesions (8%) contributed more in the permanent dentition and the pulpal lesions (4%) contributed more in the primary dentition.



**Figure 1.** Components contributing to the PUFA/pufa scores. Total ( $n=736$ ).

**Table 3** describes the dental status according to age, gender, services received and setting. There were no PUFA scores among the 6-7 year old age stratum. In this group most of the learners were exposed to the fissure sealant services ( $n=121$ ), and the majority were from urban areas ( $n=230$ ).

Among the 8-16 year old age stratum, the dmft and pufa scores with regards to age, gender, services and setting were less than the mean of 1. More of these learners were females, furthermore the majority received fissure sealants ( $n=170$ ) and were from urban areas ( $n=280$ ).

**Table 3.** Summarizing the dental status according to two age strata, gender, location and services received ( $n=736$ ).

Variables	dmft (sd)	DMFT (SD)	pufa (sd)	PUFA (SD)
Age Range				
6-7 ( $n=331$ )	0.37 (0.9)	2.5 (2.8)	0.0	0.2 (0.6)
Gender				
Female ( $n=161$ )	0.3 (0.8)	2.5 (3.0)	0.0	0.2 (0.5)
Male ( $n=170$ )	0.4 (1.0)	2.5 (2.7)	0.0	0.1 (0.6)
Services				
Fissure sealants ( $n=121$ )	0.3 (1.0)	3.2 (3.2)	0.0	0.3 (0.7)
Brushing prog. ( $n=93$ )	0.4 (0.8)	2.2 (2.4)	0.0	0.1 (0.5)
Both ( $n=117$ )	0.4 (0.9)	2.0 (2.6)	0.0	0.1 (0.3)
Location				
Peri-urban ( $n=101$ )	0.1 (0.6)	3.3 (3.2)	0.0	0.2 (0.6)
Urban ( $n=230$ )	0.5 (1.0)	2.2 (2.6)	0.0	0.3 (0.6)
Age Range				
8-16 ( $n=405$ )	1.3 (2.0)	0.2 (0.9)	0.05 (0.3)	0.02 (0.3)
Gender				
Female ( $n=214$ )	1.6 (2.3)	0.1 (0.6)	0.1 (0.4)	0.01 (0.1)
Male ( $n=191$ )	1.1 (1.6)	0.2 (1.1)	0.04 (0.2)	0.05 (0.4)
Services				
Fissure sealants ( $n=170$ )	1.9 (2.3)	0.2 (0.9)	0.1 (0.4)	0.03 (0.3)
Brushing prog. ( $n=137$ )	0.8 (1.7)	0.1 (0.5)	0.03 (0.2)	0.02 (0.2)
Both ( $n=98$ )	1.05 (1.6)	0.2 (1.1)	0.04 (0.2)	0.03 (0.2)
Location				
Peri-urban ( $n=125$ )	1.1 (1.6)	0.2 (0.9)	0.1 (0.4)	0.02 (0.2)
Urban ( $n=280$ )	1.4 (2.2)	0.1 (0.8)	0.04 (0.2)	0.03 (0.3)

### Factors influencing the dental status

All the key exposure variables were inserted into the multiple linear regression model in order to determine the size of the effect of the variables on the dental status. The DMFT of the 6-7 year old learners from urban areas increased (by a Coef: 1.12;  $p=0.00$ ) in comparison with learners from peri-urban areas (**Table 4**).

Furthermore, learners who received only fissure sealants instead of both programmes had increased levels of DMFT (Coef: 0.87;  $p=0.00$ ). A similar increasing effect (Coef: 1.36;  $p=0.05$ ) was seen on the dmft scores of children that just received fissure sealants. The pufa scores were influenced by location and services. Children who were located in urban areas and received fissure sealants only had increased pufa scores respectively (Coef: 0.70;  $p=0.00$ ); (Coef: 0.82;  $p=0.00$ ).

**Table 5** outlines the regression results of the 8-16 age stratum and indicates that the DMFT of the male learners decreased (Coef: -0.46;  $p=0.01$ ) in comparison with the female learners. In addition, learners located in urban areas (Coef: 3.02;  $p=0.00$ ) and those who received fissure sealants only (Coef: 3.10;  $p=0.00$ ) had increased levels of DMFT over those from peri-urban areas and those exposed to both fissure sealants and brushing programmes. There were no significant influencing factors on PUFA.

The Unmet Treatment Need (UTN) for the permanent dentition (DMFT) was 55.5% and for the primary dentition (dmft) 89.6%. This implied that close to 90% of the affected learners required treatment for dental caries. The SiC Index was statistically significant for both the primary teeth (dmft) and permanent teeth (DMFT) indi-

cating that the concentration of the disease was narrowly distributed among one third of the population in this cohort ( $p<0.001$ ).

## DISCUSSION

The results of this study indicate that the prevalence of dental caries in this population was relatively low in comparison with results from similar studies in South African schools.<sup>3-5</sup> Reasons could be attributed either to exposure to fluoridated water by children accessing borehole water in the Tshwane rural locations, or that learners were recipients of oral health programmes and were able to access preventative care.<sup>30</sup>

Gender, location and services received emerged as key associated factors influencing the status and severity of dental caries in this population. The female learners, learners in urban schools and those with no exposure to a brushing programme had higher levels of dental caries. The severity of dental caries affected the 6-7 year old group the most and learners located in urban areas across the ages were the worst affected.

The 8-16 year old males had lower DMFT than females. The cause of the gender bias is uncertain, however, studies suggest that it may be due to gene-by sex interactions involved in the dental experience.<sup>31,32</sup> Others report that it could be due to females experiencing early eruption times of teeth, thereby having longer exposure to cariogenic foods. In addition it

**Table 4.** Table depicting multiple linear regression model results on; effects of age, gender, services and setting on the dental status. (Age range 6-7).

Variables	Coefficients	Std. Err.	p value	[95% Conf. Interval]	
<b>DMFT</b>	<b>Coefficients</b>	<b>Std. Err.</b>	<b>p value</b>	<b>[95% Conf. Interval]</b>	
Age	-0.08	0.10	0.39	-0.28	0.11
<b>Gender</b>					
Female	0				
Male	0.10	0.10	0.28	-0.09	0.31
<b>Services</b>					
Fissure sealants	0.87	0.22	0.00*	0.43	1.31
Brushing prog.	0.01	0.12	0.89	-0.23	0.26
Both	0				
<b>Location</b>					
Peri-urban	0				
Urban	1.12	0.22	0.00*	0.68	1.56
<b>dmft</b>	<b>Coefficients</b>	<b>Std. Err.</b>	<b>p value</b>	<b>[95% Conf. Interval]</b>	
Age	-0.16	0.31	0.59	-0.79	-0.45
<b>Gender</b>					
Female	0				
Male	0.05	0.31	0.87	-0.57	0.67
<b>Services</b>					
Fissure sealants	1.36	0.69	0.05*	0.00	2.72
Brushing prog.	0.23	0.39	0.54	-0.54	1.02
Both	0				
<b>Location</b>					
Peri-urban	0				
Urban	0.14	0.69	0.85	-1.22	1.52
<b>pufa</b>	<b>Coefficients</b>	<b>Std. Err.</b>	<b>p value</b>	<b>[95% Conf. Interval]</b>	
Age (6-7)	0.04	0.06	0.44	-0.07	0.11
<b>Gender</b>					
Female	0				
Male	0.02	0.06	0.70	-0.09	0.14
<b>Services</b>					
Fissure sealants	0.82	0.13	0.00*	0.55	1.09
Brushing prog.	-0.01	0.07	0.93	-0.15	0.14
Both	0				
<b>Location</b>					
Peri-urban	0				
Urban	0.70	0.13	0.00*	0.43	0.97

\*Significant results  $p\leq 0.05$

**Table 5.** Table depicting multiple linear regression model results on; effects of age, gender, services and setting on the dental status. (Age range 8-16).

Variables	Coefficients	Std. Err.	p value	[95% Conf. Interval]	
<b>DMFT</b>	<b>Coefficients</b>	<b>Std. Err.</b>	<b>p value</b>	<b>[95% Conf. Interval]</b>	
Age	0.09	0.05	0.09	-0.12	0.21
<b>Gender</b>					
Female	0				
Male	-0.46	0.17	0.01*	-0.81	-0.11
<b>Services</b>					
Fissure sealants	3.10	0.31	0.00*	2.48	3.73
Brushing prog.	-0.29	0.25	0.23	-0.77	0.19
Both	0				
<b>Location</b>					
Peri-urban	0				
Urban	3.02	0.31	0.00*	2.41	3.62
<b>PUFA</b>	<b>Coefficients</b>	<b>Std. Err.</b>	<b>p value</b>	<b>[95% Conf. Interval]</b>	
Age	-0.01	0.01	0.36	-0.03	0.01
<b>Gender</b>					
Female	0				
Male	-0.03	0.03	0.38	-0.09	0.035
<b>Services</b>					
Fissure sealants	0.05	0.57	0.38	-0.06	0.16
Brushing prog.	0.01	0.04	0.79	-0.07	0.09
Both	0				
<b>Location</b>					
Peri-urban	0				
Urban	0.004	0.05	0.94	-0.11	0.11

\*Significant results  $p\leq 0.05$



has been observed that the fluctuating levels of estrogen in females during puberty and menstruation suppress the salivary flow rate, affect its composition and subsequently result in caries susceptibility.<sup>32</sup>

The prevalence of dental caries on the permanent teeth of the urban learners was higher than those in rural areas and the primary teeth were similarly affected by the location. The change in nutrition as most families migrate from a peri-urban to urban settings for employment is contributory.<sup>30,33</sup> In addition, as the majority of children in urban schools have working parents, the children often had access to school snack money in addition to healthy government school lunches.

In peri-urban schools learners were more reliant on the government school meals and had less exposure to snacks. Other South African studies have demonstrated a similar phenomenon on oral health trends between urban and non-urban localities.<sup>5,30,33</sup> This has largely been attributed to the higher urban sugar expenditure [mean urban 8.06 (2.78) vs non-urban 7.35 (1.94)] and reduced access to borehole water which is higher in natural fluoride than the reticulated public water supply in cities.<sup>5,33</sup>

Learners who were exposed to only a fissure sealant programme versus both the supervised brushing and fissure sealants, had higher levels of caries across the age groups and higher severity of the condition among the 6-7 year olds. This implies that a more comprehensive programme may be favourable in terms of controlling the condition at schools.<sup>11</sup>

Studies have also demonstrated that fissure sealant retention tends to be a challenge particularly when not placed in ideal clinical conditions.<sup>34</sup> It must also be noted that fissure sealants are targeted to protect permanent molars and not primary teeth or the rest of the oral cavity, hence the negative result.<sup>11</sup> The results are also dependent on the type of fissure sealants used. Moisture tolerant glass ionomer fissure sealant materials may have resulted in better outcomes in field conditions as some studies have demonstrated.<sup>35</sup>

The severe consequences of dental caries mostly affected the primary dentition as the pufa was high amongst the 6-7 & 8-10 year groups. This indicated that some form of dental neglect or poor access to treatment had been experienced, hence disease consequences such as pulpitis and fistulas resulted.<sup>27</sup> A review of parental influence on the development of caries reported that high levels of untreated caries often resulted from a combination of factors.

These could include geographic isolation leading to difficulty in travelling to services; parental attitudes, knowledge and beliefs. Attitude, knowledge and beliefs are implicated as this often determine the choices parents make for their children in terms of taste preferences in diet and dental hygiene and care.<sup>36,37</sup> Furthermore there is poor perception of the importance of primary teeth and a lack of knowledge and awareness on the significance of oral health, particularly among parents with poor education.<sup>36,37</sup>

Although the prevalence of caries was low in comparison with similar studies in South Africa and the WHO goal of mean DMFT of 3 among 12 year olds. The SiC index was high in both the primary and permanent teeth implying that the disease was unevenly distributed in this cohort and it was a few children who were carrying the major burden of the disease. This means that consideration may need to be given to the implementation of a high risk prevention approach on some services in order to address the needs of those highly affected. However this has to be carefully executed in order to avoid neglecting the rest of the learners.<sup>38</sup>

A high unmet need of over 89% was found. This is surprising given that the learners were recipients of oral health services. The parents may possibly not be following up on the referrals generated from the oral health screening processes<sup>39</sup> or the healthcare professionals at the facilities may have been experiencing difficulties in attending to the restorative needs of the children for various reasons. Young children often exhibit anxiety and fear towards dental treatment, this then is expressed in disruptive behaviour while in the chair.<sup>40</sup> Dental treatment is then hindered, particularly in public health facilities that are characterised by high patient loads and time limitations.<sup>41</sup>

### Limitations

The main purpose of the study was to highlight the oral health status of the learners receiving ongoing oral health services and to ascertain the factors influencing the oral disease experience at the school settings.

The study was observing existing participating schools in uncontrolled conditions, therefore settings and services received could not be controlled for equal distribution.

Future studies will expand more on processes of programme implementation and how this influences the oral health status of learners. In addition, as this was a cross sectional analytical study no causal inferences could be made.

### CONCLUSION

The prevalence and severity of dental caries was relatively low in this population, however the unmet treatment need and the SiC index were high. The consequences of the disease affected the primary teeth of the learners most and the factors associated with the disease were influenced by gender, location and the type of services offered by the programmes. Female learners had higher levels of dental caries on the permanent teeth of 8-16 year olds, and across the ages learners from urban locations and those who only had access to a fissure sealant programme and not a combination of services were worst affected.

### Funding

This research was supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Centre and the University of the Witwatersrand and

is funded by the Carnegie Corporation of New York (Grant No-B 8606.R02), Sida (Grant No: 54100113), the DELTAS Africa Initiative (Grant No: 107768/Z/15/Z) and Deutscher Akademischer Austauschdienst (DAAD).

The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and is supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (UK) and the UK Government. The statements made and views expressed are solely the responsibility of the CARTA Fellow (Dr MM Molete).

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## Do the CPD questionnaire on page 212

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



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# Oral health-related knowledge, attitudes and practices of adult patients in Mangaung Metropolitan Municipality, South Africa

SADJ May 2019, Vol. 74 No. 4 p180 - p186

MM Modikoe<sup>1</sup>, M Reid<sup>2</sup>, R Nel<sup>3</sup>

## SUMMARY

### Introduction

Planning and implementation of oral health education is of more value when oral health-related knowledge, attitudes and practices (KAP) are known.

### Aim

To assess and describe oral health-related KAP of adult patients in the Mangaung Metropolitan Municipality using the theory of planned behaviour.

### Methods

A quantitative descriptive design was used and data were collected from a sample of 207 adult oral health patients using a questionnaire based on the Theory of Planned Behaviour (TPB).

### Results

Positive responses by participants towards oral-related KAP were regarded as strengthening oral health-related practices. Oral health-related knowledge as reflected by participants' behavioural beliefs (93.7%), normative beliefs (81.1%), subjective norms (70%) and perceived behavioural control (71.9%) strengthened oral health behaviours positively. Participants' control beliefs did not strengthen oral health practices. Participants' attitudes (62.3%), intention (98.5%), actual behavioural control (99%) and behaviour (95.1%) strengthened oral health-related practices.

## ACRONYMS

**CHC:** Community Health Centre  
**KAP:** Knowledge, Attitudes And Practices  
**PHC:** Primary Health Care  
**TPB:** Theory of Planned Behaviour

Adult patients generally portrayed behavioural beliefs, normative beliefs, subjective norms and perceived behavioural control that strengthened oral health behaviours positively.

### Conclusions

Understanding oral health-related KAP of adult patients would assist role players in the health sector to plan evidence based oral health education. Healthcare workers should be sensitive to the KAP of adult patients receiving oral health-related care.

### Keywords

Oral health, knowledge, attitudes, practices, theory of planned behaviour.

## INTRODUCTION

The mouth is an indicator of the state of a person's oral and general health.<sup>1</sup> Oral health is illustrated by the ability to speak, smile, chew, swallow and use different facial expressions without pain and discomfort.

This favourable status may therefore be realised when there is an absence of disorders that affect different structures of the mouth, such as those causing possible pain, mouth lesions, tooth decay and gum disorders.<sup>2,3</sup> World-wide, oral health disorders are reported to affect almost all adults at some point in their lives and these disorders rank among the top 100 conditions known to affect the quality of life.<sup>4</sup> Poor oral hygiene, diet and smoking are some of the risk factors causing oral health disorders in all corners of the world.<sup>5</sup> In Africa, poverty is one of the determinants of oral health disorders, as it predisposes people to a lack of information and poor lifestyle choices.<sup>6</sup>

Poor oral health-related information and lifestyle choices can be improved by integrated oral health promotion strategies with the involvement of government,

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3. **Riette Nel** - 10 %

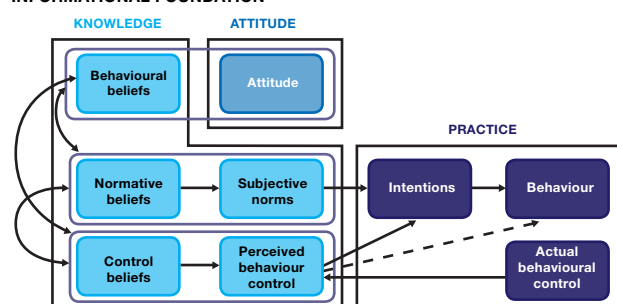
the private sector, community health workers and the community.<sup>7</sup> Oral health promotion strategies include oral health education, good nutritional guidance and increased intake of fluoride.<sup>8</sup> It is often expected that oral health promotion strategies should lead to the acquisition of knowledge, skills and attitudes that result in behavioural change.<sup>7</sup> However, behavioural change does not necessarily flow from receiving information during health promotion, as has been the case in other oral health-related studies.<sup>9</sup>

The Theory of Planned Behaviour (TPB) aims to explain how various elements play a role in predicting behaviour.<sup>10</sup> According to the TPB, behaviour is primarily determined by a the intentions of a person to perform certain behaviour. Intention is independently influenced by a person's attitude towards the behaviour and underlying beliefs and norms.<sup>11</sup>

The interactions between these elements are in actual fact not linear, but reflect a complex network. One can however still derive from Figure 1 that attitude, depicting a person's positive or negative evaluation of certain behaviour, is informed by behavioural beliefs. The behavioural beliefs in turn reflect the outcomes of performing behaviour.

Subjective norms on the other hand are influenced by the normative beliefs of significant others in a person's life. Perceived behaviour control, on the other hand, refers to the person's assessment of his or ability to perform the behaviour. It is important to note that a person's beliefs and norms may not necessarily be "correct" but they would still inform the intention to perform or not to perform, specific behaviour.

#### INFORMATIONAL FOUNDATION



**Figure 1.** Conceptual framework adapted by Reid from the Theory of Planned Behaviour.<sup>12</sup>

In this study the TPB was applied to assist in describing the knowledge, attitudes and practices (KAP) of adult oral health patients in the Mangaung Metropolitan Municipality.<sup>10,12</sup> Beliefs and norms of these patients constituted the informational foundation, which is associated with the knowledge element in this study, whereas intention together with actual behavioural control is associated with practice. Figure 1 depicts the structuring of KAP elements within the TPB.<sup>12</sup>

The majority of patients (71.4%) in South Africa in the first instance visit public health services.<sup>13</sup> In an effort to provide a comprehensive service, health promotion is therefore provided at different settings.<sup>13</sup> Oral health promotion therefore forms part of the activities lead by ward-based outreach teams.<sup>14</sup>

Oral health promotion should mainly focus on encouraging healthy behaviours.<sup>15</sup> Studies have shown that when the KAP's of people are known, oral health promotion programmes become relevant and effective,<sup>16</sup> and even more so when such a study is embedded in a behaviour prediction model such as the TPB. This combination may provide a possible structure for health promotion in a municipal areas such as Mangaung.

## METHODOLOGY

The study made use of a quantitative descriptive design with data being collected over a period of four weeks in 2015 by means of a questionnaire, which was adapted from the WHO Oral Health Questionnaire for Adults and the TPB Questionnaire.<sup>17,18</sup>

Participants were adult patients from Mangaung who were receiving oral health care at one of five public health care facilities. These included community health centres (CHCs) and district hospitals providing oral health care.

The public health establishments were identified with the assistance of the provincial oral health coordinator. A proportional sample was determined by a biostatistician with the assistance of a statistical programme, ensuring that patients were proportionally represented from amongst the five public health establishments.

Ethical approval was obtained from the Ethics Committee of the University of the Free State (ECUFS NR 65/2015) and permission from the Free State Department of Health.

The questionnaire was prepared in English and translated into Sesotho and Afrikaans. The questionnaire comprised 19 questions, presented in four parts, namely Demographic and Biographical information as Part 1, Knowledge regarding oral health as Part 2, Attitudes as Part 3 and Practices as Part 4.

A pilot study ( $n=13$ ) was conducted, and those data were subsequently included in the main study since no changes were made to the questionnaire and the participants were from the sample population. This lead to a total of 207 participants being included in the study.

The researcher and two trained fieldworkers collected data from participants at the five facilities, namely Botshabelo District Hospital dental clinic ( $n=48$ ), Dr JS Moroka District Hospital dental clinic ( $n=30$ ), Heidedal CHC ( $n=49$ ), Mangaung University Community Partnership Programme CHC dental clinic ( $n=31$ ), and the National Hospital CHC dental clinic ( $n=49$ ).

The data were captured twice using a Microsoft Excel spreadsheet before being handed over to the biostatistician for analysis. Descriptive statistics, namely the frequency of the responses of participants leading to positive oral health-related behaviours and/or practices, were given with percentages for categorical data, and the medians and percentiles for numerical data were calculated. As recorded by the TBP, a higher percentage in the responses generally indicates a positive oral health-related behaviour and/or practice.

**Table 1.** Demographic and biographic data of participants (*n*=207).

Demographic and biographic data			
Item	Attribute	Frequency	Percentage
Gender	Male/Female	98	47.3%
		109	52.7%
Language	English	35	16.9%
	Sotho	169	81.6%
	Afrikaans (Setswana, isiXhosa)	1	0.5%
Level of education	No schooling	6	3%
	Some primary school	20	9.6%
	Completed primary school	7	3.3%
	Some secondary school	88	42.5%
	Completed secondary school	69	33.3%
	Diploma/degree	16	7.7%
	Honours	1	0.4%
Illness data			
Item	Response	Frequency	Percentage
Presence of illness	Yes	63	30.4%
	No	143	69%
	Unsure	1	0.4%
Nature of illness if present ( <i>n</i> =63)	Tooth-related problems, gum-related problems,	38	60.3%
	Non-oral problems	2	3.1%
	Never	29	46%
Last visit for oral care		18	8.6%
Last visit problems* ( <i>n</i> =167)	Tooth-related problems	145	86.8%
	Gum-related problems	5	2.9%
	Oral health-related problems	7	4.2%
	Preventive measures	14	8.4%

\* Participants could indicate more than one problem

**Table 2.** Knowledge of participants (*n*=207).

Element	Frequency of participants' responses generally lead to positive oral health-related behaviours and/or practices (%)		Element	Frequency of participants' responses generally lead to positive oral health-related behaviours and/or practices (%)	
Behavioural beliefs			Perceived behavioural control		
If I do not seek treatment for toothache my whole body can become sick.	133	(64.2%)	If a person living with an oral health problem wants to have a healthy mouth he/she must....		
Pain in the mouth can result in my not being able to talk to other people.	166	(80.1%)	Clean the mouth daily with a toothbrush and toothpaste.	202	(97.5%)
Pain in the mouth can result in my not being able to eat the food I like.	190	(91.7%)	Use ash to clean the teeth.	183	(88.4%)
Toothache can only be relieved by placing a Disprin on the painful tooth.	162	(78.2%)	Remove food particles from teeth with dried grass/matchstick.	133	(64.2%)
Normative beliefs			Rinse mouth with water after meals.	198	(95.6%)
In our family we believe that:			Floss teeth daily with dental floss.	136	(65.7%)
If you eat bones it can lead to injuries and sores in your mouth.	145	(70%)	Control beliefs		
Having sores in the mouth will lead others in the community to thinking one has Aids.	48	(23.1%)	Which teeth and gum disorders do you know of?		
Having sores in the mouth will make family members not want to be close to you.	75	(36.2%)	Tooth-related problems.	73	(35.2%)
Using salt water to rinse one's mouth is generally considered to be the best treatment for sores in the mouth.	161	(77.7%)	Gum-related problems.	89	(43%)
Subjective norms			Mouth lesions.	13	(6.2%)
If I eat bones it can lead to injuries creating sores in the mouth.	146	(70.5%)	Other oral-related problems (bad breath, eating hot food, using different toothpastes).	6	(2.9%)
Having sores in the mouth will lead others in the community to thinking I have Aids.	37	(17.8%)	Do not know.	80	(40.5%)
Having sores in the mouth will make other people not want to be close to me.	41	(19.8%)	Which teeth/gum disorders can a person prevent/control?		
Using salt water to rinse one's mouth is generally considered to be the best treatment for sores in the mouth.	159	(76.8%)	Tooth-related problems.	27	(13%)
			Gum-related problems.	27	(13%)
			Other oral-related problems (Bad breath, mouth sores/ulcers, thrush on tongue).	9	(4.3%)
			Do not know.	152	(73.4%)
			Which teeth/gum disorders can a person not prevent/control?		
			Tooth-related problems.	29	(14%)
			Gum-related problems.	12	(5.8%)
			Other oral-related problems (Mouth sores, thrush on tongue).	4	(1.9%)
			Do not know.	166	(80.1%)

\* Participants could indicate more than one problem



## RESULTS

### Demographic and biographic data

Demographic and illness data of participants are given in Table 1. A total of 207 adult patients participated in the study, aged 18 to 78 years with a median of 33 years. Participants were predominantly females, speaking Sesotho and most having not completed secondary schooling. Although participants attended an oral health service, they did not perceive themselves to be ill, with tooth-related problems being the most prevalent reason for visiting an oral health service.

### Knowledge

The results of the assessment of the oral health-related knowledge of the participants, covering behavioural beliefs, normative beliefs, control beliefs, subjective norms and perceived behavioural control in accordance with TPB are presented in Table 2. In Table 3, knowledge responses are summarised, reflecting a high percentage of positive responses to behavioural beliefs, normative beliefs, subjective norms and perceived behavioural control.

Control beliefs were assessed with open-ended questions which were thematically coded. Almost 41% of the participants did not know any teeth and/or gum disorders with the majority not knowing teeth and/or gum

disorders that could or could not be prevented (Table 2). Table 3 reflects the high percentages of other knowledge elements which strengthen oral health-related behaviours and practices.

### Attitudes

Table 4 reflects the attitudes of participants which could lead to positive oral health-related behaviour and/or practices. Although not shown on the Table, more than half (62.3%) of the responses were positive towards oral health-related behaviours with a median of 50% (range 14.3%–92.9%). The findings therefore imply that the majority of participants projected positive attitudes towards oral health-related behaviours. As predicted by the TPB, positive behavioural beliefs towards oral health lead to positive attitudes towards oral health.

**Table 3.** Health-related knowledge predicting positive oral health-related behaviours and practices.

Elements	Lower quartile	Median	Upper quartile	Percentage positive responses
Behavioural beliefs	75	75	100	(93.7%)
Normative beliefs	50	50	50	(81.1%)
Subjective norms	25	50	50	(70%)
Perceived behavioural control	40	60	60	(71.9%)

**Table 4.** Attitudes of participants (*n*=207).

Attitude statement	Frequency of participants' responses generally lead to positive oral health-related behaviours (%)	
Having a mouth problem is just as important to treat as having another health problem.	180	(87.9%)
Having a mouth problem can lead to isolation from other people.	150	(72.4%)
If I did not have a mouth problem I think I would be quite a different person.	69	(33.3%)
Having a mouth problem is the worst thing that has ever happened to me.	67	(32.3%)
Most people would find it difficult to adjust to having a chronic problem in the mouth.	159	(76.8%)
I feel embarrassed about having a problem in my mouth.	54	(26%)
Avoiding getting a mouth problem involves a lot of sacrifice and inconvenience.	17	(8.2%)
I avoid telling people I have a mouth problem.	125	(60.3%)
Having a mouth problem over a long period changes the personality.	38	(18.3%)
I often find it difficult to decide whether I feel sick or well.	68	(32.8%)
Having a mouth problem can be controlled.	192	(92.7%)
There is really nothing you can do when you have a mouth problem.	161	(77.7%)
There is really no-one I feel I can talk to openly about my mouth problem.	159	(76.8%)
I often think it is unfair that I should have a mouth problem when other people are so healthy.	67	(32.3%)

**Table 5.** Practices of participants (*n*=207).

Elements	Statement	Frequency of participants' responses generally lead to positive oral health-related behaviours and/or practices (%)	
Intention	I plan to:		
	Seek treatment if I have toothache.	206	(99.5%)
	Use Disprin to relieve toothache.	51	(24.6%)
	Not eat any type of food that can injure my mouth.	189	(91.3%)
	Rinse my mouth with salty water should I have sores in my mouth.	166	(80.1%)
	Clean my mouth daily with toothpaste and toothbrush.	206	(99.5%)
Actual behavioural control	Floss my teeth daily with dental floss.	151	(72.9%)
	I have the practical means to:		
	Seek treatment if I have toothache.	204	(98.5%)
	Use Disprin to relieve toothache.	68	(32.8%)
	Not eat any type of food that can injure my mouth.	196	(94.6%)
	Rinse my mouth with salty water should I have sores in my mouth.	169	(81.6%)
Actual behavioural control	Clean my mouth daily with toothpaste and toothbrush.	207	(100%)
	Floss my teeth daily with dental floss.	149	(71.9%)
	I have in the past been able to:		
	Seek treatment if I have toothache.	193	(93.2%)
	Use Disprin to relieve toothache.	86	(41.5%)
	Not eat any type of food that can injure my mouth.	173	(83.5%)
Actual behavioural control	Rinse my mouth with salty water should I have sores in my mouth.	168	(81.1%)
	Clean my mouth daily with toothpaste and toothbrush.	206	(99.5%)
	Floss my teeth daily with dental floss.	125	(60.3%)

**Table 6.** Health practices which predict oral health-related behaviour in terms of percentage.

Elements	Lower quartile	Median	Upper quartile	Percentage positive responses
Intention	66.7	83.3	83.3	98.5
Actual behavioural control	66.7	83.3	83.3	99
Behaviour	66.7	83.3	83.3	95.1

### Practices

The reports of the participants on their oral health-related practices are presented as their intentions, actual behavioural control and behaviour in accordance to the TPB (Table 5). In Table 6, practice responses are summarised and the calculation reported in percentages. The results are again aligned to the TPB since a positive attitude had a favourable influence on oral health-related practices. The subjective norms and perceived behavioural control of the participants further supported positive oral health behaviours and/or practices.

## DISCUSSION

### Demographic and illness characteristics of participants

The ages of participants ranged from 18 to 78 years, the majority being females, in line with the gender demographics of South Africa.<sup>19,20,21</sup> Sesotho is the language spoken most often in households in the Free State Province (53.2%),<sup>22</sup> confirmed in this study. The questionnaire was presented in Sesotho and English.

The findings that numerous participants did not complete secondary schooling and that there were those who never attended school, might be attributed to the previous apartheid government laws and a lack of development affecting people in disadvantaged communities.<sup>23</sup>

The predominance of tooth-related problems experienced by participants also occurred in Jordan when Khamaiseh and Al Bashtawy evaluated oral health KAP among secondary school students.<sup>15</sup>

Participants (8.6%) in the current study who had never been seen by a healthcare worker for oral care may have missed opportunities for accessing oral health information that could have led to improved oral health behaviours and/or practices, as found in the study by Molete, Yengopal and Moorman.<sup>24</sup>

### Knowledge

#### Behavioural beliefs

Although the participants' behavioural beliefs were generally positive towards oral health behaviours, a few participants indicated beliefs that do not strengthen positive oral health practices.

Relieving toothache by placing Disprin on the painful tooth emerged as one such belief, which instead of addressing the pain may result in damage to the epithelium.<sup>25</sup>

#### Normative beliefs and subjective norms

The alignment of normative beliefs and subjective norms supported the TPB in this study. These findings are comparable to the findings by Anderson, Noar and Rogers who applied the TPB to determine dental check-ups among the young adults in Midwestern Universities, USA. The findings revealed that normative beliefs influenced the young adults' subjective norms towards regular dental check-ups.<sup>26</sup>

### Control beliefs and perceived behavioural control

The apparent ignorance of participants of actions that they could take that would offer some control over their own oral health is of import. The reason may be attributed to their poor knowledge regarding tooth and gum disorders that can or cannot be prevented. The findings in this study regarding this poor knowledge differ from findings in Tehran where the KAP of adults towards periodontal health were determined.

Most of those study participants demonstrated a knowledge of how gum disorders could be prevented.<sup>27</sup> The perspectives of adults in Maryland regarding tooth decay were also assessed and many participants mentioned how tooth decay could be prevented.<sup>28</sup> If participants from the reported study had such knowledge, they would perceive themselves as having control over factors influencing and strengthening their behaviour and/or practices related to oral health.

When it came to perceived behavioural control, most of the participants recorded responses which were positive towards oral health behaviour and/or practices; however, negative perceived behavioural responses were revealed in the use of traditional and unhygienic behaviours and/or practices. The use of ash reported in this study is not surprising since it was also highlighted as a common practice in a recent study which determined oral hygiene knowledge and practices among the Dinka and Nuer people from Sudan.<sup>29</sup>

Cleaning materials, such as charcoal and soap, were reported as being used in the North West Region of Cameroon when gum health and the oral hygiene practices of school children were determined.<sup>30</sup> It would be expected that this would also be the practice of adults in the community.

Unhygienic flossing items were also identified in a KAP study in Nigeria where 35.6% of participants used wooden toothpicks, 25.2% plastic toothpicks, 20% splinters from broomsticks and 12.4%, pins.<sup>31</sup> Continual performance of these behaviours and/or practices may lead to injuries and damages in the mouth reflecting that positive oral health practices did not take place.

The perceived behavioural control reported in this study contradicts the TPB in the sense that participants did not consider themselves to have control over factors that could determine their behaviours and/or practices regarding oral health. There was a lack of alignment between control beliefs and perceived behavioural control. A similar finding was made by Starkel in Chicago, USA, who tested the ability of the TPB to predict dental visit behaviour in adults. Respondents in the Chicago study had positive control beliefs towards dental visits but their perceived behavioural control towards dental visits was insignificant in influencing their intentions.<sup>32</sup>

### Attitudes

The positive attitudes in this study were consistent with the TPB since participants reflected positive behavioural beliefs which strengthened positive oral health

behaviours and/or practices. French and Cooke also noted that influence on attitudes and the performance of behaviour.<sup>33</sup> Although negative attitude responses emerged from some participants, the mainly positive attitudes of participants towards oral health in this study strengthened their intentions, resulting in positive performance of oral health behaviours and/or practices, as aligned to the TPB.

These findings are supported by Domitrescu, Wagle, Dogaru and Monalescu who tested the efficiency of an extended model of TPB in predicting the intentions to improve oral health behaviours in first-year undergraduate students at the University of General Medicine and Pharmacy Carol Davila, Romania.<sup>34</sup> They found attitude to be a strong determinant of intention.

Similar findings were reported by Starkel who reported that the favourable attitudes of respondents towards dental visits led to the intention to actually visit the dentist.<sup>32</sup> Positive attitudes towards the importance of oral health were strongly associated with oral health self-care behaviour among nursing home personnel in rural Virginia, USA.<sup>35</sup>

## Practices

### Intention, actual behavioural control and behaviour

The findings of this study support the TPB in that a positive attitude, perceived behavioural control and specific subjective norms strengthened positive intentions towards oral health behaviours and/or practices. Attitudes, subjective norms and perceived behavioural control were found by Huda, Rini, Mardoni and Putra to lead to intentions in terms of Islamic religious obligations and similar conclusions were drawn in a study by Cooke, Dahdah, Norman and French that applied the TPB to predict practices in alcohol consumption.<sup>36,37</sup>

Similar findings were reported when Van den Branden, Broucke, Leroy, Declerck and Hoppenbrouwers tested the TPB in oral health-related behaviours of parents towards their preschool children in Belgium,<sup>38</sup> their finding was that attitudes, perceived behavioural control and subjective norms determined the intentions and performance of oral health behaviours. In contrast, French and Cooke found that only attitude and subjective norms predicted intention, but that perceived behavioural control did not influence intention.<sup>33</sup>

When Knabe applied the TPB to an online course in public relations, she found that attitude, subjective norms and perceived behavioural control led to an intention, with subjective norms having a much greater influence than attitude and perceived behavioural control.<sup>39</sup>

The present study has found that only behavioural and normative beliefs were closely related to the attitude and subjective norms of the participants. However, control beliefs seemed not to have an influence on perceived behavioural control.

These findings differ from those of Haydon, Obst and Lewis where the beliefs of women's intentions to consume alcohol were assessed.<sup>40</sup>

Those authors found that behavioural beliefs, normative beliefs and control beliefs influenced the intention of their subjects to drink alcohol. Behavioural beliefs, normative beliefs and control beliefs were all associated with adherence to antidiabetic treatment in Brazil when salient beliefs regarding the treatment were analysed according to the TPB.<sup>41</sup>

Positively strengthened intentions and actual behavioural control recorded in the results presented in the present study, influenced the planned performance of oral health-related behaviours and/or practices, as predicted by the TPB. A study in Belgium also found that the intentions of parents led to the performance of oral health-related behaviours.<sup>38</sup> Table 5 presents the translation of participants' intentions and actual behavioural control into behavioural performance. An example here is the response of participants towards the use of a toothbrush and toothpaste to clean the mouth and rinsing the mouth with salty water when mouth sores occur.

## Limitations

The results of this study cannot be generalised to public oral health establishments in South Africa. However, they can provide insight into the oral health-related KAP of adult patients in Mangaung Metro and the Free State. Whilst the structured questionnaire was based on the Theory of Planned Behaviour (TPB), it has not as yet been validated.

## CONCLUSION

This study has shown that adult patients generally portrayed behavioural beliefs, normative beliefs, subjective norms and perceived behavioural control that positively strengthened oral health behaviours. Control beliefs in this study did not strengthen oral health behaviour.

Positive attitudes, subjective norms and perceived behavioural control strengthened adult patients' intentions towards enhanced performance of oral health-related behaviours and/or practices. Lastly, adult patients' intentions and actual behavioural control led to the performance of oral health-related behaviours and/or practices.

The outcomes of this study can be used to inform the planning of integrated oral health promotion strategies, specifically in Mangaung and the Free State Province of South Africa. It would be beneficial to focus on the control beliefs of adults, since this may strengthen positive oral-health related behaviour. The TPB-based questionnaire used in this study could guide future interventions that are aimed at improving oral health practices of patients. The findings of this study may be used as a catalyst for further oral health-related research.

## Acknowledgements

The authors would like to gratefully acknowledge financial support by the National Research Foundation.

## Conflict of interest

None declared.

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# Root canal preparation: A literature review and clinical case reports of available materials and techniques

SADJ May 2019, Vol. 74 No. 4 p187 - p199

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## SUMMARY

Mechanical enlargement and shaping of complex endodontic root canal systems to facilitate disinfection remain the main foci of endodontic treatment. A large variety of root canal shaping and preparation systems with different design features and advantages are available to the clinician. Although there are many studies in the literature comparing these different systems, the aim of this paper is to provide the clinician with an overview of some of the available systems as well as their clinical applications.

## INTRODUCTION

Shaping and enlargement of root canal systems to facilitate irrigation, disinfection and proper obturation are the most important aspects in endodontic treatment.<sup>1</sup>

Maintaining the original canal anatomy and preservation of dentine thickness of a root canal system is critical to the successful shaping of a root canal. Procedural errors like instrument fractures, ledge formation, canal zipping,

strip perforations, apical perforations, elbow formations and apical blockage can possibly lead to endodontic failure as a result of incomplete debridement.<sup>2</sup> Most of these errors can be contributed to the stiffness of stainless steel instruments.<sup>3</sup>

The introduction of nickel titanium (NiTi) rotary instruments with a decreased modulus of elasticity, revolutionised endodontics. Recent developments in endodontic instrumentation can be characterised by more flexible alloys with an increase in fatigue resistance, altered shaping motion (reciprocation in addition to rotation action) and a reduction in the number of files used for canal enlargement and shaping.<sup>4</sup> Improved design of file systems in order to clean a greater section of the canal without the need for coronal flaring has also become one of the key features of recently developed endodontic systems.<sup>5</sup>

Mechanical preparation goes hand in hand with chemical disinfection of the root canal system and should be studied concurrently. In this paper the authors will however only focus on the mechanical aspects of a few different canal shaping systems, their advantages, design features and clinical applications.

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1. **Peet van der Vyver:** Responsible for some of the scientific writing and planning of the article. Provided most of the clinical cases reported in the article.
2. **Farzana Paleker:** Responsible for some of the scientific writing, final layout of the article and collecting cases that were not provided by Prof P vd Vyver.
3. **Martin Vorster:** Responsible for some of the scientific writing, contributed to the writing of the abstract, literature review as well as concluding remarks and was also involved in the editing and proofreading of the article as well as editing and verifying of references.
4. **Francois A de Wet:** Responsible for some of the scientific writing and for proofreading of the article.

### 1.1. BioRaCe (FKG Dentaire)

BioRaCe (FKG Dentaire, La Chaux-de-Fonds, Switzerland) (Figure 1) is a rotary NiTi shaping system consisting of instruments that are manufactured using a conventional austenite NiTi electro-polishing surface treatment, have a non-cutting safety tip, and a triangular cross section with alternating cutting edges.<sup>6</sup> The basic set has six instruments: BR0 (25/08), BR1 (15/05), BR2 (25/04), BR3 (25/06), BR4 (35/04) and BR5 (40/04). According to the manufacturer, the varying diameters and tapers of this sequence reduce the contact area of each instrument with the canals walls, which minimises stress and provides the ability to safely reach the working length.

A recent study compared the shaping ability of two rotary file systems; BioRaCe and ProTaper NEXT (Dentsply Sirona, Baillagues, Switzerland) (PTN) during the preparation of curved root canals and in extracted teeth with the use of micro-computed tomographic imaging.<sup>7</sup> This study evaluated procedural errors in curved root canals and found that both instrumentation systems caused negligible procedural errors with minimal apical transportation.



Pasqualini et al. (2015) evaluated the shaping properties of two glide path-shaping NiTi rotary systems: ProGlider/ProTaper NEXT (Dentsply Sirona) (PG/PTN) and ScoutRaCe/Bio-RaCe (FKG Dentaire) (SR/BR).<sup>7</sup>

Specimens were scanned for matching volumes; surface areas and post-treatment analyses with the use of micro-CT. These researchers concluded that both SR/BR and PG/PTN shaping systems provided root canal preparation without significant shaping errors in maxillary first molar curved canals. The PG/PTN system, however, resulted in a more centered and less invasive preparation.



**Figure 1.** BioRaCe (FKG Dentaire) instruments from top to bottom: BR0 (white), BR1 (yellow), BR2 (red), BR3 (blue), BR4 (green), and BR5 (black).

### Case report

The patient, a 43 year old female presented with irreversible pulpitis on a recently crowned mandibular right first molar (**Figure 2a**). After access cavity preparation, three root canal systems were located (mesiobuccal, mesiolingual and distal) and length determination was confirmed radiographically (**Figure 2b**).

Glide path preparation was done with ScoutRace files (ISO sizes 10,15 and 20) followed by root canal preparation with the BioRace file system. The two mesial root canal systems were prepared with five instruments ((BR0 (25/08), BR1 (15/05), BR2 (25/04), BR3 (25/06),

BR4 (35/04)) and the distal canal with six instruments ((BR0 (25/08), BR1 (15/05), BR2 (25/04), BR3 (25/06), BR4 (35/04) and BR5 (40/04)). **Figure 2c** shows the final result after root canal obturation.

### 1.2. OneShape (Micro-Mega)

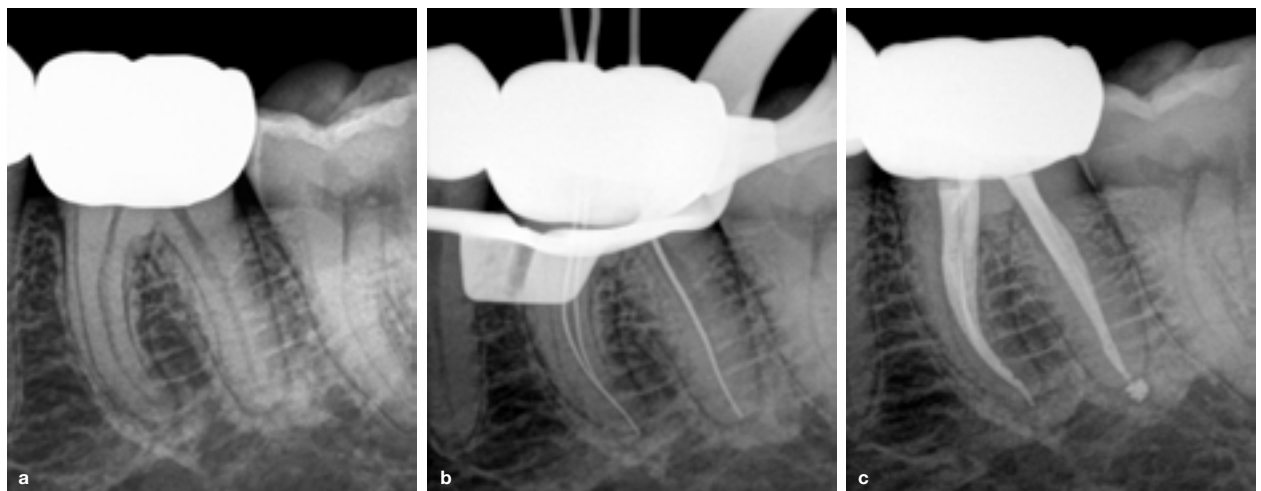
OneShape (Micro-Mega, Besançon, France) (**Figure 3**) is a single-file NiTi rotary shaping system made of a conventional austenite 55-NiTi alloy. The instrument has a tip size of 25, a constant taper of 6%, and is characterised by different cross-sectional designs over the entire length of the file.<sup>9</sup> This single-file instrumentation system is used in a full clockwise rotation. The cross section of the tip region has three cutting edges. The cross section of the middle region progressively changes from a three-cutting-edge design to two cutting edges, and the cross section of the shank is an S-shaped cross section with two cutting edges. The asymmetric cross section geometry of the file generates travelling waves of motion along the active part of the file.<sup>8</sup>



**Figure 3.** OneShape single file NiTi rotary file.

A 2015 study compared the amount of apically extruded bacteria following the use of OneShape-, PTN- and Twisted File (TF) (TF; SybronEndo, Orange, CA) systems.<sup>10</sup> The study concluded that all instrumentation systems extruded bacteria beyond the foramen but that the OneShape system extruded fewer bacteria compared with the TF- and PTN systems.

The results of the study by Bürklein, Benten and Schäfer showed that OneShape decreased the preparation time by 59% compared with Mtwo (VDW, Munich, Germany), a full-sequence rotary NiTi system.<sup>9</sup> A concern raised in this paper and in earlier studies was the associated decrease in irrigation time and subsequent chemical debridement of the root canal system. As a result, these authors recommended increased volumes of irrigation solutions in addition to irrigant activation for improved chemical dissolution of residual debris and disinfection of the root canal system.



**Figure 2.** (a) Preoperative periapical radiograph; (b) Working length confirmed radiographically; (c) Postoperative result after obturation.

This study also examined canal straightening, as well as preparation time. The results for all the instruments were comparable with those of other investigations carried out under similar experimental conditions.<sup>11,12</sup> The mean straightening value for OneShape was 1.74° and for Reciproc – a single-file reciprocating system – was 1.35°.

A study evaluating canal straightening and apical transportation between OneShape-, WaveOne- and Reciproc instruments showed significantly less canal straightening and apical transportation in the WaveOne and Reciproc groups. These researchers attributed the results to the flexibility of the instruments in these two groups, which stems from its M-Wire construction.<sup>13</sup> Pereira et al. have shown that the physical and mechanical properties of M-Wire renders root canal instruments more flexible and more fatigue resistant than those made from conventional austenitic NiTi, like OneShape.<sup>14</sup>

According to these researchers, another feature that contributed to these results was the use of WaveOne and Reciproc in a reciprocating motion as opposed to the continuous rotation of OneShape. Several studies have claimed that this working motion is associated with well-centered preparations and reduced procedural errors.<sup>15,16</sup> Furthermore, this reciprocating motion extends the lifespan of instruments in comparison with continuous rotation.<sup>17,18</sup> OneShape, however, prepared the root canals significantly faster than did Reciproc and WaveOne. All the file systems considered in the study by Pereira et al. successfully maintained the original curvature of severely curved canals in extracted teeth. These results are in accord with those found in other studies.<sup>8,12,19,20</sup>

### Case report

The patient, a 32 year old male presented with a history of an emergency root canal treatment on his maxillary right first premolar (Figure 4a). After glide path preparation with a One G instrument (Micro-Mega, Besançon, France) both root canal systems were prepared with the OneShape (25/06) instrument. Figures 4b

illustrates the cone-fit radiograph to confirm the fit of two size 25/06 gutta-percha points. The final result after root canal obturation is shown in Figure 4c.

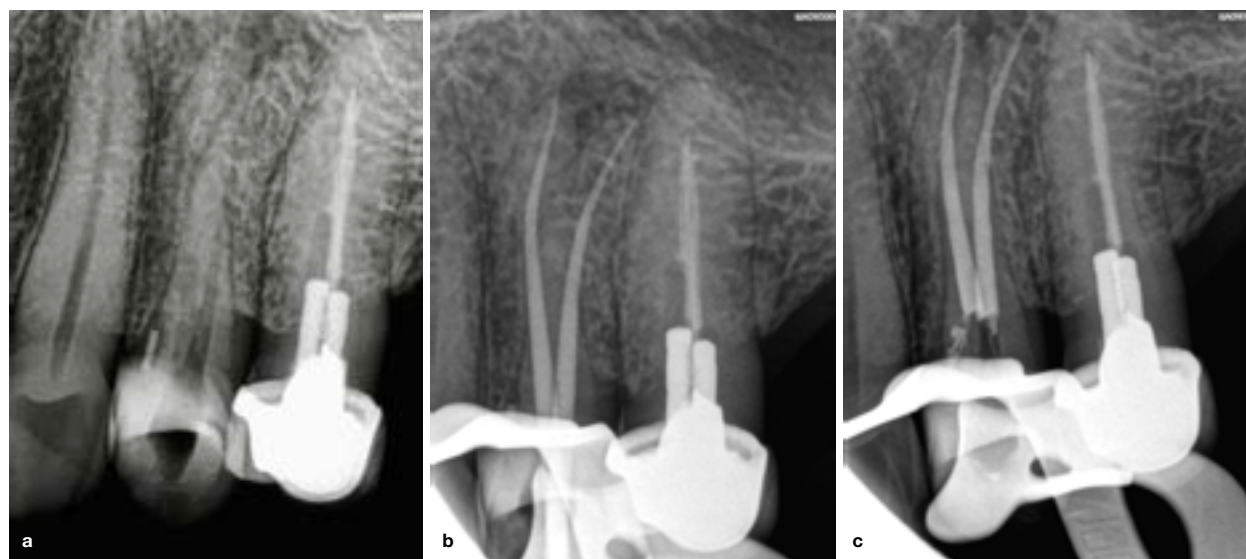
### 1.3. ProTaper Gold (Dentsply Sirona)

ProTaper Gold instruments (PTG) (Dentsply Sirona) (Figure 5) are newly introduced endodontic instruments with the same geometries as ProTaper Universal instruments (PTU) (Dentsply Sirona). The manufacturer claims that these instruments present enhanced mechanical properties because of their innovative metallurgy, which exhibits two-stage specific transformation behaviour and high Af temperatures.<sup>21</sup> Like the PTU and PTG instruments, each demonstrates a convex triangular cross section and has a continuously changing helical angle.

Each instrument falls into one of two categories: shaping instruments (SX, S1, S2) and finishing files (F1, F2, F3, F4, F5). Although shaping instruments demonstrate a progressively tapered design, finishing instruments have fixed tapers between D1 and D3, and their tapers decrease progressively from D4 to D14.<sup>22</sup> The study by Hieawy et al. (2015) examined phase transformation behaviour and resistance to bending and cyclic fatigue of PTG and PTU. ProTaper Gold files were found to be significantly more flexible and resistant to fatigue than PTU files.<sup>21</sup>

The fatigue life of size S1 and S2 was significantly longer than that of sizes F1 to F3 files. Apart from demonstrating two-stage transformation behaviour, the study found that Af temperature of PTG instruments (50.1°C ± 1.7°C) was higher than that of PTU instruments (21.2°C ± 1.9°C). A recent study evaluated the cyclic fatigue and torsional resistance of Hyflex EDM files (Coltene/Whaledent, Altstätten, Switzerland), PTG instruments and PTU instruments through the use of a stainless steel block with 1.5mm diameter and 3mm radius of a 60° angle of curvature.<sup>23</sup>

In this study, Hyflex EDM files demonstrated significantly higher resistance to cyclic fatigue which could



**Figure 4.** (a) Preoperative periapical radiograph; (b) Periapical radiograph confirming the fit of the gutta-percha points; (c) Postoperative result after obturation.

be explained by the controlled memory effect of the NiTi alloy (CM-Wire) and Electric Discharge Machining (EDM) process during construction, which allows well-controlled- and non-contact shaping of the files and could improve their mechanical properties.

ProTaper Universal instruments presented lower cyclic fatigue and torsional resistance than did PTG instruments in spite of their similar design. These results were in accord with those presented by Elnaghy and Elsaka who also attributed the results to the metallurgy of PTG.<sup>24</sup>

A separate study comparing the flexibility and cyclic fatigue resistance of PTG and PTU showed that PTG files were significantly more flexible and resistant to fatigue than were PTU files.

ProTaper Gold instruments and PTU exhibited dissimilar phase transformation behaviour, which may be attributed to the special heat treatment history of PTG instruments. These researchers concluded that PTG might be more suited for preparing canals with more abrupt curvatures.



**Figure 5.** ProTaper Gold instruments (Dentsply Sirona): SX (top), S1 (purple), S2 (white), F1 (single striped yellow), F2 (red), F3 (blue), F4 (black), and F5 (bottom).

A study examining canal transportation in simulated curved canals prepared with PTU and PTG showed that these two systems produced similar canal transportation in the straight part of the canal.<sup>25</sup>

In the curved part, however, Silva et al. found that the PTG system produced overall less canal transportation when compared with the PTU system. This finding contrasts with a study that showed PTG and PTU as having similar root canal shaping abilities in the preparation of mesial canals of mandibular first molars.<sup>24</sup> It is important to note that the former study examined colour stereomicroscopic images after shaping resin blocks while the latter used CBCT images.

### Case report

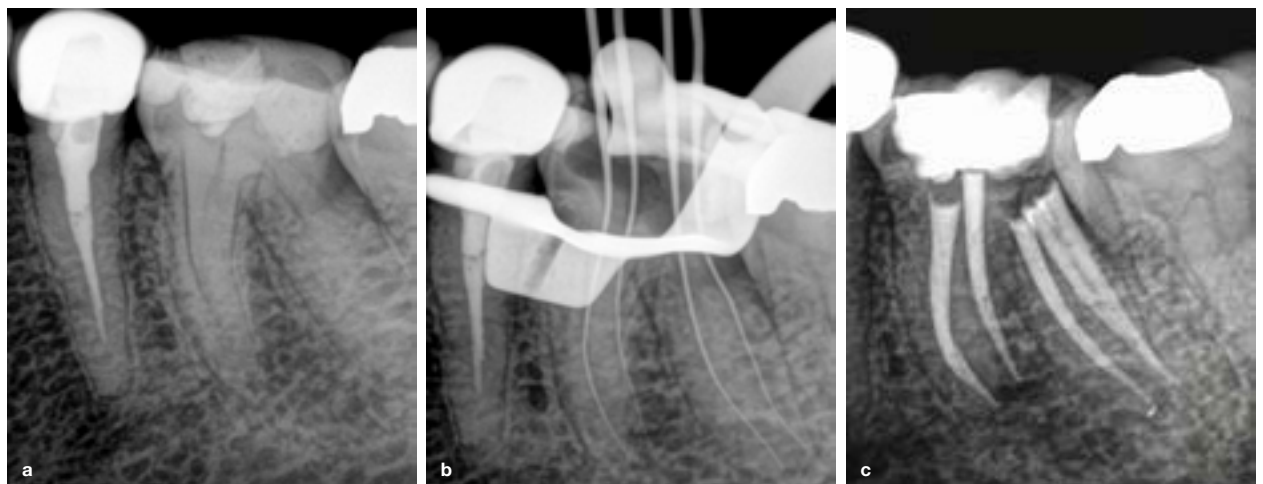
The patient, a 41 year old female presented with a non-vital mandibular left first molar (**Figure 6a**). After access cavity preparation, four root canal systems were detected (mesiobuccal, mesiolingual, distobuccal and distolingual) and length determinations were confirmed radiographically (**Figure 6b**). Glide path preparation was done with a ProGlider (Dentsply Sirona).

After glide path preparation another distal canal (mid-distal) was detected. Root canal preparation of the five root canal systems were done with the S1, S2, F1 and F2 ProTaper Gold instruments.

**Figure 6c** depicts the final result after root canal obturation with Protaper Gold F2 Gutta Percha Points (Dentsply Sirona) and Pulp Canal Sealer (Kerr, Bioggio, Switzerland), using System B (Kerr) and Obtura II (Obtura Spartan) obturation units. Note that the mid-distal canal joins in the apical third with the distobuccal root canal system to end in one apical foramen.

### 1.4. ProTaper NEXT (Dentsply Sirona)

The ProTaper NEXT (Dentsply Sirona) rotary shaping system is reported to deliver the same predictable results as its predecessor PTU (Dentsply Sirona), but reportedly with greater efficiency and with fewer files.



**Figure 6.** (a) Preoperative periapical radiograph; (b) Working length of two mesial and two distal root canal systems confirmed radiographically; (c) Postoperative result after obturation. Note the three distal root canals, with the mid-distal canal joining with the distobuccal root canal system in the apical third.

There are five instruments in the system but, according to the manufacturer, most canals can be prepared with the use of the first two only. The system comprises X1 (17.04), X2 (25.06), X3 (30.07), X4 (40.06), and X5 (50.06) (Figure 7), which are all characterised by a rotational phenomenon known as “precession” or “swagger”.

This innovative off-centered rectangular cross section is claimed to give the files a “snake-like” swaggering movement as they advance into the root canal<sup>26</sup> (Figure 8a and b).

ProTaper NEXT features a bilateral symmetrical rectangular cross section with an offset from the central axis of rotation, except in the last 3mm of the instrument (D0-D3). The exception is ProTaper X1, which has a square cross section in the last 3mm to give the instruments a little more core strength in the narrow apical part.

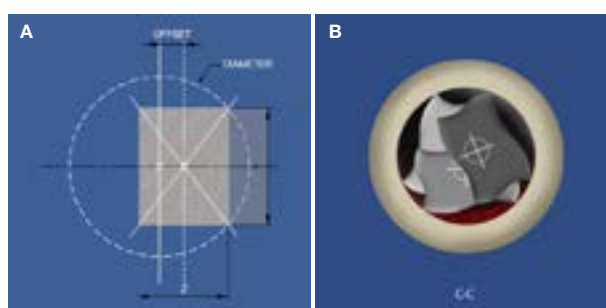
The shorter handle of PTN also allows for improved accessibility to teeth and the file's M-Wire NiTi construction increases flexibility and makes it almost 400% more resistant to cyclic fatigue, decreasing the potential for broken instruments.<sup>27</sup>

According to van der Vyver and Scianamblo the benefits of the PTN design include:<sup>28</sup>

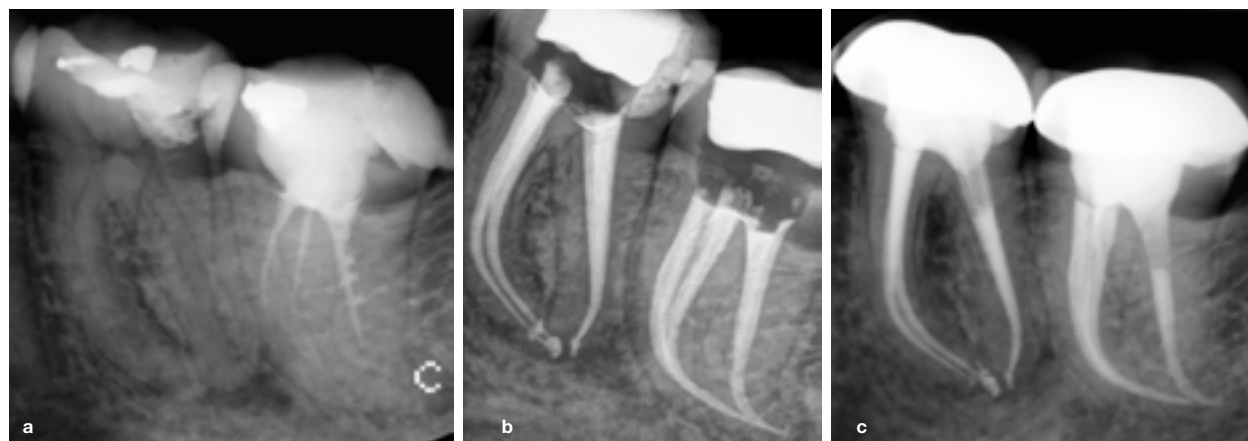
1. Further reduction in the engagement between the instrument and the dentine walls, which contributes to a reduction in taper lock, screw-in effect, and stress on the file.
2. Removal of debris in a coronal direction because the off-centre cross section allows for more space around the flutes of the instrument, leading to improved cutting efficiency through continuous contact of the blades with the surrounding dentine walls.
3. The swaggering motion of the instrument initiating activation of the irrigation solution during canal preparation and improving debris removal.
4. Reduced risk of fracture through less stress on the file and more efficient debris removal.
5. The ability of each instrument to perform a larger envelope of motion (larger canal preparation size) compared with a similarly sized instrument with a symmetrical mass and axis of rotation. This allows the clinician to use fewer instruments to prepare a root canal to adequate shape and taper to allow for optimal irrigation and obturation.
6. A smooth transition between instruments because of a design that ensures sequential and exponential expansion of performance.



**Figure 7.** ProTaper NEXT files (Dentsply Sirona): X1 (top), X2 (red), X3 (blue), X4 (black) and X5 (bottom).



**Figure 8.** Schematic representation of (a) an off-set rectangular file demonstrating the adjustability of the distance of the offset from the central axis; (b) rectangular offset cross section of ProTaper NEXT showing two points of contact with the dentine wall as the file rotates (Courtesy of Dr. M Scianamblo, San Rafael, California).



**Figure 9.** (a) Preoperative periapical radiograph; (b) Immediate postoperative result after the root canal systems were obturated with six size 25 Thermafil Obturators; (c) Postoperative result four years after the teeth were restored.



A study of curved canals by Pasqualini et al. that compared PTN to the BioRaCe system (BR) (FKG, Dentaire) demonstrated that PTN resulted in a more centered and less invasive preparation than that obtained with the BR system.<sup>7</sup>

That study showed no significant differences in post-instrumentation volumes and surface areas between the two groups. However, at a level 1mm from the canal apex and at the point of maximum curvature, lower canal transportation scores were recorded for PTN used after glide path enlargement than for the BR instrument used after glide path enlargement with ScoutRaCe (FKG Dentaire).

Centrifugal increase in canal diameters between the two groups was similar but PG/PTN demonstrated a more conservative increase of canal areas and a reduction of the inner dentinal wall thickness at the point of maximum curvature. The same study also analysed the final canal taper after shaping with PTN X2 in 3D. Results showed a homogeneous increase in canal taper, ranging from 6% to 7%, which was consistent with the declared taper of the instrument profile.

A study by Da Silva Limoeiro et al. demonstrated the inability of NiTi systems to completely shape root canal walls. The authors showed that following instrumentation with BR, 11.42% of the surfaces were untouched, while 15.46% of the walls remained unprepared after the use of PTN.<sup>29</sup> These values are in line with those reported by Busquim et al. in which files left 9% to 16% of the walls untouched<sup>30</sup> and with those reported by Gagliardi et al. who found a mean range of 6% to 13% of untouched areas.<sup>27</sup>

The Gagliardi et al. (2015) study evaluated the shaping characteristics of PTG, PTN, and PTU in curved canals, and showed that the first and last of these systems produced significantly less transportation than PTN and that PTG maintained more dentine than PTU. PTN, however, displayed less canal wall contact than either PTG or PTU.<sup>29</sup>

A study used micro-computed tomography to evaluate the frequency of dentinal micro-cracks after root canal preparation with PTN- and TF Adaptive systems (Kerr).<sup>31</sup> Results showed that root canal preparation with the two systems did not induce the formation of new dentinal micro-cracks.<sup>31</sup>

### Case report

The patient, a 29 year old female presented with a non-vital mandibular left first molar and a poorly root canal treated second molar (Figure 9a). After removal of the previously placed gutta-percha in the second molar all the root canal systems in both teeth were negotiated to patency.

Glide path preparation was done with PathFiles (Dentsply Sirona) and root canal preparation was done with the X1 and X2 ProTaper NEXT instruments. Obturation of the six root canal systems was effected with size 25 Thermafil Obturators (Dentsply Sirona) (Figure 9b). Figure 9c shows the result at a four year follow up visit.

### 1.5. TRUShape 3D Conforming Files (Dentsply Sirona)

TRUShape 3D Conforming Files (TRS) (Dentsply Tulsa Dental Specialties, Tulsa, OK, USA) (Figure 10) were launched in 2015 in four available sizes (20, 25, 30, 40), each with a variable regressive 6% taper to a maximum flute diameter of 0.80 mm.

All instruments have the same symmetric triangular cross section and exhibit an S-curve shape, resulting in a variable overall taper of the instrument. The cutting part of these instruments is made of heat-treated NiTi alloy with proprietary processing. The heat treatment is applied after flutes are ground into blanks from commercially available nickel titanium to shape-set a file into characteristic bends.<sup>32</sup>

The unique S-shape of the TRS files creates an innovative envelope of motion within the canal that conforms to unconstrained spaces while respecting



**Figure 11.** (a) Preoperative periapical radiograph; (b) Working length confirmed radiographically; (c) Postoperative result after obturation.



constrained spaces. This shape allows the files to adapt to areas of the canal greater than the nominal size of the instrument. TRUShape 3D Conforming Files are claimed to preserve more dentinal structure when they are used to prepare the entire root canal.<sup>33,34</sup>



**Figure 10.** TRUShape 3D Conforming Files (26/06, 35/06 and 40/06) (Dentsply Tulsa Dental Specialties)

TRUShape 3D Conforming Files are reported as allowing for a predictable apical shape while producing up to 32% less apical transportation than conventional ISO prepared canals. The TRS instruments are also reported to reduce bacteria loads from root canal walls in the absence of antimicrobial irrigant more than do Twisted Files (SybronEndo).<sup>35</sup>

### Case report

The patient, a 52 year old female patient presented with a non-vital maxillary right first molar (**Figure 11a**). After access cavity preparation the working length of the three located root canal systems (mesiobuccal, distobuccal and palatal) were confirmed radiographically (**Figure 11b**).

Glide path preparation of the three located root canal systems were done with a ProGlider instrument and root canal preparation was done with the 25/06 TRUShape 3D Conforming File. **Figure 11c** demonstrates the final result after root canal obturation.

## 2. Reciprocating root canal shaping systems

Nickel titanium instruments used in a reciprocating motion were recently introduced for endodontic shaping. Reciprocating NiTi files differ from NiTi files that use continuous rotation by working in a similar but reverse “balanced force” action, using a pre-programmed motor to move the files in a back and forth “reciprocating motion”.<sup>36</sup>

A significant limitation of the NiTi instruments used in rotation has been the fracture rate of these files, which has been attributed to the effects of the continuous rotation.<sup>37,38</sup> There are claims that reciprocating endodontic instruments are more resistant to instrument separation, allow for easier treatment and, ultimately, will shorten the learning curve for NiTi file systems.<sup>39</sup>

The reciprocating working motion consists of a cutting direction that is counter-clockwise (CCW) and a reverse direction that is clockwise (CW). The fact that the angle of the CCW cutting direction is greater than the angle of the reverse direction is alleged to ensure that the instrument continuously progresses towards the terminus of the root canal.<sup>9</sup>

The resistance to separation of reciprocating endodontic instruments can be explained by the endurance limit, defined as the level of torsional stress or strain at which a file can be subjected to virtual infinite cycles without failure, where a cycle is regarded as a loading and releasing stress or strain.<sup>40</sup> This value will be a specific deflection angle characteristic of each instrument and it will depend on the size and design features.<sup>40</sup>

Virtually each time that a file is cutting dentine in rotation and is constricted inside the canal, a certain degree of torsional deformation develops on its axis. If this deformation is maintained under the limits of the plastic deformation, there will be no structural changes. However, if this repeated cyclic axial deformation is accrued and exceeds the endurance limit, the metal will fracture because of torsional fatigue. This mechanism of stress is added to the flexural fatigue that is developed within a curved root canal.<sup>41</sup> The idea of limiting the angle of rotation in the cutting motion under the endurance limit of the instruments led to the development of the reciprocating movement. The aim was to create a motion with a rotary effect in which the angle of rotation in the cutting motion is higher than the angle of rotation in the opposite noncutting direction. This determines the final rotation of the instrument that will perform a complete rotation for a certain number of reciprocating cycles.<sup>39</sup>

Stainless steel files have been used in a similar motion during glide path enlargement. Studies have demonstrated that NiTi reciprocating instruments decrease preparation time, increase cyclic fatigue life, and have a shaping ability similar to that of systems that use continuous rotation.<sup>42-44</sup> Incidences of deformation and fracture of reciprocating instruments are fewer than those reported for rotary instruments.<sup>45,46</sup> Another reported advantage of using reciprocating endodontic systems is that in contrast to conventional rotary systems that utilise a series of instruments for shaping, reciprocating systems such as WaveOne (Dentsply Sirona) and Reciproc (VDW), are able in some cases to shape canals with the use of one instrument only.<sup>47</sup> Significantly fewer incidences of instrument separation and deformations of reciprocating files have been reported.<sup>45,46</sup>

Studies comparing the fracture risk of conventional rotating files and reciprocating instruments showed a significantly higher number of fractures in the rotating file group.<sup>15,48</sup> Further reports show that file deformation and life span are not influenced by operator experience or the establishment of a mechanical glide path.<sup>49-51</sup> Wan et al. claim that reciprocating files undergo decreased stress and should therefore have a greater fatigue resistance because these files travel shorter circumferential distances than do rotary files.<sup>52</sup> Various studies have concluded that the reciprocating motion extends the life span of NiTi endodontic files.<sup>53-55</sup>

### 2.1. Properties of reciprocating root canal shaping systems

#### 2.1.1. Cyclic fatigue and bending resistance

The amplitude of reciprocation has been shown to influence the cyclic fatigue life of reciprocating files.

Increased angles of reciprocation with subsequent increases in the angle of progression for each reciprocation cycle reportedly reduce the resistance to cyclic fatigue.<sup>56,57</sup>

A study by Shin et al. reported that the fatigue life is reduced when the reciprocating amplitude increases in stationary reciprocation (i.e. reciprocation remains constant and the instrument does not progress down the canal) but may be increased by 50% to 355% over the fatigue life associated with conventional rotating files.<sup>58</sup>

The results for progressive reciprocating files are even higher, for a fatigue life enhancement of up to 990% beyond that of conventional rotating files may be achieved. During progressive reciprocating motion, the most critically strained locations move forward to new sites as the file advances, distributing fatigue damage to various points on the circumference of the instrument.

### 2.1.2. Cutting efficiency

Studies examining the cutting efficiency of Reciproc, Twisted File (TF) Adaptive (SybronEndo, Orange, CA) in both reciprocating files and conventional rotating modes showed no significant difference in the cutting ability between the two types of movement.<sup>59,60</sup> There are, however, only a few studies investigating the cutting efficiency of the new reciprocating files. Ploton et al. and Tocci et al. revealed that Reciproc and TF Adaptive exhibited significantly higher cutting efficiency than WaveOne.<sup>61,62</sup>

Another study by Gambarini et al. showed that the cutting ability was not reduced by prolonged clinical use.<sup>59</sup> A combination of the two movements has proved successful. Conventional rotating files used during glide path enlargement and shaping with reciprocating files have produced centered preparations.

Berutti et al. found that endodontic preparation with the Primary WaveOne file following glide path enlargement with the PathFile system produced a preparation that was more centered.<sup>42</sup>

### 2.1.3. Other Reported Advantages

Two studies compared the extrusion of debris during retreatment procedures using either rotary files or reciprocating files, the results showing that reciprocating files are associated with reduced debris extrusion.<sup>63,64</sup>

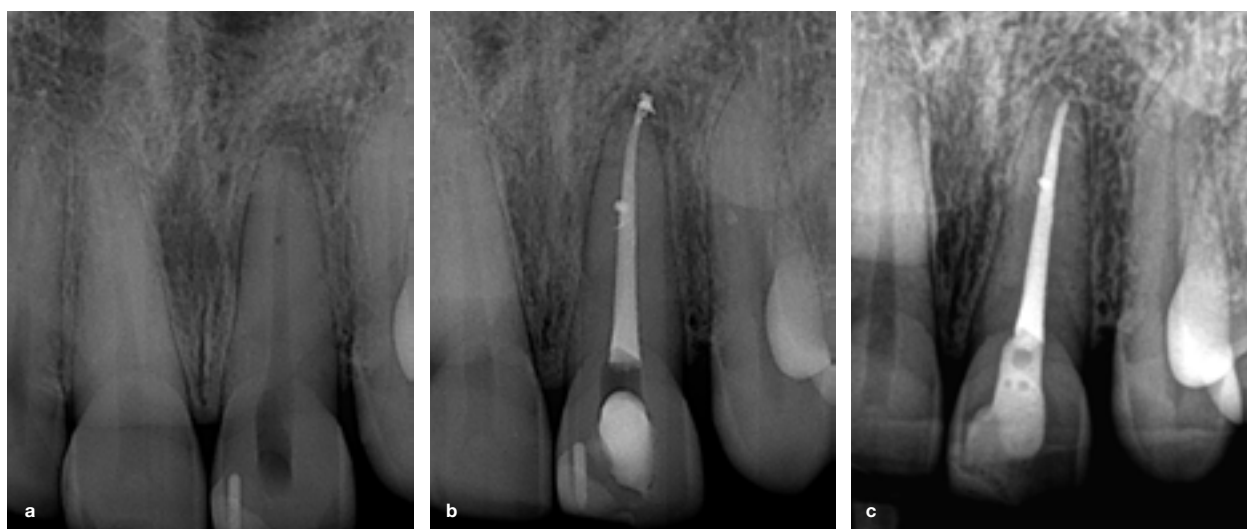
Reciprocating files are effective in removing the root canal filling material in less time compared with rotary files. These files also seem to cause fewer or an equivalent rate of dentine micro-cracks compared with rotary full-sequence systems.<sup>65</sup> A study by Alattar, Nehme and Diemer demonstrated that increasing the number of brushing strokes creates increased dentinal cutting in the direction of those strokes.<sup>66</sup>

### 2.2. WaveOne (Dentsply Sirona)

In 2011, the WaveOne NiTi files system (Dentsply Sirona) (Figure 12) was launched as a single-use single-file system to shape the root canal in a reciprocating motion. The system is constructed of M-Wire and is made up of three files. The WaveOne Primary (25/08) and WaveOne Large (40/08) files have fixed tapers of 8% from D1-D3, whereas from D4-D16, the instruments demonstrate a progressively decreasing percentage tapered design.<sup>67</sup>

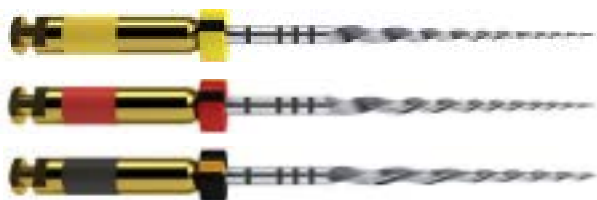
The WaveOne Primary file is used to prepare the majority of root canals with a secured glide path preparation. The WaveOne Large file is mainly indicated for larger diameter and relatively straight root canal systems.<sup>66</sup> The WaveOne Small file (21/06) has a fixed taper of 6% over its active portion and is mainly used when the Primary WaveOne file will not progress in canals with a smooth reproducible glide path. It is mainly designed to work in smaller diameter, longer length, and more apically curved root canals.<sup>67</sup>

The rationale behind the use of a single Primary WaveOne instrument (25/08) began with the assumption of Buchanan when he defined the ideal diameter for the final instrument used for curved root canals as ISO sizes 20 or 25.<sup>68</sup>



**Figure 11.** (a) Preoperative periapical radiograph; (b) Immediate postoperative result after the root canal system was obturated with size 40 GuttaCore Obturator; (c) Postoperative result at a follow up visit five years after treatment.

Each of the WaveOne instruments exhibits a modified convex triangular cross section at the tip end and a convex triangular cross section at the coronal end, which improves overall instrument flexibility. The convex triangular section is modified with a radial land at the tip and presents a cutting angle projected to the left that differentiates it from continuous rotation systems.<sup>47</sup>



**Figure 12.** WaveOne system (Dentsply Sirona).

The variable pitch flutes along the length of the instrument are said to considerably improve the safe use of these files. The WaveOne instruments are used in a modified CW/CCW movement. These instruments are used with different angles in cutting and noncutting motions in a partial reciprocation motion of 170°/50° with an average speed of 350 rpm.<sup>39</sup>

### Case report

The patient, a 40 year old female presented with a non-vital maxillary central incisor (**Figure 13a**). Root canal preparation was done with a WaveOne Large 40/08 instrument and the root canal was obturated with a size 40 GuttaCore obturator (Dentsply Sirona) (**Figure 13b**). **Figure 13c** illustrates the result at a five year follow-up visit.

### 2.3. WaveOne Gold (Dentsply Sirona)

The conventional WaveOne system was manufactured from M-Wire technology. WaveOne Gold instruments are manufactured with the use of a post-manufacturing thermal process during which a new phase-transition point between martensite and austenite is identified to produce a file with super-elastic NiTi metal properties.

This process gives the file a gold finish and improves mechanical characteristics. The properties of gold wire have been previously discussed. The WaveOne Gold Primary file is 50% more resistant to cyclic fatigue, 80% more flexible and 23% more efficient than the conventional WaveOne Primary instrument.<sup>69,70</sup>

Owing to the super-elastic properties of the new gold metal, the file may appear slightly curved when it is removed from a curved root canal because the metal demonstrates less memory compared with conventional NiTi or M-Wire (**Figure 14**).

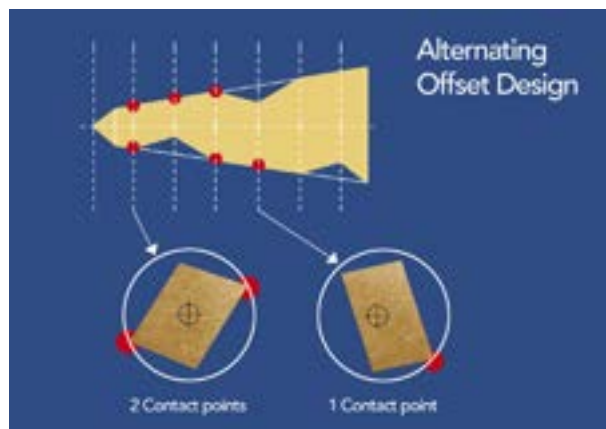
The file can either be straightened out or if it is placed back into a root canal it will follow the natural shape of



**Figure 14.** WaveOne Gold files may appear slightly curved when removed from a curved root canal because the metal demonstrates less memory.

that canal.<sup>69</sup> Another advantage of this reduced memory of the file is that in cases with difficult straightline access it is possible to slightly pre-curve the file to allow easy placement into the canal orifices.

Conventional WaveOne instruments are characterised by different cross-sectional designs over the entire length of the working part of the instruments. The WaveOne Gold file exhibits a unique alternating off-centered parallelogram-shaped cross-section design with two 85° cutting edges (**Figure 15**).<sup>69</sup>



**Figure 15.** Schematic representation illustrating the alternating off-centered parallelogram-shaped cross-section design with two 85° cutting edges. The design limits engagement between the file and dentine to only one or two points of contact at any given cross section (Adapted from Ruddle, 2016).

According to Ruddle, this design limits the engagement between the file and the dentine to only one or two contact points at any given cross section.<sup>70</sup> This reduces taper-lock and the screw-effect, improves safety, increases cutting efficiency, and provides more chip space to auger debris coronally, in comparison with its predecessor WaveOne.

The newly designed files are also manufactured with an ogival (pointed arch shape), roundly tapered and semi-active guiding tip to ensure that progress along canals is safe with a secured and confirmed reproducible glide path.<sup>69,70</sup>

The WaveOne Gold single-file reciprocating system is available in four different file tip sizes in lengths of 21 mm, 25 mm, and 31 mm:

1. **WaveOne Gold Small File** (yellow ring) (**Figure 16**) with tip of the file size ISO 20 and the first 3mm of the file (D1-D3) having a continuous taper of 7%.



**Figure 16.** WaveOne Gold Small File (20/07).

2. **WaveOne Gold Primary File** (red ring) (**Figure 17**) with tip of the file size ISO 25 and the first 3mm of the file (D1-D3) having a continuous taper of 7%.



**Figure 17.** WaveOne Gold Primary File (25/07).

3. **WaveOne Gold Medium File** (green ring) (**Figure 18**) with tip of the file ISO 35 and the first 3 mm of the file (D1-D3) having a continuous taper of 6%.



**Figure 18.** WaveOne Gold Medium File (35/06).

4. **WaveOne Gold Large File** (white ring) (**Figure 19**) with tip of the file ISO 45 and the first 3 mm of the file (D1-D3) having a continuous taper of 5%.



**Figure 19.** WaveOne Gold Large File (45/05).

From D4-D16 each file demonstrates a progressively decreasing-percentage tapered design to ensure more flexibility and to preserve more dentine in the body of the prepared root canal to ensure more conservative root canal preparations.<sup>69,70</sup>

The WaveOne GOLD files also have shortened 11 mm handles that improve straight-line access into the posterior region of the mouth. They are colour-coded (according to ISO size) with an ABS ring which expands after autoclaving to promote the philosophy of single use.<sup>69</sup>

All the above mentioned features produce a file system with improved mechanical and clinical benefits to ensure predictable root canal preparation. In the majority of cases a single file can be used to complete root canal preparation with adequate resistance form to ensure exchange of irrigation solutions for adequate disinfection prior to root canal obturation in single- or multiple-root canal systems.

According to the manufacturer, the Primary 25/07 file is usually the only file needed to fully shape almost any given canal. The semi-active guiding tip of the file is said to enable its progression along canals that have undergone glide path enlargement.<sup>70</sup>

The WaveOne Gold CCW engaging angle is 150 degrees, while the CW disengaging angle is 30 degrees. Three CCW/CW cutting cycles of the file describe one full circle of rotation. According to Ruddle there are three major clinical advantages to WaveOne Gold's unique movement:

- (1) compared with continuous rotation, there is improved safety, as the CCW engaging angle is designed to be less than the elastic limit of each file;
- (2) in contrast with equal CW/CCW angles, unequal CW/CCW angles enable a file to more readily advance toward the desired working length without the use of excessive and potentially dangerous inward pressure;
- (3) compared with equal CW/CCW angles, unequal angles strategically enhance the auguring of debris out of the canal.<sup>70</sup>

### Case report

The patient, a 37 year old female, presented with irreversible pulpitis on her mandibular right first molar (**Figure 20a**). After access cavity preparation five root canal systems were detected (mesiobuccal, mesiolingual, midmesial, distobuccal and distolingual) (**Figure 20b**).

Glide path preparation was done with a WaveOne Gold glider and root canal preparation was done with the Primary WaveOne Gold file (25/08). **Figure 20c** shows the final result after root canal obturation with WaveOne Primary Gutta Percha points and Pulp Canal Sealer, using the Calamus Dual Obturation Unit.

### 2.3. Reciproc Blue (VDW)

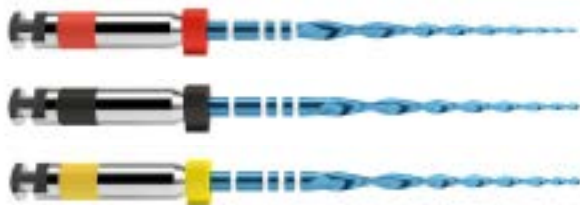
Over the last few years, Reciproc (VDW) (**Figure 21**) and WaveOne (Dentsply Sirona) have been touted as the most commercially available systems with reciprocating motion for root canal preparation. In 2011 the Reciproc System was introduced to the market by VDW (Munich, Germany) as a single-file reciprocating system. The claim was made that root canals could be completely prepared with only one Reciproc instrument.



**Figure 20.** (a) Preoperative periapical radiograph.  
(b) Magnified occlusal view of the pulp chamber.  
Note the three mesial and 2 distal root canal systems.  
(c) Postoperative result after obturation.  
Note the three mesial root canals, with the midmesial canal joining with the mesiobuccal root canal system in the apical third.



According to Bürklein et al. Reciproc allows for more rapid shaping than full-sequence rotary systems and is suitable for use in curved canals. Reciproc files have a tip diameter of 25 and a taper angle of 0.08.<sup>12</sup> The tapers are fixed 3mm from the apex of the files and decrease in the middle and coronal sections.<sup>71</sup> The Reciproc file is S-shaped with two cutting edges and its manufacture requires the use of M-Wire alloy.<sup>72</sup>



**Figure 21.** Reciproc Blue (VDW) - 25 (red), 40 (black) and 50 (yellow).

Reciproc Blue (Fig. 21), is based on its predecessor Reciproc, and was recently launched by VDW (Munich, Germany). Blue NiTi is a newly developed alloy that is obtained through a proprietary-specific oxide surface layer thermo-mechanical manufacturing process.

Like M-Wire and Gold, Blue NiTi is thermally treated NiTi designed to improve the mechanical properties of endodontic instruments such as fatigue resistance, flexibility, cutting efficiency, and canal centering ability.<sup>73,74</sup> Thermal treatment modifications, in addition to the reciprocating motion, have already been shown to extend the life span of a NiTi instrument and its resistance to fatigue in comparison with files designed for continuous rotation movement.<sup>17,54</sup>

Blue NiTi is produced after NiTi has undergone a complex heating-cooling proprietary treatment that results in a visible layer of titanium oxide in the surface of the instrument. This treatment controls the transition temperatures and creates a shape memory alloy, which is claimed by the manufacturer to result in superior mechanical properties and performance of the NiTi instruments.<sup>21,25</sup>

Reciproc Blue is available in sizes 25 (with a taper of 8%), 40 (with a taper of 6%) and 50 with a taper of 5%. A recent study compared the bending resistance and cyclic fatigue of conventional Reciproc files with that of Reciproc Blue.<sup>75</sup>

The study concluded that the Blue thermally treated NiTi files showed overall improved performances when they were compared with conventional M-Wire super-elastic NiTi. Reciproc Blue demonstrated improved flexibility, enhanced fatigue resistance and reduced micro-hardness while at the same maintaining similar characteristics of the surface.

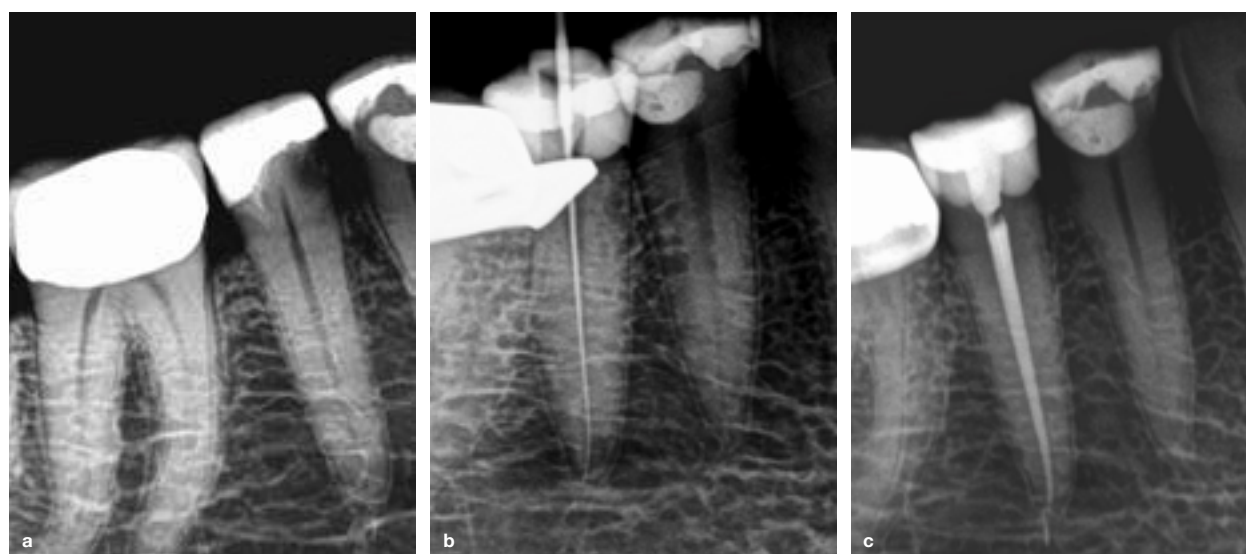
### Case report

The patient, a 47 year old male, presented with a large carious lesion on his previously restored mandibular right second premolar (Figure 22a). After caries removal, working length was determined (Figure 22b) and a glide path prepared with the R-Pilot glide path instrument (VDW) and root canal preparation was done with the 25/08 Reciproc Blue instrument. Figure 22c depicts the final result after root canal obturation.

### Conclusion

An increase in flexural strength, an increased resistance to cyclic fatigue as well as a decreased modulus of elasticity are some of the advantages of modern endodontic canal preparation systems. Single file rotary and reciprocating systems also ensure ease of use and reduced preparation time.

Selecting the appropriate canal shaping system remains case dependant and in this paper the authors illustrated some of the advantages and clinical applications of these modern endodontic canal shaping systems.



**Figure 22.** (a) Preoperative periapical radiograph. (b) Periapical radiograph confirming the working length. (c) Postoperative result after root canal obturation.



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# Cemento-osseous dysplasia: a diagnostic challenge

SADJ May 2019, Vol. 74 No. 4 p200 - p202

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## SUMMARY

Cemento-osseous dysplasia is the most common fibro-osseous lesion affecting the jaw bones. Due to the potential risk of introducing an infection, biopsy of an asymptomatic lesion is contra-indicated and it is therefore mandatory to establish an accurate diagnosis only on clinical and radiological information. In order to achieve this, a thorough knowledge of the clinical manifestations of cemento-osseous dysplasia together with the pertinent radiological features is required.

This paper is aimed at providing oral health practitioners with the diagnostic features and clinical differential diagnosis of the spectrum of lesions categorised as cemento-osseous dysplasia.

## INTRODUCTION

Cemento-osseous dysplasia (COD) is defined by the World Health Organization (WHO) as “a non-neoplastic fibro-osseous lesion of the tooth-bearing regions of the gnathic bones”.<sup>1</sup> It is generally accepted as the most common benign fibro-osseous lesion affecting the jaw bones.<sup>1,2</sup> Uncomplicated cases are asymptomatic and discovered as incidental findings on dental radiographs. In order to prevent infection of a lesion, a surgical biopsy is not advised.<sup>2</sup> It is therefore important to accurately diagnose COD by employing a non-invasive approach.

To this end a thorough knowledge of the radiological manifestations of COD and the lesions considered in its differential diagnosis is obligatory. The aim of this manuscript is to provide oral health care workers with the competency to diagnose COD and to manage the lesions appropriately.

## ACRONYMS

**COD:** Cemento-Osseous Dysplasia

**WHO:** World Health Organization

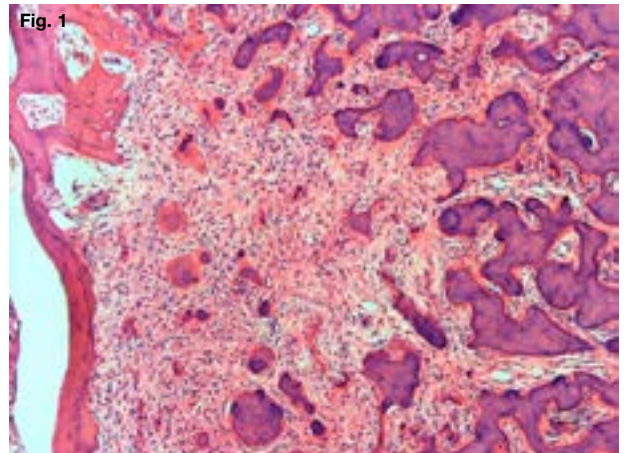
## CLINICAL MANIFESTATION

On the basis of anatomical distribution, COD's manifest with three variants: focal-, florid- and periapical types. Focal COD is a single lesion with a predilection for females and the posterior mandible,<sup>3,4</sup> florid COD manifests with lesions involving more than one jaw quadrant<sup>5,6</sup> and periapical COD is located in the periapical regions of mandibular incisor teeth.<sup>2</sup> Florid- and to a lesser extent periapical COD's have a tendency to be associated with simple bone cysts.<sup>5-7</sup> All variants are asymptomatic and although sporadic cases have been reported in Caucasians, it is middle-aged to elderly Black- and Asian females are primarily affected.<sup>8-11</sup>

The epicentre of all types is the alveolar bone close to the apices of vital teeth and uncomplicated mature lesions manifest without tooth displacement or root resorption and no- or minimal expansion.<sup>2,5</sup> Most COD's only become symptomatic when secondarily infected.

## PATHOGENESIS AND PATHOLOGY

All types of COD are characterized by mineralized tissue which, with advancing maturity, replaces the fibrous component centrifugally<sup>2</sup> (from the centre towards the periphery of the lesion) (Figure 1). All lesions mature into hypocellular, mineralized lobular masses (frequently described as a ginger root-like masses<sup>12,13</sup>) and cease to enlarge when this stage is reached.



**Figure 1.** Micrograph of a COD showing the mature central part which consists of globular calcifications (right side of image) and the peripheral zone of fibrous tissue on the left side of the image (H&E stain, X100).

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Antibiotic treatment of an infected mature COD is severely compromised by the poor blood flow through the lesion, which subsequently invariably sequesters.

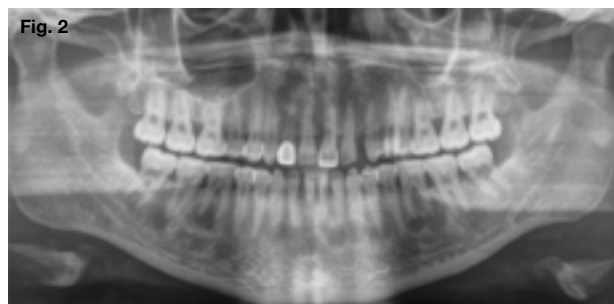
The periodontal ligament space is not involved by a COD and unlike proliferations of dental cementum, the lesion is not attached to the root surface of the associated tooth or teeth.

Several authors view the dense mineralized tissue as bone and not cementum because of the separation from the root surface and question the use of "cemento" in the terminology pertaining to the condition.<sup>7,9</sup>

The development of a simple bone cyst, which occurs more frequently in florid COD than in the other types, is due to the initiation of foci of resorption of the mineralized tissue. This results in the development of non-epithelial lined cavities which ultimately fuse, creating a large multilocular space which is visible on radiographs.

## RADIOLOGY

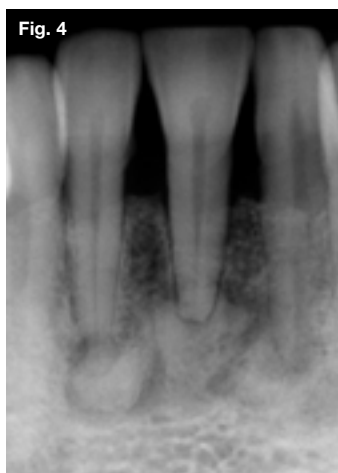
Focal-, florid and periapical osseous dysplasias (COD's) share similar radiological features and are distinguished by the location and distribution of the lesion(s). Separation of the COD from the root surface by an uninvolved periodontal ligament space can be demonstrated radiographically.



**Figure 2.** Panoramic image showing the radiolucent stage of florid COD. Note the radiolucencies in the periapical regions of several asymptomatic vital mandibular teeth.



**Figure 3.** Cropped panoramic image showing the mixed radiopaque stage of a focal COD associated with a mandibular first molar tooth. Note the central lobulated radiopacities surrounded by a radiolucent rim.



**Figure 4.** Radiopaque stage of periapical COD. Note the periapical radiopaque masses separated from the apices of vital and asymptomatic mandibular incisors by an uninvolved periodontal ligament space.

Maturation with progressive opacification from the centre outwards is a key feature which underscores the radiological diagnosis of COD. Although the process of maturation is continuous, three stages are generally agreed upon. The predominant fibrous content of the early stage manifests radiologically as well-defined oval to round periapical radiolucencies (Figure 2). The intermediate stage consists of a mixture of fibrous- and mineralized tissues and presents with a mixed radiolucent-radiopaque internal structure (Figure 3).

The characteristic central lobular radiopacities are surrounded by a radiolucent zone of varying width which corresponds to the maturity of the lesion. In the intermediate stage, the lesion is well-defined and may show a sclerotic border, which indicates reactive bone associated with the slow rate of enlargement. Mature lesions cease to enlarge and present as lobular radiopaque masses with a narrow radiolucent border (Figure 4).

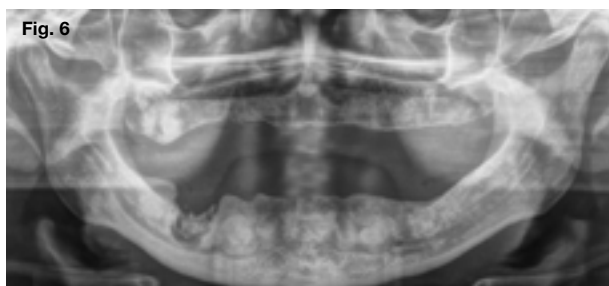
The multiple lesions of periapical- and florid COD may become confluent in all stages. Simple bone cysts manifest radiologically as uni- or multilocular radiolucencies which may cause cortical expansion (Figure 5).



**Figure 5.** Panoramic image of florid COD (mixed radiopaque stage). Note the simple bone cysts manifesting as multilocular cavities in the right mandibular premolar and molar regions.

Transition of the lobular radiopacities into sharply pointed structures indicates infection which is frequently associated with pain, sequestration, root resorption and tooth displacement.

Mature lesions which are not infected and located in edentulous areas may show migration towards the alveolar crest where they may be exposed to the oral environment and become infected (Figure 6). Although resorption of the edentulous alveolar process may contribute to the change in the relative position of the lesion, the reasons for the migration are speculative.



**Figure 6.** Panoramic image of a mature florid COD in an edentulous mandible. Note the broad radiolucent border and pointed radiopacities in the right mandibular molar area which indicate secondary infection with sequestration in contrast to the non-infected mature lesions in the left mandible which manifest as lobular radiopacities.

## DIFFERENTIAL DIAGNOSIS

The main distinguishing features of lesions and conditions which closely resemble COD on dental radiographs are reflected in Table 1.

**Table 1.** Differential diagnosis of COD.

Lesion/ condition	Main differentiating features from COD
<b>Radiolucent stage</b>	
Periapical inflammatory disease (periapical radicular cyst and granuloma) <sup>2</sup>	Always associated with a non-vital tooth, <sup>2</sup> involves the periodontal ligament, signs of external root resorption in chronic cases.
Osteoporotic bone marrow space	Vicinity of mandibular molars, one or more randomly distributed radiolucencies which fail to mature.
Multiple myeloma	Elderly patients, commonly in posterior mandible, multiple punched-out radiolucencies, monoclonal protein peak in serum.
Primary hyperparathyroidism	Multiple random skeletal radiolucencies, generalized osteopenia, usually associated with kidney disease. <sup>14</sup>
<b>Mixed radiolucent-radiopaque stage</b>	
Ossifying fibroma	Mandibular molar region, expansive growth with bowing of inferior mandibular cortex, <sup>15</sup> growth in centrifugal pattern, tooth displacement and root resorption, fails to show signs of maturation, removed with relative ease.
Focal sclerosing osteomyelitis	Associated with dental infection, irregular and ill-defined, blends into adjacent normal bone, no radiolucent border.
Diffuse chronic sclerosing osteomyelitis	Diffuse irregular mixed lesions associated with periodontal infection or infected florid COD, wider radiolucent border around radiodensities.
<b>Radiopaque stage</b>	
Enostosis	No radiolucent border, blends with the surrounding bone, outgrowth of cortical bone with thorny projections on axial CBCT projections, may present bilaterally.
Odontoma	Often prevent eruption of a tooth, radiolucent border with tooth-like structures and outer cortical border.
Root remnant	Morphology of a root.
Cementoblastoma	Mandibular molars and premolars, mineralized mass attached to root surface, round or oval, frequently pain and expansion, difficult extraction
Hypercementosis	Fusiform widening of cementum attached to root surface, difficult extraction.
Paget's disease of bone	Affects gnathial and extragnathial bones, also located below the inferior alveolar canal, cotton wool appearance, generalized hypercementosis and loss of lamina dura, elevated blood alkaline phosphatase concentrations.

## MANAGEMENT

Asymptomatic CODs which are discovered as incidental findings on radiographs require no management except for the prevention of dental infections through regular follow-up, prophylaxis and maintenance of good oral hygiene.<sup>2,16,17</sup>

Secondary infection is usually the result of periapical infective disease, extraction of an associated tooth, an open fracture or a surgical biopsy procedure and is resistant to antibiotics due to failure to achieve therapeutic concentrations in the avascular mineralized tissue of a mature lesion. All invasive surgical procedures in asymptomatic COD, including the extraction of a tooth, should be considered only if other management options have been exhausted.

The placing of an implant in a COD is contra-indicated due to the adverse infective complication which invariably leads to sequestration with implant failure. Unlike cementoblastoma and hypercementosis, where the removal of the involved tooth is complicated by the excessive dental cementum attached to the root surface, the extraction of teeth associated with COD is technically not problematic.

## CONCLUSION

The accurate diagnosis of a COD is the most important step in preventing the devastating complication of infection with sequestration of an asymptomatic lesion. This can only be achieved with an adequate knowledge of the clinical and radiological features of COD.

## Conflict of interest

The authors declared no conflict of interest.

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# What's new for the clinician?

- excerpts from and summaries  
of recently published papers

SADJ May 2019, Vol. 74 No. 4 p203 - p206

Compiled and edited by V Yengopal

## 1. The Erich arch bar versus embrasure wires for intraoperative intermaxillary fixation in mandibular fractures

AS Satpute, SA Mohiuddin, AM Doiphode, et al. Oral Maxillofac Surg. 2018; 22: 419-28.

The mandible is the largest and main bone of the lower part of the face. Anatomic parts of the mandible are the symphysis, parasymphysis, body, angle, ramus, coronoid process, condyle, and alveolus. Inherent weak sites of mandible which are liable to fracture include the angle of the mandible (especially when third molar is impacted), the socket of the canine tooth (due to long root of canine, the associated bone amount is reduced), and the condylar neck.

Maxillofacial injuries constitute one of the common and major health problems worldwide. Maxillofacial fractures are often associated with substantial morbidity, deformity, loss of function, and high treatment cost. The important factors to be considered while treating mandibular fractures are reduction, fixation, immobilization, and occlusal stability. The intermaxillary fixation (IMF) provides a stable base, from which facial form and function can be restored. However, in recent practice with the advent of open reduction and internal fixation (ORIF), the use of IMF is now limited intraoperatively.

The arch bar technique has been used since World War I. In spite of its simplicity and reliability, there are numerous problems associated with this technique such as compromised periodontal status, high needle prick injuries, and long treatment time. In 1999, Hollows and Brennan described a simple technique of IMF called "embrasure wire," which they claimed was less time consuming, had low needle prick injuries, and was cost effective. Satpute and colleagues (2018) from India reported on a trial that sought to compare the conventional Erich arch bar with embrasure wire during intraoperative IMF for ORIF in mandibular fractures under general anesthesia.

### ACRONYM

**IMF:** Intermaxillary Fixation

**ORIF:** Open Reduction and Internal Fixation

### MATERIALS & METHODS

In this prospective, comparative clinical study, 50 dentulous patients with mandibular fractures who required IMF followed by open reduction and internal fixation under general anaesthesia as a part of the treatment plan were selected.

Patients between 18 and 60 years of age with favourable/unfavourable fractures of the mandible were included in this study. Edentulous patients, patients with primary and mixed dentition, pathologic mandibular fractures, mandibular condylar fracture, maxillary fracture, pan-facial fractures, and patients with gross generalized spacing in the dentition were excluded from this study.

Patients were selected by simple randomized sampling and the sample was subsequently divided into group A and group B, each having 25 patients. Group A patients received IMF with Erich arch bars, and group B patients received IMF with embrasure wire.

Patients in Group A received the technique for IMF by using the Erich arch bar. After administration of general anesthesia, a prefabricated arch bar with hooks incorporated on the outer surface of the flat malleable stainless steel metal strip, was cut accurately to the lengths of both upper and lower dental arches.

On the upper jaw, the hooks were arranged in an upward direction and to the lower jaw in a downward direction. The arch bar was adapted to the buccal surface from 1<sup>st</sup> molar to 1<sup>st</sup> molar in both arches. It was fixed to each tooth, using prestretched 26-gauge stainless steel wire, which was passed from the mesial surface of the teeth

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to the lingual side and back to the buccal side from the distal surface of the tooth, making sure that one end of the wire passed above the arch bar and the other below it.

After this, both ends of the wire were twisted together in a clockwise manner and the arch bar was thus attached securely and firmly to the necks of each tooth on the buccal surface of the arch.

Open reduction and internal fixation were then carried out. Patients in Group B were treated by IMF by using embrasure wires. After administration of general anesthesia, the number and position of the embrasure wires to be inserted was determined according to the type and location of the fracture.

A single prestretched 20-gauge wire of 15 cm length was passed through the facial embrasure between the maxillary first molar and first premolar, and then the palatal end of the wire was looped and passed through the opposite lingual embrasure in the mandible. A similar procedure was repeated on the contralateral side to achieve intermaxillary fixation. After securing the occlusion, the ends of the wire were twisted together on the buccal surface of the lower premolar and molar teeth on both sides and intermaxillary fixation was achieved.

For removal, the embrasure wires were untwisted and cut on the facial surface, and pressure was applied on the chin to gently push the mandible away from the maxilla, creating a small gap between mandibular and maxillary dentitions. Then, the wire was displaced towards the tongue, making removal simple.

The operating surgeon and assistants were the same during the whole study. The following parameters were recorded in both the groups:

- Time was recorded in minutes from the beginning of the device fixation till the end of IMF.
- Needle stick injuries, that is, the incidence of perforations in the gloves of surgeon and the first assistant, were identified by the water inflation method of the double gloving system.
- Postoperative occlusion was recorded 24 h after the surgery, at the first month, and the third month postoperatively as a stable or unstable occlusion, based on Angles classification.
- The Oral Hygiene Index (simplified) given by Greene and Vermillion was used to evaluate the oral hygiene status of the patient after 24 h of surgery, and recorded as good, fair, or poor.
- Any iatrogenic injury such as tooth avulsion, teeth fracture, interdental papilla striping, and tooth mobility was recorded after completion of the procedure.
- In both groups, gender and age distribution were also recorded.

## RESULTS

In group A, mean age of the patients was 32.04 years in comparison with 29.88 years in group B. The mean age of male patients was 30.27 years, and that of female patients was 41.66 years. The difference between the two groups was statistically significant ( $p < 0.05$ ).

The mean age among all 50 patients was 30.96 years. Of the 50 patients, 47 were male and 3 were female. Group A had 23 males and 2 females in comparison with 24 males and 1 female in group B. The ratio of male to female patients included in this study was 9:1.

The average surgical time taken was 48.08 min for group A and 3.48 min for group B ( $p < 0.05$ ). Needle stick injuries to operator as well as to the assistants while performing IMF were found for all the 25 patients of group A and for six patients in group B. More than four needle stick injuries ( $>4$ ) while performing IMF were seen in 20 patients in group A (80%) and no patient in group B (0%), and less than four needle stick injuries ( $<4$ ) while performing IMF were seen in five patients in group A (20%) and for all 25 patients in group B (100%). This difference between the two groups was statistically significant ( $p < 0.01$ ).

Occlusion assessment was checked 24 h after surgery, first month, and at third month, postoperatively.

Postoperatively 24 h after surgery, all 25 patients had stable occlusions in group A, while 18 patients (72%) in group B had stable occlusion and seven (28%) had unstable occlusions. This difference between the two groups was statistically significant ( $p < 0.05$ ).

Postoperatively one month after surgery, all 25 patients in group A, and 19 patients (76%) in group B had stable occlusions while six patients (24%) had unstable occlusions ( $p < 0.05$ ). Postoperatively three months after surgery, all 25 patients had stable occlusions in group A, and 19 patients (76%) in group B were stable ( $p < 0.05$ ).

Oral hygiene status according to OHI-S in all patients in group A was also significantly better than patients in Group B ( $p < 0.05$ ). Iatrogenic injuries were seen in eight patients in group A (Five: interdental papilla striping, and three: grade one mobility) and two patients in group B (crown fracture, and avulsion of teeth) ( $p < 0.05$ ).

## CONCLUSIONS

The researchers concluded that the embrasure wire technique for intraoperative IMF provided an effective alternative to the traditional arch bar technique for the treatment of uncomplicated mandibular fractures.

Embrasure wires proved to be a quick, easy, and reliable technique when considered for the minimal or moderately displaced fractures of dentate region of the mandible.

### Implications for practice:

Embrasure wires have been shown to reduce operating times, needle prick injuries, periodontal trauma, and to promote oral hygiene when compared with the Erich bar technique in the dentate patient with a mandibular fracture.

## Reference

1. Satpute AS, Mohiuddin SA, Doiphode AM, et al. Comparison of Erich arch bar versus embrasure wires for intraoperative intermaxillary fixation in mandibular fractures; Oral Maxillofac Surg. 2018; 22: 419-28.

## 2. Comparative study of all-ceramic crowns obtained from conventional and digital impressions

S Berrendero, MP Salido, A Ferreira, et al. Clin Oral Invest. 2019; 23: 1745-51.

Traditional fabrication of crowns uses a multistage process which involves an indirect technique that requires an impression and subsequent laboratory completion of the restoration. CAD/CAM systems allow for the production of indirect restorations in a single visit.

CAD/CAM stands for computer-assisted design/computer-assisted manufacture. These systems use an optical camera to take a virtual impression by creating a three dimensional image which is forwarded to a software program. This impression results in a virtual cast on which the restoration is designed.

The software then controls a milling process that uses prefabricated blocks of restorative material, either ceramic reinforced composite or all-ceramic material, to produce the restoration. The end result is chairside production of the crown which is then cemented onto the tooth.

Berrendero and colleagues (2019) reported on their study that sought to compare clinical aspects like “marginal fit,” “occlusal contacts,” “interproximal contact points,” “primary retention,” and “final selection,” of 30 all-ceramic crowns fabricated from both conventional and digital impressions based on Ultrafast Optical Sectioning™ technology.

The tested null hypothesis was that no significant difference would be found in clinical aspects between crowns fabricated from both impression techniques.

### MATERIALS AND METHODS

Patients in need of a single crown in an asymptomatic posterior tooth were considered for inclusion. Of the 44 patients evaluated, 30 patients (21 females, 9 males, aged between 19 and 70 years) were included in the present study.

The exclusion criteria were advanced periodontal attachment loss, signs of bruxism, absence of adjacent or antagonist teeth to the abutment tooth, and marginal preparation located deeper than 1 mm subgingivally. Subgingival preparations were excluded due to the inability of the optical scanners to record them.

One posterior tooth was prepared for a crown restoration, and two all-ceramic crowns were fabricated for each recruited patient. One crown was made from a conventional impression technique (group C) and another from a digital impression with an intraoral scanner based on ultrafast optical sectioning technology (Trios intraoral scanner, 3Shape, Copenhagen, Denmark) (group D).

Fifteen molars and 15 premolars, 19 in the maxilla and 11 in the mandible, were treated. All patients received the same clinical protocol, carried out by the same experienced prosthodontist.

The crown margin was placed at juxta-gingival level, and in any case not exceeding a subgingival depth of 1 mm. After tooth preparation, a provisional PMMA restoration previously prepared in the laboratory from a wax-up was placed after being readapted using a temporary acrylic-based and finally bonded with a non-eugenol temporary cement (Temp-Bond).

Impressions were taken one week after tooth preparation. The sequence of the impression procedure (silicone versus digital) was randomized by an external operator using a smart phone application. Digital impressions were taken using the intraoral scanner TRIOS®, according to the manufacturer's scanning protocol.

The quadrant of the prepared tooth, the antagonist arch, and the buccal occlusal bite in maximum intercuspation were optically scanned. The captured data were checked for artifacts and were sent online by the scanner itself directly to the dental production centre.

For conventional impression, a vinyl polysiloxane (VPS) material was used in a two-step impression technique (Express 2 Penta Putty™ as tray and Express 2 Light Body™ as wash material) in a standard metallic tray. The antagonist arch impression was taken with irreversible hydrocolloid impression material.

Once removed, impressions were disinfected and poured within one hour in type IV plaster. The conventional models were mounted in a semi-adjustable, Arcon type articulator. The upper model was positioned by means of the associated facebow, and all the lower models were mounted in maximum intercuspitation.

The restorations in both groups were all designed and fabricated at the same dental laboratory by the same dental technician.

The clinical evaluation of the crowns was performed through a double-blind study design. The two crowns to be evaluated were presented in two identical white boxes marked with the letter A or B according to a random assignation reflected in an Excel sheet. Only the studio controller knew which box corresponded in each case to the digital or conventional crown. Two external operators evaluated the all-ceramic crowns, without any communication between them.

Four items were assessed:

(1) Marginal fit was checked around the entire preparation perimeter, using probes with defined tip diameters of 150 µm to clinically examine the gap size before cementation; (2) Occlusal contacts were verified with 8 µm articulating paper; (3) Interproximal contact points were verified with waxed dental floss; and (4) Primary retention was verified with tactile sensation, assuming the presence of passive fit.

The examiners were calibrated for the assessment of the clinical parameters. Operators checked each variable evaluating its behaviour as eligible, not eligible or indistinct for every crown, and filling in a data sheet.

Then, considering all the variables in total, they had to select which of the two crowns digital or conventional had the best clinical conditions (final selection). All information was registered on a data sheet.

## RESULTS

Sixty all-ceramic crowns in 30 patients were evaluated in the present study. The number of times that each operator selected each type of crown for each variable is shown in the Table below

For the items marginal fit and interproximal contact points, moderate agreement between the two operators was described, and significant differences were found between two study groups.

Although significant differences were described for the variables primary retention and occlusal contacts, the agreement between the operators was fair, and these results were not consistent.

The results for the final selection (clinical selection) obtained a substantial agreement between the two operators, and Pearson's chi-square test showed significant differences between two study groups.

## CONCLUSIONS

The researchers concluded that clinically, the digital crowns were statistically superior at the interproximal contact points and the marginal fit. For the variables occlusal contacts and primary retention, no differences were found between the two groups.

In most of cases and in a significant way, both evaluators concluded that the digital crowns produced better clinical conditions.

## Implications for practice

The use of digital technology and the recently updated software and equipment now available, together with the cost and time savings, support a growing view that the digital option offers superior performance over conventional methods still in use.

## Reference

1. Berrendero S, Salido MP, Ferreiroa A. et al. Comparative study of all-ceramic crowns obtained from conventional and digital impressions: clinical findings. Clin Oral Invest. 2019; 23: 1745-51.

Item/Situation	Operator	Group D [digital]	Group C [conventional]	Indistinct	Kappa test	p value
Marginal fit	1	15	12	3	0.58	0.000
	2	18	10	2		
Occlusal contacts	1	14	10	6	0.34	0.001
	2	9	3	18		
Interproximal contact points	1	12	9	9	0.54	0.000
	2	14	6	10		
Primary retention	1	9	9	11	0.34	0.008
	2	7	9	14		
Clinical selection	1	18	12	-	0.63	0.000
	2	18	12	-		

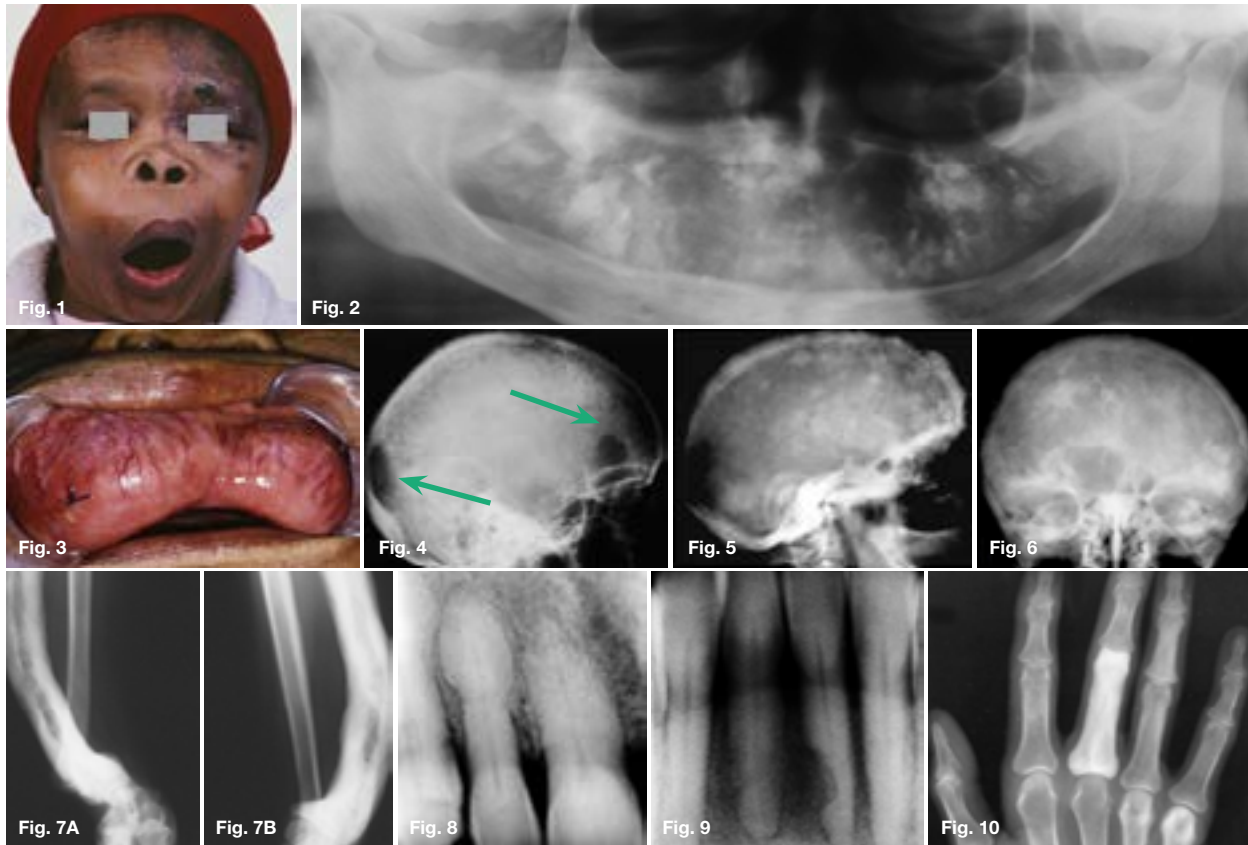


# Maxillofacial Radiology 170

SADJ May 2019, Vol. 74 No. 4 p207

CJ Nortjé

Below are pictures and radiographs of various stages of a chronic, progressive disease of bone diagnosed in elderly patients leading to sclerosis and expansion of the affected bones. What are the most important clinical and radiological features and what is your diagnosis?



## INTERPRETATION

Figures 1, 2, & 3 show a mixed radiolucent/opaque lesion affecting the maxilla, crossing the midline in an edentulous patient, causing flattening of the palate. A lateral skull radiograph of another patient (Fig. 4) shows osteoporosis imperfecta in the posterior and anterior parts of the skull (green arrows) along with thickening of the calvarium and cranial vault which are cardinal radiological signs of the condition. Figures 5 & 6 illustrate "cotton wool" radio-opacities in the skull and the base of the skull shows dense sclerosis. All the images mentioned so far are typical features of Paget's disease. Sir James Paget, surgeon and pathologist who is best remembered for naming Paget's disease. The disease is idiopathic and can be divided into three stages: initial bone resorptive phase, vascular phase with osteoblastic repair, and appositional/sclerosing phase. The jaws are involved in approximately one in five cases, with the maxilla being affected about twice as frequently as the mandible. During the initial phase of bone resorption, the affected bones may be deformed or painful, particularly the weight-bearing structures such as the long bones of the legs (Fig. 7A & B). Later the affected bones expand, commonly in the max-

illa, mandible or cranium. At this stage, the dental patient who wears full dentures may complain that the fit of the dentures is becoming progressively poorer. When the maxilla is affected, the alveolar ridge widens and the palatal vault can flatten (Fig. 2). When teeth are present, they may become increasingly spaced, with extensive jaw enlargement. Neurologic complaints can result from increased deposition of bone in the areas of the foramina of the skull causing headaches, auditory disorders progressing to deafness, visual disorders progressing to blindness, facial paresis, and vertigo. The bones are relatively brittle; hence, fractures are likely. Generalised radiolucency/osteoporosis intermediate stage with mixed radiolucency/radiopacity, "driven snow" coarse trabeculation, "cotton wool" radio-opacities in the final stage (Figs. 5 & 6). Hypercementosis, loss of lamina dura, obliteration of the periodontal ligament spaces (Fig. 8) and external root resorption (Fig. 9) may also be present. The upper hand wrist radiograph (Fig. 10) of another patient shows the disease affecting the phalanx of the third digit.

## Reference

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# Justice and oral health - implications for reform: Part Two

SADJ May 2019, Vol. 74 No. 4 p208 - p211

PD Motloba<sup>1</sup>, NL Makwakwa<sup>2</sup>, LM Machete<sup>3</sup>

## INTRODUCTION

Part One of the series (April SADJ) provided a comprehensive overview of Justice.<sup>1</sup> Part Two provides the application of these theories to oral health. In the first paper the evolution of Justice is traced back to Ancient Greece, through the testimony of Plato and Aristotle.<sup>2,3</sup> Their view of Justice was influenced by the occurrences in the Republic. The interaction and interpretation of politics, law, God and Man in this society shaped the ancient notion of Justice.

These philosophers assert that a just society ought to "treat equals equally and unequals unequally".<sup>3,4</sup> This is characterised by a lawful and fair state, with retributive (restorative) and distributive capacity. For Plato and Aristotle, Justice was necessary for a stable and thriving society. The Aristotelian egalitarian view of Justice was furthered by Christian medieval philosophers. Augustine and Aquinas held that God's law provided a blueprint for a just society.<sup>5-7</sup> Hence their contention to treat all mankind equally is as intended by God.

Modern philosophers like Kant, Bentham and Mill represent a radical deviation from Christian and egalitarian views of Justice.<sup>8-11</sup> Kantian deontology grounds Justice in the freedom or autonomy of moral agents, and the need to respect others to live their lives as they wish. Kant advocated for this moral imperative to be made universal law.

A diametrically contradictory view of Justice is proclaimed by Bentham and Hill. These consequentialists argue that an act is only Just when based on its utility or outcomes, hence their maxim 'greatest happiness for the greatest number'.

The contemporary interpretation of Justice to society and health is credited to Rawls and Daniels. According to

## ACRONYMS

<b>NHI:</b>	National Health Insurance
<b>NOHD:</b>	National Oral Health Directorate
<b>UHC:</b>	Universal Health Coverage

Rawls,<sup>8,12</sup> a Just society which all would be part of is supported by the following Rawlsian fair principles:

(i) Equality of liberties, or freedom of choice, (ii) equality of opportunity, through the creation of a functional universal healthcare service and (iii) creation of a safety net, such as free health care services for the indigent. Daniels applied Rawls' aspiration of a just society to health, indicating the importance of it as a means to ensure equal and fair opportunities "...for all to realise their maximum species - typical level of functioning".

The proverbial battleground of Justice represents a fierce contestation of moral viewpoints, without clear winners. Yet, winner(s) must emerge among the contenders to the applause of spectators. In case of oral health, this paper critiques the moral stance of the State, and the progress towards a just health service. Additionally, specific proposals are suggested on how to reform oral health in the country.

## State of Oral Health Services in South Africa

Access to oral health services in South Africa is generally poor and inequitable. The two tier health care system is characterised by a costly and exclusive private sector, which offers limited choice to consumers and providers, with questionable oral health outcomes. The public sector remains under-resourced, overburdened and unable to meet the needs of South Africans. This dual funding of oral health reveals fundamental deficiencies and there are dire consequences of these two streams.

The private oral health service is experiencing a decline in insurance subscriptions, resulting in the reduction in the benefits packages of the patients.<sup>13</sup> The limited private dental cover has caused patients to seek dental care in the public sector when the funds run out. This form of "patient dumping" is indicative of financial inequality and related health consequences. Until a uniform framework is developed oral health services will remain segregated.

Equally, the apportionment of public funding for oral health has dwindled over time.<sup>14</sup> Additionally, misappropriation of oral health allocations is prevalent at all levels of public service delivery. Anecdotes reveal that oral health is comparatively least prioritised amongst other health services. As a consequence, the limited and or

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ring-fenced oral health resources are often redirected to “more deserving programs”. Hence the failure (inability) of the oral health service to provide critical package of care to citizens.

At the organisational level, the National Oral Health Service is dysfunctional. Structurally, strategically and operationally, the office is obscure and inconsequential. The national coordinating office, viz. the National Oral Health Directorate (NOHD) has been repurposed and hollowed out and rendered obsolete.

Currently, the NOHD lacks the personnel and capacity to guide and lead a National Oral Health Service. By implication, this means that numerous national opportunities to reform and direct the national oral health agenda have been missed. Expectedly, the country lacks a coherent national oral health policy, strategy and structures to achieve the vision of “oral health for all”. It is evident that national oral health structures operate asynchronously in the delivery of these critical oral health services. For instance, the Human Resources for Oral Health policy,<sup>15</sup> and water fluoridation<sup>16</sup> have not been implemented to date.

The National Oral Health Service is presently facing serious staffing challenges. The State has failed to enforce this critical human resources policy. Similarly, the universities have not transformed with regard to the training (production) of critical oral health personnel. Likewise, the services are unable to attract, deploy and retain the oral health professionals post-qualification or after community service. The unemployment rates are further compounded by high barriers which limit entry to private practice whilst the public sector is fully subscribed. These challenges have deepened the disproportional distribution of the oral health workforce away from the rural areas. The obvious consequences of these structural failures are poor service delivery and deterioration of the National Oral Health Service.

Meanwhile, the oral health disparities among South African are widening. These inequalities are fuelled by stark variations in socioeconomic resources, location, social position, discrimination and marginalisation.<sup>17-19</sup>

The oral health service is unable to respond to the definitional principle of access to care. These include acceptability, accessibility, adequate, appropriate and availability of services. South Africans are exposed to symptomatic and emergency dental care, mainly dental extractions.

Restorative and rehabilitative services are infrequent, expensive or non-existent in most public facilities. The lack of these specialist services is indicative of the disparities by location, cost, and operation times. Health promotion and preventative services are in disarray and ineffective for impact. Overall, oral health services are beyond the reach of most South Africans.

This evidence points to an oral health system that is inaccessible, inequitable, discriminatory, unjust and unfair for the majority of South Africans. Hence a case for urgent reform of the oral health system.

## Towards Oral Health Reform in South Africa

The following questions arise about the oral health service in South Africa:

1. What would be considered a just oral health system in South Africa? That is what stance or position or stature is held by the State, society and other role players about oral health. In other words how is the oral health service perceived, prioritised and compared with other health services.
2. What type and nature (structure and design) of oral health care system would be commensurate with a just service? A response to this question should provide information about the structural and strategic position of the sectors to deliver a just oral health service.
3. What existing or aspirational policies and principles would be supportive of a just oral health system?
4. What philosophy underpins the allocation of resources for oral health (equality, equity, need, liberty or free market)?
5. What operational and governance processes would ensure the delivery of a just health care system?

## Framework and Guidelines for a Just Oral Health System

The discussion of the framework and guidelines provides the perspective and outline for the critique of Oral Health Service. The argument is premised on the notion that a health system represents an interaction of interconnected building blocks to achieve a specific purpose,<sup>20,21</sup> and that for a health system to functioning well, it will typically comprise the following structures:

- 1). Leadership and Governance, through which policy setting, regulation and oversight can be exercised over all other components.
- 2). Inputs factors including, financing, information systems, human resources, technologies and service delivery.
- 3). Outputs and outcomes such as access, health status and quality of life.<sup>22</sup>

These functions and attributes of a health system, its structures and operations should be aligned to ensure the delivery of the desired health service. Any failure in a single or several of these components would invariably render the delivery of health service unachievable.

However, these building blocks are necessary but not sufficient to deliver a just oral health system for all. As highlighted by Buchanan<sup>23</sup> and Benatar in their seminal works, several key elements ought to be considered in developing a just health care system:

## Universal Health Coverage (UHC)

This health system's objective is underpinned by a moral and legal obligation to ensure that all members of the community have universal access to a defined package of care.<sup>24</sup>

Implementing UHC is agreeable to several forms of Justice. For example, UHC appeals to equality be-

cause at the very least all citizens have access to a minimum package of care.<sup>25</sup> Similarly, this package satisfies the consequentialist doctrine of utility, by increasing access to the greatest number of patients. However, the limitation of the defined package is that it may not accommodate extraneous needs, and may limit freedom to choose.

Therefore, this proposal is contrary to the Kantian deontological view and the Libertarian assertion of freedom of choice. To mitigate this shortcoming, it has been suggested that this minimum package of care should be comprehensive and include promotive, preventive, curative, rehabilitative and palliative services.

Providing a comprehensive service builds some level of choice and alternative intervention, and in so doing the libertarian conception of Justice is satisfied, as well as an accommodation of varieties of needs.

This notion of decent (quality) minimum care implies that this level of care prescribed benefit is less than the best available, yet sufficiently acceptable to all. The health care services should be effective to ensure quality health outcomes. This will safeguard users from enduring additional burden, specifically financial liability.

#### **Capacities towards a just health care system**

It is evident that the chasm between the private and public health sectors represents a major threat to achieving equitable access to care. Hence the need for the State to deploy its resources to regulate and coordinate activities across these sectors.

Strategies like the National Health Insurance (NHI) could be used to purchase services from the private sectors, thereby increasing access. Change in the work ethic of public bureaucrat and public support for the project ought to be galvanised for a just health care system. Similarly, the professional altruism and duty should be stimulated in favour of common good.

Reforms towards a just health system will face huge impediments and resistance from professionals and business. A similar resolve and tenacity is necessary in oral health care system for the future generation. Operationally, the present delivery machinery should be re-engineered to incorporate efficiency and accountability.

Wastage should be minimised, while safe and effective quality care is provided as and when is necessary. Meaningful thrusts towards a just health system will not be achieved without deliberate investment in appropriate infrastructure; health information system; development, human resource and other building blocks. Entrenchment of culture of public service, accountability and productivity is equally essential.

#### **Continuity and coordination of services**

The oral health services should be organised in order to ensure uninterrupted continuity of care to patients. To achieve this objective, services should be coordinated based on the levels of care, across networks, according to types of care and providers, involving all related sectors and throughout life.

#### **Proposal for Oral Health Reforms in South Africa**

The following activities constitute an attempt to progressively reform the ailing oral health service in South Africa.

1. Reform in oral health requires a major paradigm shift, by the State and by all stakeholders. That is, the recognition that oral health is an essential contributor to overall health, and is therefore worthy of serious investment. A positive view on oral health will harness political and strategic alliances, galvanise the necessary resources and propel oral health to a visibly recognisable position.
2. Adoption of a singular and dominant funding structure for oral health, for example the NHI.
3. Leadership and governance – creation of an integrated national, provincial and district oral health service.
4. The organisational structure for the delivery of oral health should be efficient and permit a development and seamless devolvement of national strategy to provinces, regions and local services.
5. Investment in infrastructure and technology in the Oral Sustainable and appropriate training and deployment of oral health professionals.
6. Gradual expansion of the existing public health services, until the whole population is covered.
7. Ensuring unrestricted access to a comprehensive list of emergency care by citizens.
8. Progressive introduction of restorative and rehabilitative services.
9. Strengthening of health promotion and preventive oral health services.

## **CONCLUSION**

The path towards a transformed and just oral health service in South Africa is long and arduous. The journey is rewarding and necessary, but the means towards this objective are not guaranteed and require resolve and persistence.

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# CPD questionnaire

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## GENERAL

### Parental participation in the mitigation of adolescents' unhealthy behaviour of excessive consumption of free sugars: a qualitative study

1. The amount and not the frequency of consumption of free sugars found in table sugar, confectionery, soft drinks, biscuits, honey, cakes, sweets, chocolate and fruit juice is more strongly associated with the rate of caries formation and periodontal diseases.  
A. True  
B. False
2. It has been suggested that the brushing of teeth immediately after eating sugary foods may not adequately prevent the harmful effects, but rather it is better to brush before a sugary meal or snack as this helps to remove plaque, reducing the bacteria population and hence the quantity of acid produced. This is because plaque bacteria will start producing acid as soon as fermentable sugar enters the mouth.  
A. True  
B. False
3. Parents should not substitute fruit juice for solid or whole fruits because solid or whole fruits not only contain less sugars (approximately 35% less sugar), but the intracellular sugars in them are healthier than the extracellular sugars produced when cell membranes rupture during the juicing process. Solid or whole fruits also provide a lot more nutrition and fibres that are usually lost in the juicing process.  
A. True  
B. False

### Root canal preparation: a literature review and clinical case reports of available materials and techniques

4. Which of the following is a single-file root canal preparation system?  
A. BioRace (FKG Dentaire)  
B. ProTaper Gold (Dentsply Sirona)  
C. Reciproc Blue (VDW)  
D. ProTaper Next (Dentsply Sirona)
5. Which of the following systems has a swaggering motion aiding in debris removal during endodontic canal preparation?  
A. ProTaper Next (Dentsply Sirona)  
B. BioRace (FKG)  
C. WaveOne Gold (Dentsply Sirona)  
D. Reciproc Blue (VDW)

6. NiTi reciprocating glide path enlargement files have the following advantage(s) compared with other glide path preparation systems.  
A. Increased preparation times  
B. Decreased cyclic fatigue resistance  
C. Fewer file separations/deformations  
D. All of the above

### Cemento-osseous dysplasia: a diagnostic challenge

7. Identify the INCORRECT statement.  
In the case of a mature cemento-osseous dysplasia a surgical biopsy is NOT advised because:  
A. there is a danger of infection  
B. the poor blood supply reduces efficacy of antibiotic treatment  
C. the infected lesion then metastasizes  
D. the infected lesion then sequesters
8. Identify the INCORRECT statement.  
A florid cemento-osseous dysplasia:  
A. involves more than one jaw quadrant  
B. is associated with a carious tooth  
C. has a tendency to be associated with simple bone cysts  
D. is asymptomatic
9. Identify the INCORRECT statement.  
The intermediate stage of a cemento-osseous dysplasia:  
A. shows no growth  
B. consists of a mixture of fibrous- and mineralized tissues  
C. presents with a mixed radiolucent-radiopaque internal structure  
D. presents with radiolucent zones of varying width surrounding the lobular radiopacities

### Oral health related knowledge, attitudes and practices of adult patients in Mangaung Metropolitan Municipality

10. The knowledge component in this study comprised intention and actual behavioural control.  
A. True  
B. False
11. The results of behavioural beliefs in the reported study contradicted the Theory of Planned Behaviour.  
A. True  
B. False
12. According to the Theory of Planned Behaviour, behaviour is primarily determined by a patient's:  
A. attitude towards the behaviour  
B. perceived control over behaviour  
C. intention to perform the behaviour

### Dental characteristics among recipients of school oral health programmes in Tshwane

13. What was the caries prevalence in the primary dentition of the study population?  
A. 30,2%  
B. 25,9%  
C. 35,8%  
D. 39,2%
14. The Significant Caries Index (SiC index) was of concern among the study population.  
A. True  
B. False

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

15. In the Satpute et al. trial, the average surgical time for IMF using the arch bar was significantly greater than when doing IMF using the wire.  
A. True  
B. False
16. In the Satpute et al. trial, patients who received the arch bar had similar oral hygiene status when compared with patients who had received IMF via the embrasure wire.  
A. True  
B. False
17. In the Berrendero et al. study, the digital crowns were found to be statistically superior at the interproximal contact points and the marginal fit when compared with conventional crowns.  
A. True  
B. False
18. In the Berrendero et al. study, the digital crowns were found to be inferior to conventional crowns for the variables occlusal contacts and primary retention.  
A. True  
B. False

### Maxillofacial and oral radiology

19. In the presence of Paget's disease the teeth may become increasingly spaced.  
A. True  
B. False
20. Cotton wool radiopacities in the skull are normally present in the final stages of Paget's disease.  
A. True  
B. False

### ETHICS

21. The Christian medieval philosophers' view of Justice was further clarified by Aristotelian egalitarian concepts.  
A. True  
B. False
22. Justice according to Kant is synonymous with respecting the need of people to live their lives as they wish, with freedom or autonomy of moral agents.  
A. True  
B. False
23. Inequalities in the South African health systems are further fuelled by minor disparities in socioeconomic resources, location, social position, discrimination and marginalisation.  
A. True  
B. False
24. Identify the CORRECT answer.  
A well-functioning health system will typically comprise the following structures:  
A. Leadership and Governance, through which policy setting, regulation and oversight can be exercised over all other components  
B. Input factors including, financing, information systems, human resources, technologies and service delivery  
C. Inputs such as access, health status and quality of life  
D. a and b are correct
25. Identify the INCORRECT statement.  
The following activities constitute an attempt to progressively reform the ailing oral health service in South Africa:  
A. Investment in infrastructure and technology in the oral health service  
B. Sustainable and appropriate training and deployment of oral health professionals  
C. Gradual expansion of the existing public health services, until the whole population is covered  
D. Sustaining the two tier health care system which is characterised by an affordable and inclusive private sector  
E. Ensuring unrestricted access to a comprehensive list of emergency care by citizens

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  - ♦ 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 or 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](mailto:abayman@sada.co.za)



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\*GfK New expert performance tracking 2018.

For any product safety issues, please contact GSK on +27 11 745 6001 or 0800 118 274.

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