THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

JUNE 2022
Volume 77 Number 5

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

SADA
THE SOUTH AFRICAN
DENTAL ASSOCIATION

Lake Sibaya

"An estimated 7,750 hectares of Lake Sibaya is the largest lake of its kind and is listed as an internationally important Ramsar wetland. The presence of sea canyons and estuary fauna relics on the shores of Lake Shibaya suggests that the lake was once connected to the sea by a large river. Its pristine, clear waters, bordered by pure white sand, are fully fed by the runoff of tall, overgrown dunes that reach 165 meters. There are no rivers flowing in or out of Lake Sibaya"

HELPS **REBUILD** AND **STRENGTHEN ACID DAMAGED ENAMEL**

No.1 **DENTIST RECOMMENDED BRAND** FOR SENSITIVE TEETH*

SENSODYNE PRONAMEL

Specialised Enamel Protection
Rebuilds, Restores, Refreshes

*Expert Performance Tracking 2020

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ

Published by:
A Division of:
Pharmcom CC - CK 2002/097498/23
On behalf of:
SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

CONTENTS

Our Front Cover for this Issue...

Lake Sibaya

"An estimated 7,750 hectares of Lake Sibaya is the largest lake of its kind and is listed as an internationally important Ramsar wetland. The presence of sea canyons and estuary fauna relics on the shores of Lake Shibaya suggests that the lake was once connected to the sea by a large river. Its pristine, clear waters, bordered by pure white sand, are fully fed by the runoff of tall, overgrown dunes that reach 165 meters. There are no rivers flowing in or out of Lake Sibaya"

THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

PRODUCTION OFFICE

Pharmcom CC - CK 2002/09/498/23
Electronic Doctor (E-Doc),
a Division of Pharmcom CC

Tel: +27 (0)10 020 1013
Physical Address: 91 Opaal Rd,
Lyttelton Manor X 03, Pretoria, 0157
Postal Address: P.O. Box 37545,
Faerie Glen, Pretoria, 0043
Website: www.edoc.co.za

Publisher and Project manager

Mr René Smulders

GENERAL AND ADVERTISING ENQUIRIES

Mr René Smulders

Email: rene@edoc.co.za

Design and Layout

Mrs Melani de Beer

Email: production@edoc.co.za

Website smalls advertising / CPD Enquiries and Member contact detail update

South African Dental Association

Tel: +27 (0)11 484 5288

Email: info@sada.co.za

Published by:

A Division of:

Pharmcom CC - CK 2002/097498/23

On behalf of:

SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

CONTENTS

Accredited by the Department of Education

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

Should we be concerned about deskilling in dentistry?

SADJ June 2022, Vol. 77 No. 5 p255

Prof NH Wood - ***MDent, PhD***

In many industries, workers are often confronted with deskilling due to the sustained development and implementation of technological advances. In many industries this holds economic benefits that may include the increase speed in which activities are performed, or a substantial increase in productivity and output. The same can hold true for Dentistry. However, must the inevitable deskilling necessarily be viewed in a negative light? Do all practitioners still require some skills that are comfortably managed through automation or through some form of new technology? There are of course also the views that deskilling could be a threat to dentistry, resulting from perpetuating possible educational shortcomings; and also in the scenario where dentists are placed in rural areas for community service without any facilities or support to uphold specific clinical skill or competency levels.

In the case where important skills are lost or have been eroded, a dentist would have to reskill. Reskilling differs from upskilling in which the latter involves investing in the skillset of a particular area of practice. Upskilling does not involve the loss of capacity or potential but is rather about helping clinicians upgrade their existing roles to perform better and more efficient tasks, whereas reskilling is about preparing them to fulfill existing roles and functions appropriately and efficiently. Losing, or phasing out skills that are considered superfluous, archaic, or purely of historical value can be seen as a necessary function in the evolution of clinical care in dentistry. A balance is achieved in that new skills are developed and honed during competency training, and hopefully maintained in practice. This goes hand-in-hand with the development and evolution of dentistry itself.

Practitioners are not relegated to a "would you rather" scenario just because technology is advancing and many manual tasks are becoming automated or facilitated in some way or another by these technical advances. Instead, I believe it provides an opportunity for the clinician to advance even further in diagnostics and planning, and more specific and individualized provision of care, but also in developing the beauty and the artistry that is such a definite component of dentistry. The clean-up of the skillset of the dentist could be viewed positively to shift from a curative care approach to preventive care, but at the same time allow for upskilling into advanced areas of service delivery and care. It does raise the obvious question concerning the crossing into the arena of specialist-care from general dental practice, and it is perhaps time for stakeholders to assess this situation in the context of the advancements in dentistry. It would also be proactive of our training institutions to look at specific niche areas where reskilling of competencies might be needed.

With the relief of the upliftment of all lockdown restrictions we will see an increase in on-site visits and treatment delivery. Let us remain vigilant and continue will all infection control and other safety measure put in place in the preceding years. We herewith present the June issue of the SADJ and trust that you will enjoy the diversity of content herein.

Your participation into our cover pages

SADA wishes to extend its heartfelt gratitude to you for your continued contributions to the journal and to research in the oral health space. Your contributions have helped the journal to be competitive with other scientific journals globally.

In the spirit of broader inclusivity we would like to invite authors to provide us with suggestions for the cover page content of the SADJ. This should be all encompassing and not limited in appeal to a single grouping. We hope that these contributions will better our journal in line with our main objectives.

We look forward to receiving meaningful contributions from our membership, and thank you for your continued support and participation.

Warm regards,
Prof NH Wood – Managing Editor
Dr N Metsing – Head: Professional Development SADA

Preparedness for Disaster Management and Emergencies

SADJ June 2022, Vol. 77 No. 5 p256

Dr Nthabiseng Metsing, Head: Professional Development, SADA

South Africa faces an ever-increasing level of disaster risk. The country is exposed to a wide range of adverse weather patterns, which include famine, tempests and severe flooding that can initiate widespread destitution and destruction. In addition, South Africa's general coastline and immediacy to shipping routes present a number of marine and coastal threats. Similarly, the shared boundaries with six southern African neighbouring countries present bothordinary and human-induced cross-country risks, and benevolent assistance obligations during emergency and disaster situations.

In addition to these natural and human-induced threats and despite ongoing progress to extend essential services to the needy urban and far-flung communities, the country has huge numbers of people who live in conditions of serious propensity to disasters in underserviced, environmentally fragile or peripheral areas where they are faced with the possibility of recurrent natural and other threats that range from drought to repeated informal settlement fires. (South African Goevernment, 2005)

State of Disaster due to the Covid-19 Pandemic

In 2020 the Minister of Cooperative Governance and Traditional Affairs Dr Nkosazana Dlamini Zuma declared a state of disaster in the country after considering the magnitude and severity of the COVID -19 outbreak. At that time Covid-19 had been declared a global pandemic by the World Health Organisation (WHO). The state of disaster is designated under Section 3 of the Disaster Management Act, 2002 (Act No. 57 of 2002 (Government, 2020)). This declaration empowered government with the ability to take measures in preventing more people from becoming severely ill and preventing loss of lives.

Although the pandemic has not ended 750 days after the country been placed in the state of disaster, the president of Mr Cyril Matamela Ramaphosa on 04 April 2022 lifted the state of disaster with certain limitations. This was to allow growth of the economy and for jobs to be created in order to allow the country to somehow regain what it had lost during the hard lockdown. Members of the public are still compelled to wear masks in indoor spaces and to sanitise regularly to prevent the spread of Covid-19.

KZN State of disaster due to floods

While the country was anticipating a steady recovery from the covid-19 pandemic, some parts especially in KZN were hit by heavy rainfalls that led to severe flooding. These floods resulted in many people losing their lives and many more going missing.

Survivors and victims told the president and his delegation heart-breaking stories about how children, parents, siblings and neighbours being swept away as their homes crumbled under the pressure of the flood waters. (Government, 2022). This has led to the province being placed in a state of disaster by the president.

The events that have taken place around the country over the past couple of years have really shown the importance of emergency readiness whether as a country or individually as a citizen as well as in one's personal space. The association sympathises with all members who have suffered loss of any kind during these difficulties.

Preparedness for disasters has also been shown to be an important component for workplaces as much as it is for countries because they also have a direct impact on the day-to-day activities in businesses and eventually affects the recovery post the disaster.

It is also important for businesses to have an emergency plan which should include:

1. Assessing local capacity
2. Planning
3. Capability maintenance
    - Training
    - Rehearsal
4. Disaster risk reduction (Lee, n.d.)

We are certainly wish that the country is not plunged into another disaster however are hoping that our members and society are ready in the unfortunate event that it does happen. Our thoughts are with everyone who has to deal with the results of all the events.

REFERENCES

1. Government, S. A., 2020. Goverment Gazette. [Online] Available at: https://www.gov.za/sites/default/files/gcis_document/202003/43096gon313.pdf [Accessed 20 April 2022].
2. Government, S. A., 2022. www.gov.za. [Online] Available at: https://www.gov.za/speeches/president-cyril-ramaphosa-declaration-national-state-disaster-respond-widespread-flooding. [Accessed 20 April 2022].
3. Lee, D. A., n.d. Emergency Preparedness. Cheffield: Peoples University. South African Goevernment, 2005. SA National Disaster Framework, Pretoria: Government printers.

SADA

DENTAL & ORAL HEALTH CONGRESS AND EXHIBITION

26-28 AUGUST 2022 | Emperors Palace Convention Centre, Johannesburg

A whole new world

All 11 key oral health societies and groups are actively participating at this Congress - SAAPD, YDC, SAAAD, SAAO, OHASA, DAASA, SADTA, DTASA, SASPIO, SASO, SASMFOS and APSA

We have something for everyone...

3 FULL DAYS WITH

5 STREAMS AND **50** SPEAKERS

VDDI
Dental Solutions.
German Manufacturers.

Register today:
www.sadacongress.co.za and earn CEU's
Call +27 11 484 5288 for assistance to register or email
events@sada.co.za

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a1

Buccal corridor changes in orthodontically treated extraction and non-extraction Class 1 patients

SADJ June 2022, Vol. 77 No. 5 p258- p263

NM Choma[1], TK Madiba[2], PMS Sethusa[3]

ABSTRACT

BACKGROUND
Patients seek orthodontic treatment mainly to improve their facial aesthetics and obtain an acceptable smile. It is purported that orthodontic extraction treatment may result in narrow buccal corridors which in turn may lead to unaesthetic smile.

AIM
To determine if the dimensions of the buccal corridors are influenced by extraction or non-extraction treatment in Class 1 patients.

DESIGN
Retrospective record-based study conducted between 2012 and 2017 at University of Pretoria Orthodontic department.

MATERIALS AND METHOD
Smile pictures of pre- and post-treatment Class 1 patients treated with or without premolar extractions were matched. Buccal corridors between the two groups were measured by measurement of visible maxillary dentition and oral aperture dimensions. Data analysis included frequencies and correlations using chi-square test, with a significance level set at $p<0.05$.

RESULTS
Seventy-one patient records met the selection criteria with the majority being females (70%). The age range was between 10 and 37 with a mean of 17.5 years. Thirty-five patients were treated with extractions and thirty-six patients with non-extraction treatment. There was a significant difference in the visible maxillary dentition pre and post treatment with extraction patients showing a 6 to 6 and non-extraction showing 5 to 5 dentition post treatment ($p<0.05$). There were no differences in the ratios of the visible maxillary dentition and oral aperture in both groups pre and post treatment ($p> 0.05$).

CONCLUSION
Orthodontic treatment of Class 1 cases with premolar extraction did not lead to deleterious changes in the buccal corridors.

Keywords: Buccal corridors changes, extraction, non-extraction, visible maxillary dentition, oral aperture

Author affiliations:
1. Dr Ntwampe M Choma: *BChD, MChD* (Orthodontics) Department of Orthodontics, School of Dentistry, University of Pretoria, Pretoria, South Africa. ORCID: 0000-0002-2819-6346
2. Prof Thomas K Madiba: *B.Dent Ther, BDS, DHSM, MChD* (Community Dentistry), Department of Community Dentistry, School of Dentistry, University of Pretoria, Pretoria, South Africa. ORCID:0000-0002-0171-0595
3. Prof Peter MS Sethusa: *B Rad, BDS, M Dent* (Orthodontics), Department of Orthodontics, School of Oral Sciences, Sefako Makgatho Health Science university, Pretoria, South Africa. ORCID: 0000-0002-0884-3008

Corresponding author:
Prof TK Madiba
Email: thommy.madiba@gmail.com
Tel: (012) 319-2417
Cell: 0845036175

Author contributions:
1. Dr Ntwampe M Choma: 40%;
2. Prof Thomas K Madiba: 35%,
3. Prof Peter MS Sethusa 25%,

INTRODUCTION
Patients increasingly seek orthodontic treatment to improve their aesthetics and create a beautiful smile. Goldstein stated that second to the eyes, a smile rates as the most important feature of facial attractiveness.[1] Patients with different personality traits ranging from very shy to very confident, introverts to extroverts, prioritized an attractive smile at the top of their list with regards to their aesthetic requirements. The amount of teeth that show when an individual smile as well as other characteristics such as the buccal corridors are deemed important.[2]

The term "buccal corridor" was added to the dental terminology list by specialists in the discipline of prosthodontics in the late 1950's who described it as the space revealed between buccal surfaces of posterior teeth and commissures of the lips when the patient is smiling.[3, 4] When arranging teeth of removable prostheses, clinicians aimed to recreate a natural appearance by incorporating the buccal corridors. In an ideal smile, bilateral buccal corridors should be evident separating the teeth from the commissures of the mouth. This space is said to be altered by transverse narrowing of the maxilla, palatal inclination of the posterior maxillary teeth, the degree of smile arch, vertical facial pattern, antero-posterior positioning of the maxilla, and extraction and non-extraction orthodontic treatment[3]. The influence of the buccal corridor on smile aesthetics has been described by some researchers as having no influence,[5, 6] while other investigators believe that the absence of buccal corridors gives the patient an unnatural "denture" appearance.[7] On the other hand, prosthodontists aim to recreate a natural dental presentation when setting denture teeth and deemed a molar-to-molar smile (which eliminated the buccal corridors) a characteristic of a poorly

constructed denture.[7] It has been postulated that the eye is able to detect subtle variations in a smile, even when those variations are seen in the context of the entire face. The presence of broad smile fullness (minimal buccal corridors) was consistently judged by lay persons to be more attractive than narrower smile fullness (larger buccal corridors). Observational studies looking at the acceptability threshold for the size of the buccal corridor across different ethnic groups have also been carried out. The threshold is measured as a percentage measure of the visible maxillary dentition width against the oral aperture width. Results revealed that thresholds from as little as 10% to as much as 40% were deemed acceptable aesthetically.[8]

The Inclination of teeth is one of the six keys described by Lawrence Andrews in 1927 to be important in occlusion.[9] Inclination of the canines, the first premolars and the second premolars have an impact on the size of the buccal corridors and the attractiveness of the smile. When treating patients with a skeletal transverse discrepancy, a trade-off may be necessitated between occlusal function and smile aesthetic. This is due to the fact that varying the bucco-lingual inclination of teeth could affect both the functional occlusal contact and the attractiveness of the smile.[10]

Normal values proposed by Andrew for canines, first premolars and second premolars were -7°, -7° and -7° respectively. Laypersons observing the effect of bucco-lingual inclinations of maxillary canines and premolars on perceived smile attractiveness, preferred frontal smiles with the canines and premolars positioned at inclinations varying from 3° to 10° whereas orthodontists preferred smiles showing canine inclination of 0° - 10° and -3° to -11° for premolars. Within this range, changes in inclination were considered not immediately likely to affect smile aesthetically.[10]

Features that have been postulated to impact the size of the buccal corridors include: arch form and size, degree of smile arch, antero-posterior position of the maxilla in relation to the mandible, transverse dimension of the maxilla and the extraction of premolars.[11] Some authors are of the opinion that extraction treatment results in narrower dental arches which, in turn, are associated with a less aesthetic smile on account of the dentition being less full during a smile.[12] In addition, this arch width reduction creates unaesthetic spaces lateral to the buccal segments. In a study done to compare arch width changes and smile aesthetics in patients treated with and without extractions, it was concluded that constricted arch widths were not a usual outcome of extraction treatment.[13] Another finding of this study was that neither extraction nor non-extraction treatment had a preferential effect on smile aesthetics. The mean aesthetic score between the extraction and non-extraction groups were the same. Most subjects displayed ten teeth, second largest group displayed eight teeth (33 percent) and the least group displayed twelve teeth (17 percent), and all these were equally distributed between the extraction and non-extraction group.[13]

An average smile in untreated individuals displays teeth from incisors to premolars and the aesthetic value of such a smile was reviewed by Dong and colleagues in prosthodontic patients where they found that most patients (57%) displayed teeth up to the second premolar. The subjects who displayed teeth up to the second premolar had the highest aesthetic score of all the groups.[14] In extraction treatment the closure of extraction spaces often results in mesial movement of premolars and molars to a narrower part of the arch. The latter implies that the depth (antero-posterior dimension) of the dentition decreases in extraction treatment and leads to premolars and molars emerging into the displayed smile. The anterior segments of both arches (maxilla and mandible) represented by the inter-canine widths remain the same before and after treatment in both extraction and non-extraction groups.[15]

In previous studies done that have focused on the aesthetic rating of the buccal corridor, it has been highlighted that patients prefer to have some degree of the buccal corridor evident.[16] This factor may have an impact on the choice of treatment when considering whether to extract teeth or not. Generally, both patients and orthodontists find smiles with small and medium sized buccal corridors (0-10%) more aesthetic than those with large buccal corridors,[16, 17] with minor asymmetry in size of the corridors not having much effect on their aesthetic rating. This study aimed to investigate how the buccal corridors are affected by the extraction protocol versus non-extraction protocol in skeletal Class I patients. The results of this study may be a helpful tool in deciding which treatment protocol to follow to improve the final aesthetic result.

MATERIALS AND METHODS

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Health Sciences, University of Pretoria (Ref: 51/2018). No personal details of the patients were disclosed, and all information was strictly confidential and anonymous. A retrospective record-based study with data extracted from patients treated in the Department of Orthodontics at University of Pretoria was conducted. The study evaluated pre-treatment and post-treatment photographs of extraction and non-extraction patients of Class I patients. All subjects had been treated with maxillary and mandibular contemporary fixed appliances, with the aim in each case to provide an ideal interdigitating occlusion as suggested by Lawrence Andrews.[8] Instructions given to the patients upon taking the photos were to give “a natural and unstrained smile showing teeth”. Smile photos were taken in the same clinical ward against a white background using a Canon EOS 1200D camera with a macro lens (or equivalent) and a ring flash light.

Class 1 patients under the age of 40 years who were treated with fixed comprehensive orthodontic appliance were drawn from a list in the Dolphin tracing program used by the department of Orthodontics for patients treated between 2012 to 2017. Patients older than 40 years of age, or treated with functional appliances and who were Class 11 and 111 were excluded from the study. Measurements of the oral aperture were made from the labial commissure of one side to the other and of the visible maxillary dentition from the last visible tooth on the one side to the other. These measurements were represented as a percentage ratio for pre-treatment smile and post treatment smile of each patient. Measurements were made directly on the photographs displayed on the computer screen using a measuring software (Ruler by Maokun software). The method used in this study was initially used in a study by Martin et al., and eliminates the

Figure 1. Illustration of the pre-treatment and post-treatment measurements on frontal smile photographs.

problem of pictures not taken from the same distance away from the patient.[18]

A comparison of the size of buccal corridors between the two groups of patients (extraction patients and non-extraction patients) were then analysed. The measurement of the buccal corridor sizes was represented as a ratio between visible maxillary dentition and oral aperture width:

$$R = \frac{\text{Visible maxillary dentition X 100\%}}{\text{Oral aperture width}}$$

The photographs were selected alphabetically and divided into two groups:

- Group 1 (pre-treatment and post treatment smile photos treated with extractions)
- Group 2 (pre-treatment and post-treatment smile photos treated with non-extractions)

These initial diagnostic pictures were paired with the final pictures at the end of treatment

Data was analysed with SPSS software (version 25; IBM, Somers, NY). Descriptive statistics were calculated for all raw demographic and photographic measurements. Mean pre-treatment and post treatment values and changes (pre-treatment against post-treatment) were calculated for each dependant variable (photographic measurements). The main analyses were based on the change scores (pre-treatment versus post-treatment) as the set of dependent variables and treatment group as the main factor (non-extraction versus extraction) of interest. Chi square test was used to evaluate the association between variables. The level of significance was set at $p< 0.05$. The missing data was omitted during data analysis.

RESULTS

From a total of 871 patient records collected from 2012 to 2017 on the Dolphin program, only seventy-one records were found to meet the inclusion criteria. Most patients were female 50 (70%) and 21 (30%) were male with the ages ranging from 10 to 37 years and a mean of 17.5 years.

Thirty-five (49%) patients were treated with extractions of premolars of which twenty-seven (77%) were females and seven (23%) were males. Of the thirty-five patients treated with extractions twelve of them were older than 18 years. Thirty-six (51%) patients were treated with non-extraction of premolars and the majority were females 23 (64%)) with the rest being males 14(36%). Just over half of the patients were therefore non extraction cases.

The results for extraction cases show that post treatment the smiles showing up to canines only were in the minority with only 3 subjects. Smiles which showed up to the first molars (six to six in Table 1) were more than those showing up to the premolars. This result indicates that there was an addition of visible teeth posteriorly during smiling (Table 1).

In the non-extraction patient's pre-treatment smiles showing teeth up to the first molar were in the minority with 5 patients. The majority of patients had smiles showing up to the second premolars. Smiles showing up to the first premolars decreased from pre-treatment to post-treatment. Smiles displaying up to the second premolars increased from pre-treatment to post-treatment (Table 1).

Table 2 and 3 tabulate the changes in the ratios pre-treatment and post-treatment of the extraction and non-extraction groups respectively. In the extraction group, the results indicate that there was a slight decrease in the

Table 1: Visible dentition change in extraction and non-extraction patients n= 71

		Pre-treatment	Post-treatment
VD Extraction group (n= 35)	Three to three (canine – canine)	5	3
	Four to four (1st prem – 1st prem)	15	6
	Five to five (2nd prem – 2nd prem)	10	10
	Six to six (1st molar – 1st molar)	5	16
VD Non-extraction group (n=36)	Three to three (canine – canine)	5	0
	Four to four (1st prem – 1st prem)	19	13
	Five to five (2nd prem – 2nd prem)	10	18
	Six to six (1st molar – 1st molar)	2	5

Table 2: Comparison of the ratios (Buccal corridor) in the extraction group n=35

	Smile feature	n	Min	Max	Mean	Std. dev
Pre-treatment Extraction	Oral aperture (mm)	35	3.1	11.0	5.849	1.6283
	Visible maxillary dentition (mm)	35	2.3	10.4	4.685	1.4075
	Ratio	35	52.27%	135.48%	80.2610%	9.85578%
Post-treatment Extraction	Oral aperture (mm)	35	3.0	9.6	5.713	1.4928
	Visible maxillary dentition (mm)	35	2.1	7.7	4.515	1.2627
	Ratio	35	60.38%	92.73%	78.8979%	6.01670%

Table 3: Comparison of the ratios (Buccal corridor) in non-extraction group n= 36

	Smile feature	n	Min	Max	Mean	Std. dev
Pre-treatment Non-Extraction	Oral aperture (mm)	36	4.1	11	6.12	4.879
	Visible maxillary dentition (mm)	36	2.3	10.4	4.905	5.727
	Ratio	36	52.27	95.92	79.97	30.865
Post-treatment non-Extraction	Oral aperture (mm)	36	3.7	9.6	6.043	4.171
	Visible maxillary dentition (mm)	36	2.8	7.7	4.881	3.464
	Ratio	36	70.59%	92.73%	80.78%	15.655%

Table 4: Association between treatment type and smile width pre- and post-treatment n=71

		Extraction (n=35)	Non-extraction (n=36)	P-value
Pre-treatment	Three to three	5	5	0.000
	Four to four	15	19	
	Five to five	10	10	
	Six to six	5	2	
Post treatment	Three to three	3	0	0.000
	Four to four	6	13	
	Five to five	10	18	
	Six to six	16	5	

mean ratio (R) which represents a decrease in the buccal corridor size from pre-treatment to post-treatment (Table 2). In the non-extraction group, the mean ratio remained the same from pre-treatment to post-treatment. See Table 3.

There was a statistically significant difference between treatment type and the smile width pre- and post-treatment (Table 4). The extraction group had 15 patients displaying a smile up to the premolars (Four to four). The non-extraction group had 19 patients with a dentition displaying up to the first premolars. This shows a statistically significant difference in the dentition display between extraction and non-extraction groups $p< 0.05$. There were no smiles in the non-extraction group displaying a three-to-three dentition.

There was also a statistically significant difference between dentition display of six-to-six in extraction and non-extraction. Interestingly, there was a statistically significant association found between the treatment type and the smile width post-treatment. Majority of patients treated with non-extraction displayed a smile up to the second premolars. In the extraction group the majority of patients displayed a smile up to the first molars, followed by those with smiles up to the premolars. When an association was made between the buccal corridor of the visible maxillary dentition and the oral aperture in the extraction and non -extraction cases there was found to be no difference $p>0.005$

DISCUSSION

This study's results demonstrated an increase in the number of teeth displayed post-treatment. The number of patients displaying dentition up to first molars in extraction patients were equal to those displaying teeth up to the first premolars. These results correlate with those found by Kim in 2003[11] where they demonstrated subjects displaying ten teeth being the majority group at 50%. They further explained that there was an equal distribution of these types of smiles between extraction and non-extraction groups. Johnston in 1993 investigated the outcomes of premolar extraction in extraction and non-extraction patients on a long-term basis and one of their findings was that in non-extraction treatment, the upper buccal segments were commonly distalized whereas in extraction treatment the upper buccal segments tended to come forward.[16] The results of this study differ to that of Kim because there were more smiles from the non-extraction group displaying dentition up to the second premolar.[11]

Interestingly, this study found no dentitions displaying a canine-to-canine type of smile in the non-extraction group, and only one patient displaying a first premolar to first premolar dentition in the extraction group, and more subjects in the extraction group displaying dentition of up to first molars. This observation could be explained in terms of the type of mechanics employed in closing the extraction spaces in the institution, which is reciprocal space closure which is prone to show dentition up to the first molars as compared to controlled space closure which is more likely to show dentition up to premolars. In light of the mechanics of closing spaces, it can be deduced that the shape of the arch is not necessarily changed by the technique of space closure. Consequently, this implies

that the size of the buccal corridors cannot be altered by extraction or non-extraction treatment as confirmed by Cakan and colleagues.[16]

In this study the buccal corridors represented as a ratio (R) in the extraction group of patients showed a slight decrease from pre-treatment to post-treatment. In the non-extraction group of patients, the mean ratio remained the same from pre-treatment to post-treatment. The results of this study are similar to those found by Meyer and colleagues where they found no significant differences between any pre-treatment and post-treatment measurements of the buccal corridors between the extraction and non-extraction groups.[17]

This study demonstrated an association between treatment type and smile width post-treatment. In patients treated with extractions the majority of patients displayed a smile up to the first permanent maxillary molars, followed by those with a smile up to the premolars. In patients treated with non-extractions the majority displayed a smile up to the second premolars, followed by those with a smile up to first premolars. This study results are similar to those found by Dong and colleagues.[12] Johnson and Smith explained these treatment changes as first molars moving mesially into extraction spaces and emerging into the visible frame of the smile.[18]

There has been a difference in opinion regarding the aesthetic value of buccal corridors. Some hold the opinion that they have no aesthetic value while others believe there is some aesthetic value to buccal corridors.[19] Wylie emphasized that the goal of orthodontic treatment should be to attain the best possible aesthetic result, both facially and dentally.[20] There is the assertion that extraction treatment is inadvertently going to result in constriction of the dental arches, larger buccal corridors and poor aesthetic results.[18] Supporters of non-extraction therapy argue that four premolar extraction results in narrowing of the dental arches with subsequent large and un-aesthetic buccal corridors.[11, 19]

This study aimed to investigate the changes on the buccal corridors effected by orthodontic extraction and non-extraction treatment in skeletal class I patients. The significance of observing this parameter was to investigate if the buccal corridors have an implication on the aesthetic outcome of orthodontic treatment.

CONCLUSIONS

Within the limitations of this study the following can be concluded:

- Most patients were treated with non-extractions, of which the majority were female
- There was a significant increase in the visible maxillary dentition in both extraction and non-extraction groups after treatment
- There were no significant changes in the buccal corridors pre- and post-treatment in extraction and non-extraction patients.
- There was a significant association between the treatment type and the smile width post-treatment.

Limitations of the study

The sample size was not large enough to be able to make more general conclusion results.

There was no record to determine which pattern of extractions was employed in each case in the extraction group. This may shed some light on the type of space closure mechanics used which ultimately would explain the final visible maxillary dentition achieved.

Recommendations

A similar follow-up study including the investigation of the association between extraction patterns and visible maxillary dentition post-treatment on a larger sample is recommended. The study will also have to take into consideration the advances that have taken place with technology which includes advances in photography and cameras and the need for patients to look beautiful like well-known models

REFERENCES

1. Goldstein R. Study of the need for easthetics in dentistry. J Prost Dent. 1969;21(6):589 - 98.
2. Abu Alhaija ESJ, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. Eur J Orthod. 2011;33(4):450-6
3. Sharma PK, Sharma P. Dental Smile Esthetics: The Assessment and Creation of the Ideal Smile. Semin Orthod. 2012;18(3):193-201.
4. Frush JP, Fisher RD. The dynesthetic interpretation of the dentogenic concept. J Prosthet Dent. 1958;8(4):558-8.
5. Hulsey CM. An esthetic evaluation of lip-teeth relationships present in the smile. Am J Orthod. 1970;57(2):132-44.
6. Roden-Johnson Dustin, Gallerano Ronald, Jeryl E. The effects of buccal corridor spaces and arch form on smile esthetics. Am J Orthod Dentofacial Orthop. 2005;127(3):343-50
7. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: part 2. smile analysis and treatment strategies. Am J Orthod Dentofacial Orthop. 2003;124(2):116-27.
8. Andrews LF. The six keys to normal occlusion. Am J Orthod Dentofacial Orthop. 1972;62(3):296-309.
9. Xu H, Han X, Wang Y, Shu R, Jing Y, Tian Y, et al. Effect of buccolingual inclinations of maxillary canines and premolars on perceived smile attractiveness. Am J Orthod Dentofacial Orthop. 2015;147(2):182-9.
10. Meyer AH, Woods MG, Manton DJ. Maxillary arch width and buccal corridor changes with orthodontic treatment. Part 2: attractiveness of the frontal facial smile in extraction and nonextraction outcomes. American journal of orthodontics and dentofacial orthopedics : official publication of the AAO, its constituent societies, and the ABO. 2014;145(3):296-30.
11. Kim E, Gianelly AA. Extraction vs Nonextraction-Arch Widths and Smile Esthetics. Angle Orthod. 2003;73(4):354-8.
12. Dong JK, Jin TH, Cho HW, Oh SC. The esthetics of the smile: a review of some recent studies. Int J

Prosthodont. 1999;12(1):9-19.
13. Luppanapornlarp S, Johnston LE Jr. The Effects of Premolar-extraction: A Long-term Comparison of Outcomes in “Clear-cut” Extraction and Non-extraction Class II Patients. The Angle Orthod. 1993;63(4):257-72
14. Nascimento DC, Santos ÊRd, Machado AWL, Bittencourt MAV. Influence of buccal corridor dimension on smile esthetics. Dental Press J Orthod. 2012;17(5):145-50
15. Martin AJ, Buschang PH, Boley JC, Taylor RW, McKinney TW. The impact of buccal corridors on smile attractiveness. Eur J Orthod. 2007;29(5):530-7..
16. Germec-Cakan D, Taner TU, Akan S. Arch-width and perimeter changes in patients with borderline Class I malocclusion treated with extractions or without extractions with air-rotor stripping. Am J Orthod Dentofacial Orthop. 2010;137(6):734-5..
17. Meyer AH, Woods MG, Manton DJ. Maxillary arch width and buccal corridor changes with orthodontic treatment. Part 1: Differences between premolar extraction and nonextraction treatment outcomes. Am J Orthod Dentofacial Orthop. 2014;145(2):207-16
18. Johnson DK, Smith RJ. Smile estheties after orthodontic treatment with and without extraction of four first premolars. Am J Orthod Dentofacial Orthop. 1995;108(2):162-7..
19. Moore T, Southard KA, Casko JS, Qian F, Southard TE. Buccal corridors and smile esthetics. Am J Orthod Dentofacial Orthop. 2005;127(2):208-13.
20. Wylie W. The Mandibular Incisor: Its Role in Facial Aesthetics. Angle Orthod. 1955;25(1) :32-41: 32-41.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a2

The accessibility to oral health services in Lesotho's public health sector

SADJ June 2022, Vol. 77 No. 5 p264- p269

M Mokhethi[1], CME McCrindle [2]

ABSTRACT

INTRODUCTION
Lesotho is a land-locked mountainous country in Southern Africa. Both geography and poverty impact on dental health in low-income patients. Information on the number and function of dentists and dental therapists in public hospitals, are lacking.

AIMS AND OBJECTIVES
The aim was to investigate accessibility to oral health services. Objectives were to investigate the number and geographical distribution of oral health personnel and document the availability of dental services in Lesotho.

DESIGN
A cross-sectional mixed methods study design was used.

METHODS
Four dental therapists of the six employed by the government, participated in in-depth interviews. Questionnaires about access to oral health services were administered to government employed dentists. The Lesotho National Department of Oral Health provided information regarding dental patient statistics between 2017 and 2019.

RESULTS AND CONCLUSIONS
It was found that 20 dentists and 10 dental therapists provided limited dental services in public facilities. In 2017, 2018 and 2019; the annual numbers of dental patients were 85 776, 75 148 and 97 425 respectively. Approximately 40% of patients visited two hospitals in Maseru. It was concluded that there was a shortage of oral health personnel, resulting in inadequate access to dental services, particularly in rural areas.

Keywords
Lesotho, Southern Africa, Oral Health, Dentist, Dental Therapist, Public Health

Author affiliations:
1. Maluke Mokhethi: School of Health Systems and Public Health, Faculty of Health Sciences, University of Pretoria, South Africa; ORCID: 0000-0001-9744-6321
2. Cheryl M E McCrindle: (Prof) School of Health Systems and Public Health; Faculty of Health Sciences, University of Pretoria, South Africa; ORCID: 0000-0002-4756-8969

Corresponding author: Cheryl M E McCrindle
Faculty of Health Sciences, University of Pretoria, South Africa;
Tel: 27 12 356 3272;
Email: cheryl.mccrindle@up.ac.za. / cheryl.mccrindle@gmail.com

Author contributions:
1. Maluke Mokhethi: 60%
2. Cheryl M E McCrindle: 40%

INTRODUCTION
The small mountain kingdom of Lesotho is entirely landlocked by the Republic of South Africa. It was founded in the early 19th century by King Moshoeshoe I and today functions as a constitutional monarchy with King Letsie III serving as the ceremonial head of state1. Since obtaining its independence from Great Britain in 1966, the country has seen episodic bouts of political instability. It has undergone three coups d'état in the years 1978, 1986 and 1994.[1] In 2014, the country survived another attempted coup d'état.[2] More recently, Lesotho has had three elections in a 5-year period (2012, 2015 and 2017), with no one party winning an outright majority, so the past three governments have been coalition governments.[3] From May 2020, the ruling coalition government was replaced by a different coalition, following the resignation of the Prime Minister making it a fourth different government in a nine -year period with elections set for 2022.[3]

According to the Lesotho Bureau of Statistics, as of 2016, the population is just over 2 million people.[4] The National Dental Database, on the other hand, includes only 30 dentists[5], which means that there is one dentist for every 66 666 people. In the neighbouring country, South Africa, the ratio is considerably more favourable at 1:8900.[6] By comparison, the dentist to patient ratio in developed countries is 1 dentist for every 2000 people.[7] The actual picture in Lesotho is much grimmer, as some of these dentists work as educators at the National Health Training College, while others are in managerial, non-clinical roles. In addition, all those private dental practices registered with the Lesotho Medical Dental and Pharmacy Council are located within a 10 km radius of one another in the capital city, Maseru. This means that the rural population in Lesotho is reliant on only 22 practising dentists; all of whom are employed directly or indirectly by the government.[5] A map of this mountain kingdom indicates the inaccessibility of the rural population and this is exacerbated in winter, when many villages are snowbound (https://www.worldometers.info/img/maps_c/LT-map.gif).

Approximately 70% of the population resides in rural areas[4], while all the dentists and other oral health personnel are stationed in the more urban areas, which poses the problem of patients having to move vast distances to access a treatment centre. The Lesotho Bureau of Statistics estimates that only 31.7 percent of the population live in urban areas; while 62.9 percent of urbanites reside in the capital, Maseru.[4] This shortage of oral health personnel, coupled with the unequal distribution of the few dental personnel, has created a crisis that needs to be addressed urgently to meet the dental needs of the Basotho people, particularly those living in rural areas.

Previous studies have indicated that tooth loss was more prevalent in individuals of lower social classes and this

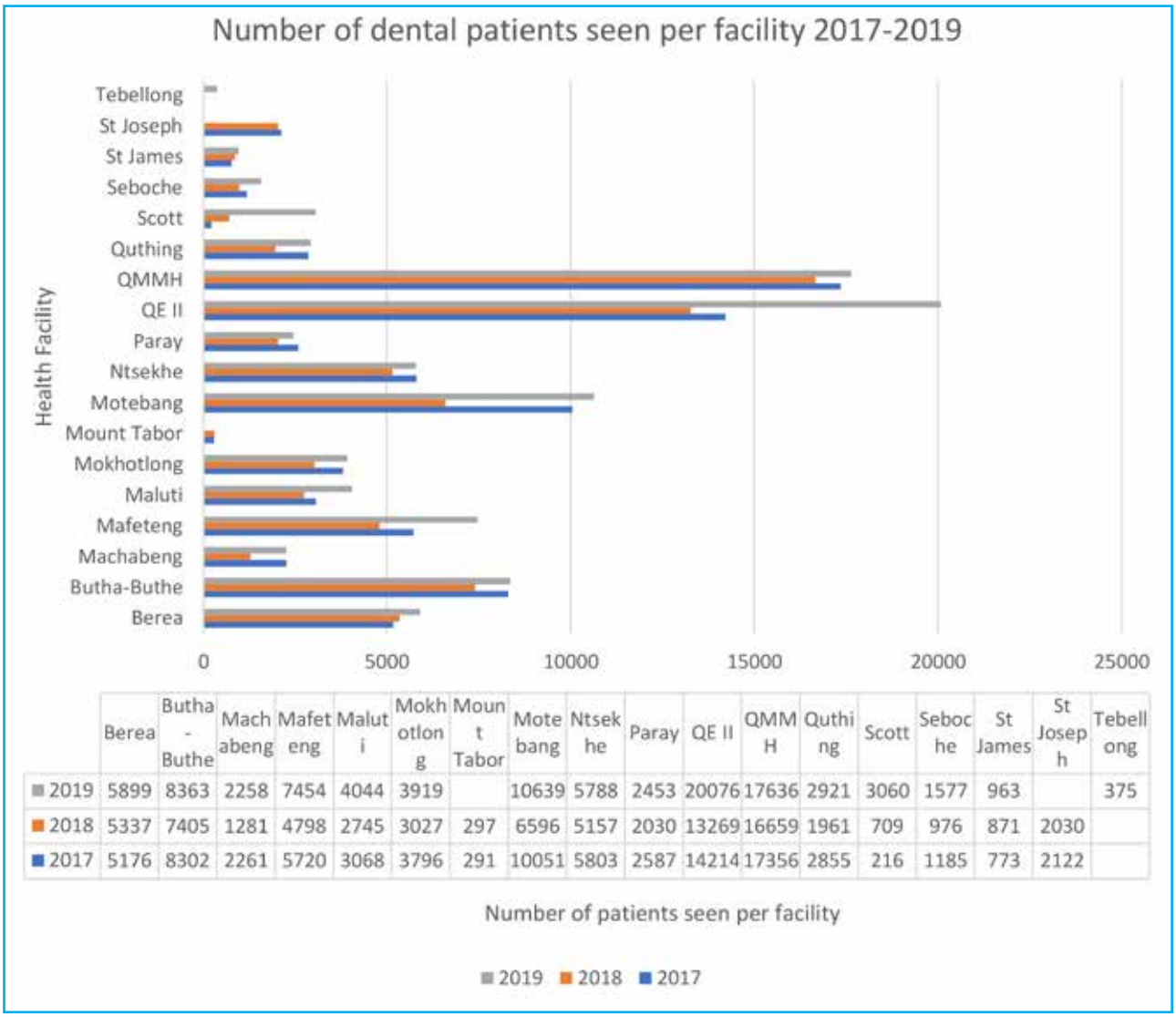
pattern has persisted over a long period of time.[8-9] In Lesotho, individuals who have a tertiary education have been shown to have a greater knowledge about oral health than those without a university qualification[10]; and are likelier to retain their natural teeth for longer.

Oral health is an important indicator of overall well-being and should begiven more attention.[11] Dental caries in permanent teeth, has been estimated as the most common disease globally; affecting an average of 2.44 billion people in 2016.[12] This is half a billion more people than the next most common disease, which is latent tuberculosis infection. Overall, the combination of diseases affecting the oral cavity, which range from dental caries, periodontitis and head and neck cancer; affect a staggering 3.58 billion people worldwide[12], which was about half of the world's population in 2016.

Periodontitis, the second most common oral disease12 is also a major source of discomfort, pain and tooth loss. It not only affects the oral cavity, but is also linked with a number systemic complications.[13] Periodontitis, like Type 2 diabetes mellitus, has chronic inflammation as the underlying pathophysiological mechanism; and studies have shown that the effective management of periodontitis plays a significant role in glycaemic control.[14-16] Five percent of all the dental patients who were seen over the past year in Lesotho had some form of periodontal disease as their presenting complaint and dental extraction was also a common procedure.[17]

In Lesotho, it is common practise for dental assistants to carry out some of the clinical work and they all receive appropriate in service training for this.[18] Lesotho also employs dental therapists to complement the oral health workforce.[19] This practice is in line with several other Commonwealth countries.[20] The literature reports that 33 members (Lesotho not included) of the 55 Commonwealth countries employ dental therapists.[20] Dental therapists provide basic to intermediate level dental care at some hospitals and health centres in Lesotho.[21] Studies in the UK reported that only 10% of the general population were familiar with dental therapists as distinct dental professionals, but none of them could correctly identify any of the procedures that fall within the scope of the dental therapist.[22] Dental therapists have been practising in the UK since July 2002[23] .However, anecdotal reports in Lesotho suggest that they have been employed by the government since 1996.[24] In the neighbouring country, South Africa, the need for mid-level dental workers in the

Figure 1.A retrospective analysis of the National dental patient records was done to determine the total number of dental patients seen per facility for 3 years between 2017 and 2019



	Berea	Butha - Buthe	Machabeng	Mafeteng	Maluti	Mokhotlong	Mount Tabor	Motebang	Ntsekhe	Paray	QE II	QMMH	Quthing	Scott	Seboche	St James	St Joseph	Tebellong
2019	5899	8363	2258	7454	4044	3919		10639	5788	2453	20076	17636	2921	3060	1577	963		375
2018	5337	7405	1281	4798	2745	3027	297	6596	5157	2030	13269	16659	1961	709	976	871	2030	
2017	5176	8302	2261	5720	3068	3796	291	10051	5803	2587	14214	17356	2855	216	1185	773	2122	

form of dental therapists was first realised in 1975; and the government made provisions for their training at Ga-Rankuwa Hospital soon thereafter.[25] The dental therapy programme was eventually offered as a distinct degree at Sefako Makgato Health Sciences University (Formerly Medunsa) [25].

The two most common oral diseases (dental caries and periodontitis) are to a large extent preventable, through relevant education and techniques, which can be provided by an oral health worker. The evidence in Lesotho suggests that despite the general knowledge of the public regarding oral health, patients only go to the dentist when there is a perceived need, usually when they experience dental pain[18], although the cost of treatment in Lesotho is heavily subsidised by the government.[19]

As of 2016, the Government of Lesotho, through the National Health Training College (NHTC) has started training dental therapists in a 3-year post high school degree programme.[26] This aimed at improving access to healthcare, especially among marginalised communities; in keeping with the principles of primary health care.

The Lesotho Medical, Dental and Pharmacy Council (LMDPC) was created by Order 13 of 1970 (Medical, Dental and Pharmacy Order of 1970) to regulate the practise of dental professionals.[27] The Order, however, has not been updated since 1970 and does not make provision for mid-level health workers like dental therapists, who did not exist in Lesotho at the time the legislation was promulgated. The rationale of this study is therefore to investigate the number; and map out the geographical distribution; of oral health personnel in Lesotho and document the availability of dental services across the country.

METHODS

Study design

This was a cross-sectional mixed methods survey of oral health providers in Lesotho. It used descriptive statistics to analyse data. Data sources included a document review, observations, a thematic review of in-depth interviews; as well as categorical and numeric data obtained from questionnaires.

Study population and sample size

This study population consisted of 4 out of the 6 dental therapists who were employed by the Government of Lesotho and all (22) of the dentists who work in the public sector providing clinical services were invited to take part in an online questionnaire.

Data Collection

Semi-structured face to face, in-depth interviews related to the study were carried out with the dental therapists (n=4). Quantitative data were accessed from the Lesotho Ministry of Health, Oral Health Departmental records. Updated records of dental personnel employed by the government of Lesotho, as well as statistics of dental patient numbers and dental procedures carried out nationwide between 2017 and 2019, were also accessed.

Data management and analysis

The data from the interviews were transcribed verbatim and thematic analysis was carried out.[28] The Quantitative data were captured and analysed using Microsoft Excel (Microsoft Office 2016)

RESULTS

Qualitative data

The responses below encapsulate some of the themes that emerged during the in-depth interviews with the four dental therapists, who agreed to be interviewed:

Theme 1: Health centres very far, oral health services limited to the rural population

Interviewee 2: *In terms of drive it's almost 3 hours' drive to Ketane, but the furthest facility is not accessible by road. I went using the helicopter from flying doctors and camped there for a week… even the nurses there say that we are neglecting them, you need a week to be there, when you arrive they mobilise the patients then you see the patients over 3 days or so, so it's not something that can be done more often.*

Theme 2: Inadequate remuneration

Interviewee 3: *The remuneration is low as compared to the region if we're looking at other countries that are using the same currency, because Swaziland is offering M19 000 almost M20 000, also transport allowance*

Theme 3: Lack of transport to facilities impairs the provision of oral health services

Interviewee 4: *I've realized that when you go with the vehicle for partners; sometimes they may also have their own priority area, they have their own activities that they may want to do with that same vehicle. So it will be the time factor, they'll drop you there where you're going to work; then the vehicle can go to another place. So if I'm having a specific vehicle for oral health I may go to an outreach, when I finish with oral health education screening and promotion, I can move on to a school within the same catchment area; so there is limitation of my activities. I'm very restricted because of the vehicle that I'm having. That's where I feel that we need our own vehicle.*

Theme 4: Not much of a difference in the roles of dentists and dental therapists in Lesotho

Interviewee 2: *I desire to see a situation whereby each professional works hard towards their scope, so that it makes a difference. A dental therapist for example, isn't trained to do endodontics and prosthodontics and all; so we don't want the situation whereby a dentist spends his or her training doing extractions… Why should a dentist spend time doing extractions in the clinic, when the assistant is also trained in doing extractions. If we don't draw lines, we won't professionalise, let's draw lines.*

Table I: Number of government-employed dentists per district

District	Population	Number of dentists working in government hospitals
Mokhotlong	100 442	1
Butha Buthe	118 242	2
Leribe	337 521	1
Berea	262 616	2
Maseru	519 186	8
Mafeteng	178 222	1
Mohale's Hoek	165 590	2
Quthing	115 469	1
Qacha's Nek	74 566	1
Thaba Tseka	135 347	1
TOTAL	**2007 201**	**20**

Quantitative data

The number of dentists currently working in the public sector, was cross matched with the list of dentists registered with the Lesotho Medical Dental and Pharmacy Council. These 18 dentists represented 14 health facilities, out of a total of 22 hospitals in the country. These are the dentists employed, either directly or indirectly, by the government. They serve just over 2 million of the population in Lesotho. The number of dentists in the public sector; as well as the population served, per district, are shown in Table I.

A retrospective analysis of the National dental patient records was done to determine the total number of dental patients seen per facility for 3 years between 2017 and 2019 (See Fig 1 above).

The two hospitals in Maseru, Queen Mamohato Memorial Hospital (QMMH) and Queen Elizabeth II; attended to the highest number of patients (17 636 and 20 076 respectively) in 2019. This accounted for 38.7% of all dental patients. Both hospitals are located in Maseru within a 7 km radius of each other. There are two additional dental hospitals in Maseru. These are St Joseph Hospital and Scott Hospital; both of which are operated by the Christian Health Association of Lesotho (CHAL).

The total number of dental patients seen in 2019 across all public hospitals was 97 425; a nearly 30% increase from the previous year. Some hospitals (Mount Tabor, St. Joseph and Tebellong) did not treat any dental patients, during periods when no oral health personnel were employed.
The total number of oral cancer patients seen in 2019, is shown in Table II.

In 2019, a total of 432 cases of orofacial cancer were reported, 78% of whom were seen at QMMH and Queen Elizabeth II in Maseru. This number however does not only represent new diagnoses, but also repeat patients. The same patient could have been counted multiple times, with each visit to a dental facility. Thus, using the current data collection tools; it is not possible to determine the number of new diagnoses each year. The current data collection tools also do not allow for the determination of the cases of Oral Squamous Cell Carcinoma (OSCC) case fatality rate in Lesotho. There are currently no oncology services in Lesotho; so every suspected cancer patient is referred to the tertiary hospital, QMMH, where a biopsy will be taken for confirmation and positive cases would be to Bloemfontein, across the border in South Africa, for oncology treatment. The dentists interviewed, were also presented with a list of dental procedures/services; then asked to report which of the services they offered at their respective facilities (See Table III)

Table III shows the dental procedures carried out by dentists working in government hospitals. These ranged from 0% for some specialist services like orthodontics to 100% for dental extractions.

DISCUSSION

Data analysis showed the perceived shortage of oral health personnel, particularly dental therapists, in the public sector of Lesotho. Due to the mountainous terrain in Lesotho, the lack of infrastructure, many rural settlements and the low socio-economic status of most the population; dental therapists have become an indispensable part of the oral health team in Lesotho.

Table II: Recorded number of oral cancer cases in 2019

District	Oral cancer cases
Berea	8
Butha-Buthe	6
Machabeng	0
Mafeteng	0
Maluti	19
Mamohau	0
Mokhotlong	0
Mount Tabor	0
Motebang	21
Ntsekhe	13
Paray	3
QE II	159
QMMH	178
Quthing	22
Scott	0
Seboche	3
St James	0
St Joseph	0
Tebellong	0
TOTAL	**432**

Source: Ministry of Health Lesotho – Oral Health[17]

When the country entered into a public private partnership for the building and running of the new referral hospital, QMMH, the agreement was also for Tsepong (Pty) Ltd to build/refurbish four filter clinics to decrease the number of patients who would go directly to the hospital.[29] These would serve as primary care facilities. Tsepong also recruited and employed all staff required for the filter clinics and the hospital. Unlike the health centres run by the government, where dental and other health services have always been free; these filter clinics would charge a subsidised dental fee; similar to fees charged at all the other hospitals. The four filter clinics each have a dental clinic, staffed by a dental therapist and dental assistant, and, like the main hospital, have a cap on the number of dental patients seen daily. Data on patients seen at the clinics were added to that of QMMH and recorded as a total; which meant the hospital itself actually saw far fewer patients than the Maseru district hospital, Queen Elizabeth II hospital (see Fig 1).

Since government employed dental therapists have to go out into the community to provide oral health services, there is a need for reliable daily transport provision. Ideally, the task of ensuring that there are adequate transport services for dental therapists to carry out work in the community belongs to the state. Dental therapists reported that the government is frequently unable to meet this demand for transport services. As a result, rural communities suffer, because visits by the dental therapists are rare. This is problematic, as it limits both the number and the duration of visits to the rural mountainous areas in Lesotho, where dental therapists; rather that dentists, provide dental services. Dental therapists often have to rely on transport facilities provided non-governmental organisations (NGOs) in their respective districts.

These NGOs include: Solidarmed, Riders for Health, Partners in Health (PIH), Baylor International Paediatric

AIDS Initiative (BIPAI), Elizabeth Glaser Paediatric AIDS Foundation (EGPAF), World Vision and University Research Council (URC). They also assist oral health departments in various districts with resources such as toothbrushes and toothpaste. These resources are also given to the community during oral health activities; especially during the oral health awareness (campaign) week, held once a year across Lesotho. Each of the NGOs have their own specific mandate, especially dealing with HIV/AIDS; so oral health services tend to feature lower down on their list of priorities. Dental therapists interviewed reported that their current salaries in the government are lower than what they would deem to be adequate. Respondents have practised in Lesotho for between two and 10 years.

The entry level pay grade for a dental therapist in Lesotho is Grade F, which is similar to other similarly qualified cadres; such as laboratory technicians and pharmacy technicians. This is the entry level salary grade for the most junior degree holders in the government. Research with dental therapists in South Africa, also showed that they regarded inadequate remuneration as one of the main reasons impacting their level of job satisfaction.[30] However, due to their lower cost of training and the scope of primary dental procedures that they can carry out, dental therapists remain affordable and widely accepted as part of the oral health team in many other countries.[20] The array of dental procedures offered to the citizens of Lesotho (Table III) is also only a portion of the total number of procedures that could be made available, if the Ministry of Health decided to provide more comprehensive dental health care. There are two forms of treatment, which are offered by all dentists who took part in the questionnaire, were dental extractions and the management of orofacial trauma. Dentists in Lesotho carry out basic extractions, scaling and polishing as well as restorations. All these procedures, which encompass the vast majority of dental procedures, also fall within the scope of dental therapists.[21] It would perhaps be more sensible to shift almost all of these procedures to dental therapists, while specifying the schedule of medications they are allowed to prescribe. Dentists, although they can perform all those routine procedures; should be involved more in the fields of endodontics; fixed and removable prosthodontics; taking and interpreting radiographs; root planing and some forms of periodontal surgery, among others. These functions could be prescribed; under regulations pertaining to National Legislation.

Table III: Dental procedures carried out in Lesotho

	Yes	No
Scale and polish	16	2
Restorations	16	2
Endodontics	9	9
Premovable prosthodontics	9	9
Fixed prosthodontics	0	18
Dentofacial trauma management	18	0
Dental extractions	18	0
Biopsy	15	3
Orthodontic treatment	0	18
Root planing	12	6
Dental implants	0	18
Cone Beam Coputated Tomograph	1	17
Intraoral radiography	10	8
Extraoral radiography	16	2

None of the dentists surveyed mentioned that they performed any services in the fields of fixed prosthodontics, orthodontics or implantology. This is not surprising, given that there are no clinical dental specialists in the country; except for one oral and maxillofacial surgeon at the referral hospital, QMMH, in Maseru. There is a similar debate in South Africa as to whether dentists are perhaps overqualified to be doing basic extractions; when they could actually be doing more specialised work.[31] Four hospitals in Lesotho have dental laboratories; which would enable them to carry out removable prosthodontics.[17]

In 2019, it was observed that only QMMH seemed to be providing this service (according to official records), perhaps due to their more efficient procurement processes, which ensure that they are never out of stock with regards to dental supplies. In 2016, the National Oral Health Office made available to all dentists, a standardised document of dental consumables. According to email records, the national office has been procuring some dental consumables at a central level and distributing them to different facilities.

Previous studies conducted on the utilisation of dental services reported that 16% of the population made use of dental services with a range of 4.7%-40.9%.32 Given that a total of 97 425 patients attended dental facilities in Lesotho in 2019 (Fig 1), it means that less than 5% of the population made use of dental facilities, only a fraction of the global average. This excludes the relatively smaller number of individuals who accessed dental services from the handful of dentists practising privately in Maseru. It also excludes patients seen by dental therapists at the primary level, whose data are not recorded in the same way that other dental hospitals record their patients. They are classified purely as community dentistry / outreach patients, despite some of the clinical work that is done on oral health. The majority of oral health personnel in Lesotho are employed by the government, followed by CHAL, and are located at each of the district and CHAL hospitals. In the neighbouring South Africa however, 90% of dentists work in the private sector, which caters for only 16 percent of the population.[31]

It was also noted during this research, that there were no active oral cancer screening programmes. This may lead to a late diagnosis of oral cancer, which in turn may result in an increasingly poor prognosis. This problem could be alleviated; if there were enough primary healthcare workers to provide education and basic screening for potentially malignant lesions, particularly in the oral cavity. Given the current oral health staff complement, it is not possible to effectively educate and screen the optimal number of individuals for oral cancer, which could be a probable reason why potentially malignant lesions in the oral cavity are not picked up as early enough to prevent mortality

CONCLUSIONS

Lesotho is in dire need of more oral health personnel and dental clinics / hospitals. The highest need is in the form of dental therapists whose scope of practise includes going into the community to provide primary oral care services to the most rural and destitute inhabitants of Lesotho. The fact that some dentists have to see a few thousand patients every year and dental therapists on occasion have

to trek 3-5 hours to reach some low-income rural areas high in the mountains; shows the importance of having more oral health personnel. Focus should be shifted towards preventive dentistry, in order to decrease the rate of dental extractions. These issues need to be addressed at a policy level, to ensure that oral health services reach all the people of Lesotho. It is disconcerting that more than 40 years after the Alma Ata Declaration, the maxim 'health for all' is still a long way from being achieved in Lesotho.

ETHICS

Ethical approval for this research was given by the Ethics Committee of the Faculty of Health Sciences at the University of Pretoria

Conflict of interest declaration

None

Acknowledgements

The authors wish to thank the National Research Foundation (NRF) for their financial support towards the cost of this study

REFERENCES

1. Shale I [Internet] Update: The law and legal research in lesotho. 2014 [cited 2019 July 24]. Available from: https://www.nyulawglobal.org/globalex/Lesotho1.html.
2. Reuters [Internet] Lesotho pm says army staged coup, flees to south africa. 2014 [cited 2020 June 16]. Available from: https://www.reuters.com/article/us-lesotho-coup/lesotho-pm-says-army-staged-coup-flees-to-south-africa-idUSKBN0GU04U20140830.
3. Fogelman C [Internet] It's the end of an era in lesotho. Mail & Guardian; 2020 [cited 2020 June 18]. Available from: https://mg.co.za/africa/2020-05-13-its-the-end-of-an-era-in-lesotho/.
4. Lesotho Government. Census 2016. In: Bureau of Statistics. Maseru: Government Printing; 2016.
5. LMDPC. Lesotho medical dental and pharmacy council statistics [Unpublished]. 2019.
6. Bhayat A, Chikte U. The changing demographic profile of dentists and dental specialists in south africa: 2002-2015. International Dental Journal. 2018; 68(2):91-6.
7. WHO [Internet] Oral health services. 2019 [cited 2019 15 June]. Available from: https://www.who.int/oral_health/action/services/en/.
8. Bernabé E, Sheiham A. Tooth loss in the united kingdom–trends in social inequalities: An age-period-and-cohort analysis. Plos one. 2014; 9(8):e104808.
9. McGrath C, Bedi R. Severe tooth loss among uk adults–who goes for oral rehabilitation? Journal of oral rehabilitation. 2002; 29(3):240-4.
10. Mndzebele SL, Kalambay JM. The influence of oral health knowledge and perceptions on dental care behaviours amongst adults attending treatment at berea hospital, lesotho : Dental public health. African Journal for Physical Health Education, Recreation and Dance. 2014; 20(sup-1):385-95.
11. Sheiham A. Oral health, general health and quality of life. SciELO Public Health; 2005.
12. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: A systematic analysis for the global burden of disease study 2016. The Lancet. 2017; 390(10100):1211-59.
13. Linden GJ, Lyons A, Scannapieco FA. Periodontal systemic associations: Review of the evidence. Journal of periodontology. 2013; 84:S8-S19.
14. D'Aiuto F, Gkranias N, Bhowruth D, Khan T, Orlandi M, Suvan J, et al. Systemic effects of periodontitis treatment in patients with type 2 diabetes: A 12 month, single-centre, investigator-masked, randomised trial. The Lancet Diabetes & Endocrinology. 2018; 6(12):954-65.
15. Correa FO, Gonçalves D, Figueredo CM, Bastos AS, Gustafsson A, Orrico SR. Effect of periodontal treatment on metabolic control, systemic inflammation and cytokines in patients with type 2 diabetes. Journal of clinical periodontology. 2010; 37(1):53-8.
16. Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the us adult population. Community dentistry and oral epidemiology. 2002; 30(3):182-92.
17. Kalambay J. Lesotho oral health statistics [Unpublished]. 2019.
18. Linjewile–Marealle N. Factors influencing utilization of oral health services in lesotho [Unpublished]. University of Western Cape: University of Western Cape; 2017.
19. Lesotho Go. Annual joint review 2017-18. In: Health Mo, editor. Maseru2018.
20. Nash DA, Friedman JW, Mathu-Muju KR, Robinson PG, Satur J, Moffat S, et al. A review of the global literature on dental therapists. Community Dentistry and Oral Epidemiology. 2014; 42(1):1-10.
21. PublicService. Dental therapist scope of practise [Unpublished]. Public Service Commission; 2017.
22. Dyer T, Robinson P. Public awareness and social acceptability of dental therapists. International journal of dental hygiene. 2009; 7(2):108-14.
23. Ward P. The changing skill mix–experiences on the introduction of the dental therapist into general dental practice. British dental journal. 2006; 200(4):193.
24. Morojele D. First dental therapists in lesotho. 2019.
25. SMHSU [Internet] Oral health sciences. 2019 [cited 2019 July 29]. Available from: https://www.smu.ac.za/schools/oral-health-sciences/.
26. NHTC. National health strategic plan 2017-2022. In: Health Mo, editor. 2016.
27. NationalAssembly [Internet] Legal document: The medical, dental and pharmacy order 1970. 1970 [cited 2019 July 28]. Available from: https://www.lesothotradeportal.org.ls/index.php?r=site/display&id=48.
28. Nowell LS, Norris JM, White DE, Moules NJ. Thematic analysis: Striving to meet the trustworthiness criteria. International journal of qualitative methods. 2017; 16(1):1609406917733847.
29. Webster PC. Lesotho's controversial public–private partnership project. The Lancet. 2015; 386(10007):1929-31.
30. Singh PK. Job satisfaction among dental therapists in south africa. J Public Health Dent. 2014; 74(1):28-33.
31. Bhayat A, Chikte U. Human resources for oral health care in south africa: A 2018 update. Int J Environ Res Public Health. 2019; 16(10):1668.
32. Bhandari B, Newton JT, Bernabé E. Income inequality and use of dental services in 66 countries. Journal of dental research. 2015; 94(8):1048-54

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a3

Demography and COVID-19 Symptoms of South African Oral Health Workers in an Academic Hospital

SADJ June 2022, Vol. 77 No. 5 p270 - p276

SM Nemutandani[1], Y Malele-Kolisa[2], E Blignaut[3]

ABSTRACT

Introduction

Oral health care workers constitute a high-risk profession to contract COVID-19. The aim of this study was to determine the prevalence and clinical experience of COVID-19 infected oral health workers at an academic hospital in Gauteng, South Africa.

Methods

A cross-sectional, questionnaire-based study was conducted among staff who contracted COVID-19 between May and December 2020. Data was captured in Excel and analyzed with Stata (StataCorp, USA).

Results

COVID-19 prevalence among 219 members of staff was 22.4%, and 46 participated. The majority ranged in age between 31- 40 years (n=18, 39%, 95% CI 25.78-54.32) and 41 – 50 years (n=19, 41%, 95% CI 7.88-56.4). Clinicians and dental assistants constituted 48%, while 76% perceived to be infected at work, with 72.7% sharing an office with ≥ 3 persons. Twenty-four staff members received post-test counselling, of whom 21.7% were counselled at work. Sixteen participants remained asymptomatic while most prevalent self-reported COVID-19 symptoms included cough (47.7%), sore throat (27.3%) and shortness of breath (20.5%). Significantly more females (55%) reported no COVID-19 symptoms than males (Chi^2 test, p = 0.01).

Conclusion

The COVID-19 prevalence in this study was much higher than previously reported for oral health workers in an academic setting. The high percentage of staff who remained asymptomatic raises the possibility of more staff being infected without being tested. Infection prevention and awareness training of all staff should be routinely provided and mitigating measures instituted to reduce office occupancy, including adequate post-test counselling.

Author affiliations:

1. **Simon Nemutandan:** School of Oral Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. President, Health Professions Council of South Africa Health. ORCID: 0000-0001-7335-4414
2. **Yolanda Malele-Kolisa:** Head of Clinical Unit, Department of Community Dentistry, Wits School of Oral Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. ORCID: 0000-0003-3368-9193
3. **Elaine Blignaut:** Department of Oral Biological Sciences, Wits School of Oral Health Sciences; 7 York Road, Parktown, 2193, Johannesburg. ORCID: 0000-0002-9937-9844

Corresponding author: Yolanda Malele-Kolisa
Head of Clinical Unit, Department of Community Dentistry, Wits School of Oral Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. E-mail: Yolanda.Kolisa@wits.ac.za

Author contributions:

1. SM Nemutandani: 30%
2. Y Malele-Kolisa: 40%
3. E Blignaut: 30%

INTRODUCTION

The COVID-19 pandemic continues to spread at an alarming and unrelenting rate across the globe and at the time of writing on 11 May 2021 more than 159 665 632 people have been infected and more than 3,3 million have succumbed to the infection world-wide[1]. South Africa has not been spared the ravages and to date recorded more than 1,6 million infections and 54 825 deaths. The country ranks 20th out of 222 countries where the disease has been recorded and is the country with the highest number of infections and deaths on the African continent[1]. The country has been placed under various levels of lockdown since a national state of disaster and initial complete lockdown (Level 5) was declared on 15 and 23 March 2020 respectively[2-4].

Health care workers (HCWs) and support staff constitute members of the essential workforce, working to contain the spread of the SARS-CoV-2 virus and managing COVID-19 patients. They are vital resources for every country and their health and safety are crucial, not only for continuous and safe patient care but also for the smooth running of health care systems[5,6]. Staff shortages occurred, either directly due to staff being infected by the SARS-CoV-2 virus or indirectly because of compulsory quarantine due to high risk exposures[7]. Additionally, some HCWs in Africa themselves fall into the category of 'high-risk' groups for COVID-19, given the high rates of certain communicable diseases such as tuberculosis and HIV, and non-communicable conditions like hypertension and diabetes[7-10].

Despite healthcare workers accepting an increased risk of infection as part of their chosen profession, caring for patients with COVID-19 nevertheless causes considerable mental stress, resulting in high levels of anxiety and post-traumatic stress disorders[11-12]. This is exacerbated by anxiety about spreading the virus to their families and friends, especially those who are elderly or have chronic medical conditions[13-15]. The rapid onset of the pandemic caught everyone off guard and there was little time to sufficiently prepare staff with the result that in the initial stages of the pandemic the lack of a clear understanding about SARS-CoV-2 transmission and disease also contributed to anxiety[16]. In addition, some HCWs feared returning to work following recovery from the infection. This further highlights

the need for psychological support in the workplace to deal with the many concerns[17,18].

The risk of HCWs being infected can be mitigated with adequate precautions within health facilities[19,20]. Primarily, this involves training and the use of personal protective equipment (PPE), including a gown, gloves, face mask and a face shield or goggles. Careful donning and doffing of this equipment constitute a key defence and requires supervision. It was anticipated that the risk of infection would be the highest at the beginning of the outbreak when healthcare workers may not have been familiar with PPE use. PPE was also in short supply, even in high-income countries, and it was to be expected that limited supplies thereof would be experienced in lesser resourced countries[19-21]. The lack or a shortage of good quality PPE can also contribute to anxiety[22]. From a moral perspective it was hoped that these scarce PPE resources would be appropriately used and distributed equitably across the globe – yet hoarding, misuse, intense competition between and within countries, price gouging, export blocks and corruption in the acquisition thereof became the norm[19,23-26].

Reports vary on the prevalence of infection with the SARS-Cov-2 virus among hospital staff[27,28]. It was reported in August 2020 that 27,360 South African hospital workers, which included doctors, nurses, porters and other hospital staff, had contracted COVID-19 since the start of the outbreak[29]. Health professionals who work in close physical proximity to patients are considered to be at a higher risk of SARS-CoV-2 infection[7,30,31], with oral health professionals being among those[32,33]. Studies reporting on the rate of infection among dental professionals revealed a prevalence of 0.9% in the United States of America, 1.9% in France and 10.8% in Italy[34-36]. A study on infection among staff in an Argentine dental training facility reported a prevalence of 4%[37]. No published information exists on the prevalence of COVID-19 infection among South African, and to our knowledge, African oral health workers (OHWs). To effectively support OHWs, this study was conducted to gain insights into the demographic profile and clinical experience of OHWs at one of the largest public hospitals in the country, namely the Charlotte Maxeke hospital, Johannesburg, Gauteng Province, in which the Wits Oral Health Centre (WOHC) is located.

METHODS

A cross-sectional, analytic study was conducted, utilising a hand delivered, self-administered questionnaire among the OHWs employed at the WOHC who tested positive for COVID-19 between 1 May and 31 December 2020. Participation was voluntary, with anonymity assured in the reporting of results. The study received ethical clearance from the Human Research Ethics Committee of the Faculty of Health Sciences, University of Witwatersrand (M2010114). Testing was performed by real-time reverse transcription-PCR (rRT-PCR) testing on a naso-pharyngeal swab. Demographic data such as age, marital status, job category, mode of transport to and from work and isolation were collected. Other questions pertained to training in the use and availability of PPE, testing for the virus and post-test counselling, as well as comorbidities and COVID-19 symptoms experienced. Data was captured in Microsoft Excel, coded and imported into Stata (StataCorp, USA) for analysis.

RESULTS

Socio-demographic characteristics

Forty-nine members (22.4%) of a total staff establishment of 219 at the WOHC were infected with the SARS-CoV -2 virus between 1 May and 31 December 2020 according to data obtained from the Health and Safety Committee of the hospital. Of those, 46 consented to be part of the study, yielding a 94% response rate and included clinicians, human resources staff, procurement and support staff.

Table I: Socio-demographic characteristics of participants in the survey

	Freq (n=46)	Percent	95% CI
Age group (years)			
25-30	5	10.9	4.48 – 24.05
31-40	18	39.1	25.92 – 54.16
41-50	19	41.3	27.8 – 56.26
51-60	4	8.7	3.21 – 21.46
Gender			
Female	29	63	47.97 – 75.94
Male	16	34.8	22.23 – 49.87
Prefer not to say	1	2.2	0.29 – 14.55
Marital status			
Married	21	45.7	31.63 – 60.39
Single	19	41.3	27.8 – 56.26
Divorced	4	8.7	3.21 – 21.46
Widowed	1	2.2	0.29 – 14.55
Live with partner	1	2.2	0.29 – 14.55
Mode of Transport			
Own Transport	22	47.8	29.7 – 58.34
Public Transport*	20	43.5	33.59 – 62.42
Lift Club & Public	4	8.7	32.13 – 21.46
Employment category			
Human Resources	1	2.2	0.29 – 14.55
Finance	11	23.9	1.35 – 38.67
Clinical	22	47.8	33.59 – 62.42
Support staff	12	26.1	15.21 – 40.97

*Public Transport = Train, bus or taxi

From Table I it is evident that approximately 80% of staff members who participated were in the 31 to 50 year age group. Respondents who were directly involved in clinical service rendering included dentists, dental assistants, oral hygienists, dental therapists, registrars and constituted 47,8% of infected staff. Support staff, (26%) included cleaners who worked in areas where clinical services were rendered, with financial and human resource administrators comprising an equal proportion (26.1%).

Many participants (76.1%) believed that they contracted the virus at work (Table II) and more than half reported sharing an office with 5 or more colleagues. Only 24 (52.2%) reported to have received post-test counselling, of whom 58% were counselled by someone not connected to the workplace. Most staff members (72%) were tested for COVID-19 at a government health facility and the method of testing was a nasopharyngeal swab and subsequent RT-PCR.

Table II: Summary of knowledge about COVID-19, perceived source of infection, testing and post-test counselling and shared workspace.

	Freq	Percent	95% CI
Informed on COVID19 (n = 44)	42	91.30	77.64 - 96.64
Perceived source of infection (n= 46)			
Work	35	76.1	61.33 - 86.45
Unsure	10	21.7	11.91 - 36.33
Other	1	2.2	0.28 - 14.55
Sharing of office space (n=44)			
≥5	23	52.3	37.33 - 66.81
4 – 3 others	9	20.4	10.79 - 35.33
≤2	1	2.3	0.30 - 15.17
1	11	25	14.17 - 40.21
Testing facility (n = 46)			
Private	13	28.3	16.92 - 43.24
Government	33	71.7	56.75 - 83.07
Post-test counselling by whom (n=24)			
Work	4	16.7	6.05 - 38.31
Supervisor	2	8.3	1.93 - 29.52
Colleague	4	16.7	6.05 - 38.31
Other	11	45.8	26.60 - 66.38
Spiritual leader	3	12.5	3.83 - 33.87

Testing for COVID-19

Figure I depicts the number of participants testing positive for COVID-19 during the 8 months of the study, with the highest number of staff (37%) testing positive during July. This constituted a window period after the first hard lockdown (Level 5) in South Africa was lifted and another level 4 lockdown introduced shortly thereafter[38].

Table III: Summary of self-reported COVID-19 symptoms experienced by respondent during various stages of illness.

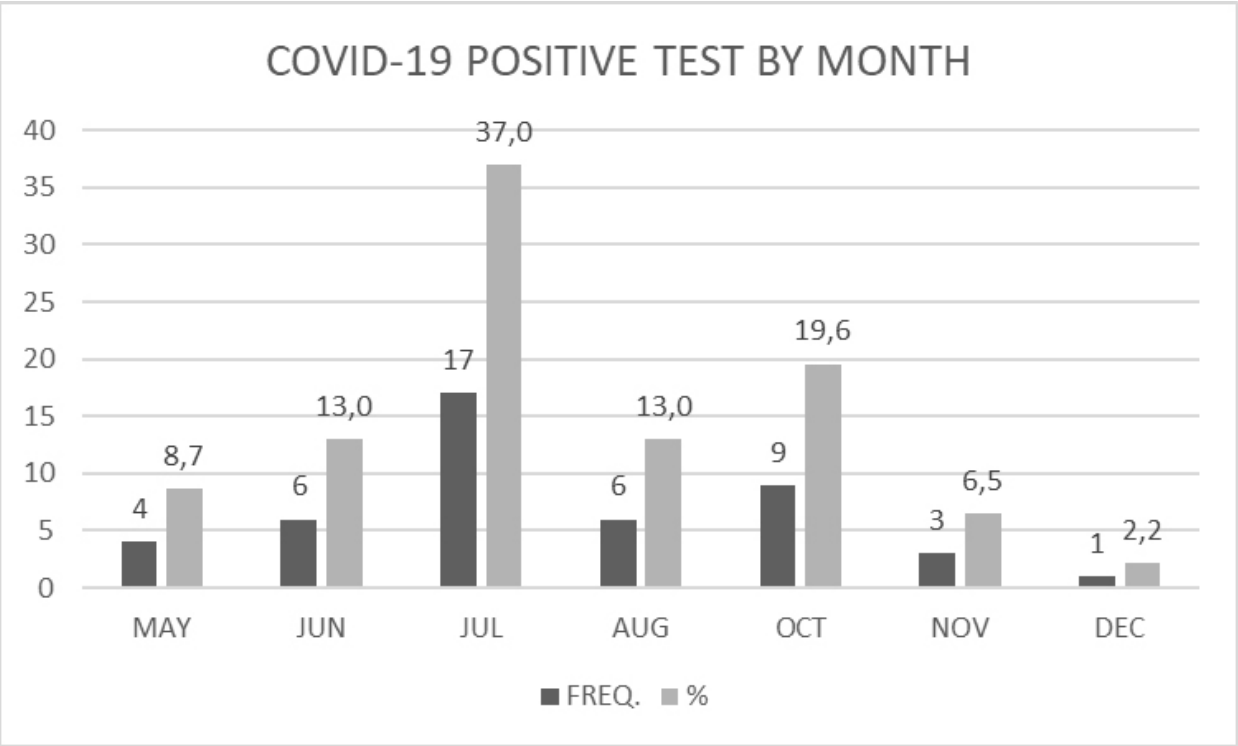
Symptoms	Before test (n=46)	During Isolation (n=44)	After isolation (n=39)
None	18 (39.1%)	16 (36.4%)	19 (48.7%)
Cough	16 (34.8%)	21 (47.7%)	14 (35.9%)
Sore throat	10 (21.7%)	12 (27.3%)	5 (12.8%)
Shortness of Breath	6 (13%)	9 (20.5%)	2 (5.1%)
Fever	6 (13%)	9 (20.5%)	1 (2.6%)
Chills	9 (19.6%)	8 (18.2%)	4 (10.3%)
Loss of appetite	3 (6.5%)	8 (18.2%)	4 (10.3%)
Chest pain	7 (15.2%)	13 (29.5%)	8 (20.5%)
Other *	4 (8.7%)	4 (9.1%)	-
Loss taste & smell	1 (2.2%)	6 (13.6%)	4 (10.3%)

* Other = Dizziness; headache; blood in sputum

Personal protective equipment

Ninety one percent of staff reported having received training on the use of PPE. Members of staff directly involved in patient treatment were dentists, dental specialists, dental therapists, oral hygienists and dental assistants, including cleaners/support staff working in the clinical area. PPE that was available to clinical staff included N95 mask (intermittently), plastic aprons, surgical masks, surgical gown, face shield and or goggles and shoe covers. All participants who worked in clinical areas reported having access to all aforementioned PPE, except N95 masks which at times were in short supply. Administrative staff had access to surgical masks which were issued in the workplace or otherwise their own cloth masks. Hand and surface disinfectants were also freely available in the workplace.

Figure I: Staff testing positive during the 8-month period covered by the study.



Comorbidities and symptoms experienced

A high percentage (68.8%) of staff were healthy, with no underlying chronic illnesses. There was no statistically significant association between individuals who reported existing co-morbidities and the number of symptoms experienced before and during COVID-19 infection.

Self-reported symptoms are summarised in Table III with respondents who reported not experiencing any symptoms before testing, during isolation and after isolation being 18 (39.1%), 16 (36.4%) and 19 (48.7%) respectively. Significantly more females reported not to have experienced any or few symptoms during isolation than their male counterparts (Pearson's chi^2 p=0.01). Cough (34.8%) and sore throat (21.7%) were the most common symptoms reported before testing and during isolation, however, 14 (35.9%) participants reported cough and lingering chest pain (20.5%) after isolation. Eleven respondents (23.9%) reported loss of taste and smell at various stages of the infection, of which one experienced it as the only symptom before testing and during and after isolation.

DISCUSSION

The current study evaluating the profile and clinical experiences 46 OHWs infected with SARS-CoV-2 virus at the WOHC, Johannesburg, is to our knowledge the first published information on OHWs in South Africa and Africa. The African continent, like other countries in the developing world, were expected to be particularly hard hit by the COVID-19 pandemic, citing the numerous socio-economic impediments, including inadequate health care resource, as well as the short supply of PPE[5,16,32]. The WOHC is situated in the Charlotte Maxeke hospital which is a large tertiary hospital in the centre of Johannesburg, the largest city in the country. Dentistry is regarded as one of the three professions with the highest occupational risk of infection[32,33]. Patients treated at government health facilities are mostly from the low socio-economic sector of the population and who are at greater risk of being infected and thus pose an increased risk of infection to staff employed in government hospitals and clinics.

The method of testing utilised during the time that study participants were identified with COVID-19 was rRT-PCR, and laborious as it is, it was the only method employed at the time with no rapid diagnostic tests available. The infection prevalence of 22.4% among staff in this study is 5 times higher compared to the 4% reported for oral health workers at an academic institution in Argentina[37], a country that is 11th on the global list of COVID-19 infections and that has 70 600 per 1 million infections compared to South Africa with 26 700 per 1 million of the general population[1].

Seventy six percent of staff in this study believed that they contracted the infection at work[27,28]. During a pandemic it is not always possible to determine the exact source of infection and infected colleagues, community exposure and the workplace may pose an equal risk to become infected[39,40]. In addition, approximately 50% of respondents make use of some form of public transport, e.g. train, bus or taxi, which are notoriously overcrowded[41-43]. With 73% of staff sharing office space with 3 or more others, social distancing requirements cannot be met and warrants the implementation of mitigating measures to reduce office occupancy and improve ventilation. This exceptionally high prevalence of COVID-19 is nevertheless of concern and all aspects of infection prevention should receive serious consideration.

The vast majority of those infected were in the 31 – 50 year age bracket (80%), with females constituting (63%) of infected staff, which corresponds with the gender (females 60%) and age (32 year mean age) related findings of other studies[44,45], however, this finding might be related to the staff composition at the WOHC which is mostly female. The high number of staff who reported no existing comorbidities (69%) is similar to a study comparing HCWs and non-HCWs in terms of severity of disease which reported HCWs to be more healthy and less likely to be hospitalised and had less severe symptoms[46,47]. The proportion of staff (31.2%) reporting co-morbidities correlates with reported comorbidities among the general South African population, namely diabetes and or high blood pressure[48,49].

Reported numbers of HCWs who tested positive for COVID-19 but remained asymptomatic vary considerably (1.3 to 50%)[50,51], with the 40% of staff members in our study who remained asymptomatic falling within this wide range. Asymptomatic participants in this study chose to be tested based on a perceived high risk of exposure either to infected patients or co-workers. The possibility exists that the prevalence of infected but asymptomatic workers could be higher with staff who experienced no symptoms not going for testing. The danger of cross-infection through asymptomatic health care workers raises the question of regular testing of clinical staff, particularly in a high-risk profession such as dentistry where patients, clinicians and dental assistants all work in close proximity and despite avoiding elective procedures, aerosol generating procedures cannot be completely excluded. In an academic or training institution students are also present in this relatively small space, further increasing the risk of cross-infection[44,52].

The most frequently self-reported COVID-19 symptoms during isolation were cough (47.7%) and sore throat (27.3%), with coughing reported by 35.9% of participants to have lingered after isolation. The prevalence of symptoms reported in the literature covers a wide range and this may be due to some being self-reported, as in this study, while in other instances they were actual diagnoses by health professionals[53,54]. Only 13.6% of participants reported loss of taste and smell during isolation, and again, the published prevalence thereof varies widely, from as low as 4% to 83.9%[55,56].

While infected staff hailed from all categories of employment, less than half (47.8%) were directly involved in clinical service rendering, which corresponds with other studies[57]. Except for N95 masks that were intermittently available, clinical staff reported to have had access to all recommended PPE[33]. The 52% of infected staff who were not directly involved in clinical service rendering, namely cleaners in the clinical areas and administrative staff, necessitate that all categories of employees be included in regular training on COVID-19 prevention. Although there can be no certainty as to the source of infection, similar to what is suggested in

other studies, the actual source of infection among workers in a health care facility may well be through exposure to asymptomatic colleagues[39].

The high number of staff who tested positive for the virus in July 2020, coincided with a brief period when stringent lockdown measures were lifted and various restrictions on movement and social gathering again being instituted[38]. Unpublished, routinely collected patient treatment data showed that patients refrained from attending hospitals and clinics during Level 5 lockdown and returned for treatment with the easing of restriction. This may correlate with the high number of staff becoming infected during July when higher numbers of patients again visited dental facilities to seek emergency dental treatment.

Working in a public hospital, it was convenient for the staff who suspected they were infected with SARS-CoV-2 virus to be tested there (72%). Another important finding of this investigation is that, although most participants reported to have been informed on COVID-19, more than half did not receive counselling after testing positive for COVID-19. In light of the widely published negative psychological impact of the pandemic on health care workers[58,59], it is important that counselling be made available in the workplace for all staff who may be in need thereof.

CONCLUSION

The exceptionally high prevalence of OHWs in this study who tested positive across the various categories of employment, emphasises the importance that OHWs be included when hospitals report COVID-19 positivity among health care staff. Another important aspect highlighted by this study is that almost equal numbers of clinical and administrative staff tested positive for COVID-19, which necessitates the inclusion of all categories of staff in training and awareness campaigns on infection prevention. Equally important is that measures be instituted to reduce the infection risk in overcrowded office/working spaces. While the report indicated adequate access to PPE for those directly involved in clinical service rendering, the high percentage of staff who remained asymptomatic warrant consideration of regular rapid screening of clinical staff. In light of the significant psychological burden that the pandemic places on health care workers, it is important that all workers who might require counselling service have access to it.

Acknowledgment

The contribution of all members of staff of the Wits Oral Health Center is gratefully acknowledged. Specifically the facilitation of Matron Sr Mquqo and Ms S Hassan during data collection stage is greatly acknowledged.

The authors report no conflict of interest and this research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

REFERENCES

1. Worldodometer. COVID-19 CORONAVIRUS OUTBREAK. 2020. [cited 2021 May 22] Available from: https://www.worldometers.info/coronavirus
2. South African Government News Agency. President Ramaphosa announces a nationwide lockdown. 2020. [cited 2020 June 21] Available from: https://www.sanews.gov.za/south-africa/president-ramaphosa-announces-nationwide-lockdown/
3. South African Government. DISASTER MANAGEMENT ACT, 2002 DECLARATION OF A NATIONAL STATE OF DISASTER. Pretoria: Government Printer, Pretoria; 2020. [cited 2020 June 20] Available from: http://www.gpwonline.co.za/Gazettes/Gazettes/43096_15-3_CoOperativeGovTradAff.pdf
4. Hatefi S, Smith F, Abou-El-Hossein K, et al. COVID-19 in South Africa: lockdown strategy and its effects on public health and other contagious diseases. Public Health 2020;185:159-60.
5. Chersich MF, Gray G, Fairlie L, et al. COVID-19 in Africa: care and protection for frontline healthcare workers. Global Health 2020;16:46.
6. Chang D, Xu HJ, Rebaza A,et al. Protecting health-care workers from subclinical coronavirus infection. Lancet Respir Med. 2020. doi: 10.1016/ S2213-2600(20)30066-7
7. Iacobucci G. Covid-19: GP surgeries close for two weeks after staff test positive. BMJ 2020;368:m936.
8. Soriano V, Barreiro P. Impact of New Coronavirus Epidemics on HIV-Infected Patients. AIDS Rev 2020;22:57-8.
9. Zhu F, Cao Y, Xu S, Zhou M.et al. Co-infection of SARS-CoV-2 and HIV in a patient in Wuhan city, China. J Med Virol 2020;92:529-30.
10. Grobler L, Mehtar S, Dheda K, et al. The epidemiology of tuberculosis in health care workers in South Africa: a systematic review. BMC Health Serv Res 2016;16:416.
11. Huang Z, Zhuang D, Xiong B, et al. Occupational exposure to SARS-CoV-2 in burns treatment during the COVID-19 epidemic: Specific diagnosis and treatment protocol. Biomed Pharmacother 2020;127:110176.
12. Kang L, Li Y, Hu S, et al. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. Lancet Psychiatry 2020;7:e14.
13. Rose C. Am I Part of the Cure or Am I Part of the Disease? Keeping Coronavirus Out When a Doctor Comes Home. N Engl J Med 2020;382:1684-5.
14. McMahon DE, Peters GA, Ivers LC, et al. Global resource shortages during COVID-19: Bad news for low-income countries. PLoS Negl Trop Dis 2020;14:e0008412.
15. Xiao H, Zhang Y, Kong D, et al. The Effects of Social Support on Sleep Quality of Medical Staff Treating Patients with Coronavirus Disease 2019 (COVID-19) in January and February 2020 in China. Med Sci Monit 2020;26:e923549.
16. O'Sullivan ED. PPE guidance for covid-19: be honest about resource shortages. BMJ 2020;369:m1507.
17. Rimmer A. Covid-19: GPs call for same personal protective equipment as hospital doctors. BMJ 2020;368:m1055.
18. Moberly T. Chinese premier rallies medics in coronavirus fight. BMJ 2020;368:m343.
19. Kapata N, Ihekweazu C, Ntoumi F, et al. Is Africa prepared for tackling the COVID-19 (SARS-CoV-2) epidemic. Lessons from past outbreaks, ongoing pan-African public health efforts, and implications for the future. Int J Infect Dis 2020;93:233-6.
20. Nkengasong JN, Mankoula W. Looming threat of COVID-19 infection in Africa: act collectively, and fast. Lancet 2020;395:841-2.
21. Makoni M. Africa prepares for coronavirus. Lancet 2020;395:483.
22. Koh D. Occupational risks for COVID-19 infection.

Occup Med (Lond) 2020;70:3-5.
23. Gilbert M, Pullano G, Pinotti F, et al. Preparedness and vulnerability of African countries against importations of COVID-19: a modelling study. Lancet 2020;395:871-7.
24. Phan LT, Maita D, Mortiz DC, et al. Personal protective equipment doffing practices of healthcare workers. J Occup Environ Hyg 2019;16:575-81.
25. Mahase E. Covid-19: hoarding and misuse of protective gear is jeopardising the response, WHO warns. BMJ 2020;368:m869.
26. Phagane T. 2020 Headlines: Corruption in procurement of PPE. SABC News; 2020. [cited 2021 April 20] Available from:https://www.sabcnews.com/sabcnews/2020-headlines-corruption-in-procurement-of-ppe/
27. Kluytmans-van den Bergh MFQ, Buiting AGM, Pas SD, et al. Prevalence and Clinical Presentation of Health CareWorkers With Symptoms of Coronavirus Disease. JAMA Netw Open 2020;3(5):e209673.
28. Lai X, Wang M, Qin C, et al. Coronavirus Disease 2019 (COVID-2019) Infection Among Health CareWorkers and Implications for Prevention Measures in a Tertiary Hospital inWuhan, China. JAMA Netw Open 2020;3(5): e209666.
29. Shange N. Coronavirus infection rate among health workers in SA is 5% — below global average (timeslive.co.za). Times Live. Johannesburg, South Africa: Sunday Times; 2020. [cited 2021 February 5] Available from:https://www.timeslive.co.za/news/south-africa/2020-08-13-coronavirus-infection-rate-among-health-workers-in-sa-is-5-below-global-average
30. Lu CW, Liu XF, Jia ZF. 2019-nCoV transmission through the ocular surface must not be ignored. Lancet 2020;395:e39.
31. Lai THT, Tang EWH, Chau SKY, et al. Stepping up infection control measures in ophthalmology during the novel coronavirus outbreak: an experience from Hong Kong. Graefes Arch Clin Exp Ophthalmol 2020. doi: 10.1001/jamanetworkopen.2020.9666
32. Gamio L. The Workers Who Face the Greatest Coronavirus Risk. New York Times. New York; 2020. [cited 2020 August 15] Available from: https://www.nytimes.com/interactive/2020/03/15/business/economy/coronavirus-worker-risk.html.
33. Kowalski LP, Sanabria A, Ridge JA, et al. COVID-19 pandemic: Effects and evidence-based recommendations for otolaryngology and head and neck surgery practice. Head Neck 2020;42:1259-67.
34. Estrich CG, Mikkelsen M, Morrissey R, et al. Estimating COVID-19 prevalence and infection control practices among US dentists. J Am Dent Assoc 2020;151:815-24.
35. Gallus S, Paroni L, Re D, et al. SARS-CoV-2 Infection among the Dental Staff from Lombardy Region, Italy. Int J Environ Res Public Health 2021;18. doi: 10.3390/ijerph18073711
36. Jungo S, Moreau N, Mazevet ME, et al. Prevalence and risk indicators of first-wave COVID-19 among oral health-care workers: A French epidemiological survey. PLoS One 2021;16:e0246586.
37. Sebastian P, Jorge P, Ariel G, et al. Assesment of SARS-CoV-2 infection-in dentists and supporting staff at a university dental hospital in Argentina. J Oral Biol Craniofac Res 2021;11:169-73.
38. Turner KJ, Le Grange K, Nkgadima R. TIMELINE : 10 months of Covid-19 in SA. IOL; 2021. [cited 2021 May 21] Available from: https://www.iol.co.za/news/south-africa/western-cape/timeline-10-months-of-covid-19-in-sa-7120954d-e536-4f0e-a7b7-7883b026bada
39. Mandic-Rajcevic S, Masci F, Crespi E, et al. Source and symptoms of COVID-19 among hospital workers in Milan. Occup Med (Lond) 2020;70:672-9.
40. Talbot LR, Romeiser JL, Spitzer ED, et al. Prevalence of IgM and IgG antibodies to SARS-CoV-2 in health care workers at a tertiary care New York hospital during the Spring COVID-19 surge. Perioper Med (Lond) 2021;10:7.
41. Schraer R. Coronavirus: What's the risk on transport? Unite Kingdom: BBC News; 2020. [cited January 10] Available from: https://www.bbc.com/news/health-51736185
42. Nakweya G. Public transport could stifle Africa's COVID-19 control. Nairobi, Kenya: SciDevNet; 2020. [Cited 2021 March 2] Available from: https://www.scidev.net/sub-saharan-africa/news/public-transport-could-stifle-africa-s-covid-19-control/
43. Morawska L, Tang JW, Bahnfleth W, et al. How can airborne transmission of COVID-19 indoors be minimised? Environ Int 2020;142:105832.
44. Alshahrani MS, Alnimr A, Alnassri S, et al. Prevalence of the SARS-CoV-2 Infection Among Post-Quarantine Healthcare Workers. J Multidiscip Healthc 2020;13:1927-36.
45. Abohamr SI, Aldossari MA, Alaklobi FA, et al. Clinical characteristics and in-hospital outcome of medical staff infected with COVID-19 in Saudi Arabia. A retrospective single-center study. Saudi Med J 2020;41:1336-43.
46. Kim R, Nachman S, Fernandes R, et al. Comparison of COVID-19 infections among healthcare workers and non-healthcare workers. PLoS One 2020;15:e0241956.
47. Huete-Perez JA, Cabezas-Robelo C, Paiz-Medina L, et al. First report on prevalence of SARS-CoV-2 infection among health-care workers in Nicaragua. PLoS One 2021;16:e0246084.
48. Hunter-Adams J, Battersby J. Health care providers' perspectives of diet-related non-communicable disease in South Africa. BMC Public Health 2020;20:262.
49. van Zyl S, van Rooyen FC, Joubert G, et al. A Comparison of the Socio-Behavioral-Metabolic Risk Profiles and Associated Factors for Chronic Diseases of Lifestyle in Urban and Rural Communities in Central South Africa. Front Public Health 2020;8:570676.
50. Mohr NM, Harland KK, Krishnadasan A, et al. Diagnosed and Undiagnosed COVID-19 in US Emergency Department Health Care Personnel: A Cross-sectional Analysis. Ann Emerg Med 2020. doi: 10.1016/j.annemergmed.2020.12.007
51. Mukhtar A, Afishawy M, Alkhatib E, et al. Asymptomatic SARS-CoV-2 infection among healthcare workers in a non-COVID-19 Teaching University Hospital. J Public Health Res 2021. doi: 10.4081/jphr.2021.2102
52. Al-Qahtani AA. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2): Emergence, History, Basic and Clinical Aspects. Saudi J Biol Sci. 2020/04/28 edn; 2020. doi: 10.1016/j.sjbs.2020.04.033

53. Gholami M, Fawad I, Shadan S, et al. COVID-19 and healthcare workers: A systematic review and meta-analysis. Int J Infect Dis 2021;104:335-46.
54. Nicolas D, Camos-Carreras A, Spencer F, et al. A Prospective Cohort of SARS-CoV-2-Infected Health Care Workers: Clinical Characteristics, Outcomes, and Follow-up Strategy. Open Forum Infect Dis 2021;8:ofaa592.
55. Kandakure VT, Valvi HR, Khokle P, et al. Prevalence and Recovery from Newly Onset Anosmia and Ageusia in Covid 19 Patients at our Teritary Care Centre. Indian J Otolaryngol Head Neck Surg 2021:1-8.
56. Sbrana MF, Fornazieri MA, Bruni-Cardoso A, et al. Olfactory Dysfunction in Frontline Health Care Professionals During COVID-19 Pandemic in Brazil. Front Physiol 2021;12:622987.
57. Persoon IF, Volgenant CMC, van der Veen MH, et al. [Impact of the coronavirus on Dutch oral health care and practice]. Ned Tijdschr Tandheelkd 2021;128:211-20.[In Dutch]
58. Temsah MH, Al-Sohime F, Alamro N, et al. The psychological impact of COVID-19 pandemic on health care workers in a MERS-CoV endemic country. J Infect Public Health 2020;13:877-82.
59. Xiao X, Zhu X, Fu S, et al. Psychological impact of healthcare workers in China during COVID-19 pneumonia epidemic: A multi-center cross-sectional survey investigation. J Affect Disord 2020;274:405-10.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a4

An evidence-based guide to occlusion and articulation. *Part 5: New roots: titanium and its influence on occlusion; and to cusp or not to cusp?*

SADJ June 2022, Vol. 77 No. 5 p277- p281

CP Owen[1]

SUMMARY AND PREAMBLE TO THE SERIES

Although this is essentially a review, it has not been written in the passive, third-person style normally associated with scientific writing, as it is intended to be thought-provoking and, hopefully, educational. It has therefore been written in more of a conversational style, and is aimed at students, dentists and dental technicians who are receptive to a slightly different view of occlusion and articulation, based on evidence.

Occlusion is a topic that has become a kind of archaic minefield of conflicting ideas, propositions, and above all, solutions, most of which are based on a complete lack of understanding of the evolution and development of teeth, and by extension, of clinically objective evidence.

That in itself is a statement of conflict (and perhaps even heretical), but it is by way of warning that this guide is not going to be much like anything you will find in standard text-books of dentistry or dental technology. It is, rather, an attempt to help you navigate through what you will read elsewhere, in the hope that eventually you will find an understanding that you can live with. It will appear as a sequential series in 7 Parts.

New roots: titanium and its influence on occlusion

Arguably the greatest advance in Prosthodontics was brought about by the successful integration of titanium implants into bone by Brånemark and co-workers.[1] Since then, and its use in dental treatment from the 1980s, thousands of implants have been placed, and thousands of papers published. At some stage, and possibly still in the minds of some clinicians, titanium was thought to be superior to teeth, but of late some sense has prevailed and several papers have now questioned what has been referred to as "implantomania" [2] and are suggesting that preserving teeth for as long as possible may be a better strategy. [3-5] A 2007 consensus report [6] stated that "teeth should be given priority whenever possible", and "oral implants represent the last resort, they are not replacing teeth; they should replace missing teeth".

But this is not intended to be a treatise on implant dentistry, but rather its relationship to occlusion. Whilst implant dentistry seems to be more common now in the partially edentulous jaw, implants were originally prescribed for the completely edentulous, and this falls into the "re-organised" approach as do complete dentures themselves. The options are a fixed prosthesis supported entirely by implants, or a removable overdenture prosthesis mostly supported by implants. The problem is not necessarily the implants themselves, but what we are putting on top of them, and if we do that as if the implants are teeth, we may have a problem.

Let's go back to the chewing cycle or rather the chewing envelope, under the influence of the central pattern generator, with its closing, contact and opening phases (see Parts 2 and 3). As the jaw closes, it is receiving afferent impulses from the muscles and joints, producing a rapid acceleration to tooth contact, which then initiates impulses from the tooth and periodontal ligament. This contact phase will provide feedback until the teeth have moved over each other (with a bolus of food in between) and as the jaw then moves from the chewing side to the non chewing side, this feedback reduces quickly, as do the afferents from the closing muscles and now the opening muscles are activated to move into the (slower) opening phase.

The feedback from the teeth and periodontal ligaments is rapid, which of course is a preventive mechanism should you encounter something too hard too quickly; if it's not fast enough, and the jaw doesn't open quickly enough, then damage to the tooth is likely. Chipped teeth, cracked teeth and even split teeth all can be the result.

If you are not sufficiently aware of all this, and have been brought up with a mechanistic view of how teeth come together, it is likely that you may not have subscribed to all the principles we have derived for conventional fixed prostheses (see Part 4), and your occlusal scheme may well be 'canine protected', based on the need to protect the other teeth in the arch. Even if it is a form of group function (as it should be) you would still be desperately trying to avoid balancing side contacts. And then if you

Author affiliations:
1. **Owen CP:** *BDS, MScDent, MChD, FCD(SA),* Professor Emeritus, Faculty of Health Sciences, University of the Witwatersrand Johannesburg, South Africa, ORCID: 0000-0002-9565-8010

Corresponding author: CP Owen
Professor Emeritus, Faculty of Health Sciences, University of the Witwatersrand Johannesburg, South Africa
Email: peter.owen@wits.ac.za
Cell: +27 83 679 2205

want to get the best aesthetic result, you are likely to have used ceramics. My contention is that you are then most likely to see much chipping and cracking and breaking if this is the scheme you use on an implant supported prosthesis. Sadly, some recent reviews bear this out. A review of prosthetic complications from implant prostheses over a 16 year period [7] concluded "porcelain veneer fracture/chipping was the most common complication identified in the studies of implant fixed partial dentures". In the same year (2018) a systematic review and meta-analysis of full-arch implant-supported fixed prostheses [8] came to a similar conclusion, which the authors described as clinically unacceptable: "chipping of the veneering ceramic was frequent, resulting in estimated 5-year complication rates of 22.8% for partial fixed prostheses and 34.8% for full-arch prostheses". In the following year two other studies, one of a 5-year follow up of ceramo-metal restorations [9] and one of a 1-12 year follow of ceramic and metal-resin restorations [10] came to similar conclusions: "the most frequent major complication was fracture of porcelain" and "the most frequent major complication was fracture of the prosthetic material".

Feedback from implants is very poor, because it depends only on osseoperception, which takes some time to develop after acceptance of the foreign body that is the implant, and the appearance of neural endings near the implant-bone interface, [11] so greater force will be required before the afferents to the opening muscles are triggered, thus somewhat overriding the central pattern generator rhythmicity. If this is correct, and if the occlusal scheme used does not take this into account, this would entirely explain the reporting of the most frequent complications of implant supported prostheses, namely chipping and fracture of the prosthetic material.

This has in fact been recognised, in a paper published in 2005, in one of the most prestigious implant journals, but which seems to have been largely ignored. The concern was that higher occlusal forces would lead to "implant overload" and peri-implant bone loss, as well as failure of the implants and prosthesis. [12] The authors did admit that "currently, there is no evidence-based, implant-specific concept of occlusion" but nevertheless made a series of recommendations for different clinical situations from single implants to full arch prostheses. But once again, if you have been following the arguments so far, it should be fairly obvious that if you think of an occlusal scheme that distributes the forces of mastication (and of parafunction, which may just be more important), as widely as possible, just as happens in a natural dentition that wears naturally, then you will protect the materials being used, be they ceramics or acrylics or anything in between (such as composites) and you will automatically protect the implants, if you think that is also necessary. But frankly, it is not the implants that need protecting, but the materials.

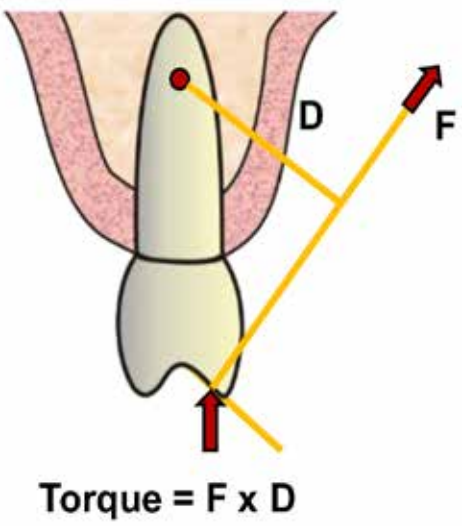
Which brings us to my next contention, which is why you do not need the beautiful occlusal surfaces that expert ceramicists create, and that exist in libraries of digital designs.

To cusp or not to cusp?

Whatever occlusal scheme you end up adopting, here is some of the evidence for keeping cusp angles low and grooves non-existent.

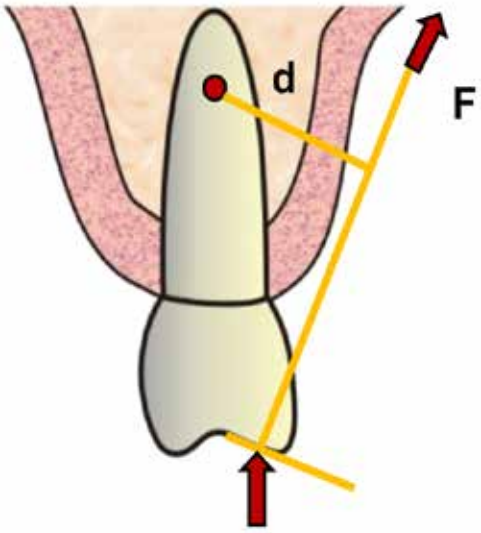
One of the first papers to be concerned with occlusal design (mainly because of its effects on implants) was a review from 1993. [13] The author expanded on this in a later paper [14] and pointed out that cuspal inclines influence the torque exerted on a tooth because an axially directed force against an incline produces a resultant force vector at right angles to the incline (Fig. 1). As the point of rotation of the tooth is approximately one third from the apex, the distance from the force vector to that point will determine the torqueing effect of the force because torque = the force multiplied by that distance.

Fig. 1. A force vector F is produced as a response to an axial force against a cusp incline, at a distance D from the point of rotation of the tooth (redrawn after Weinberg 2001 [14]).



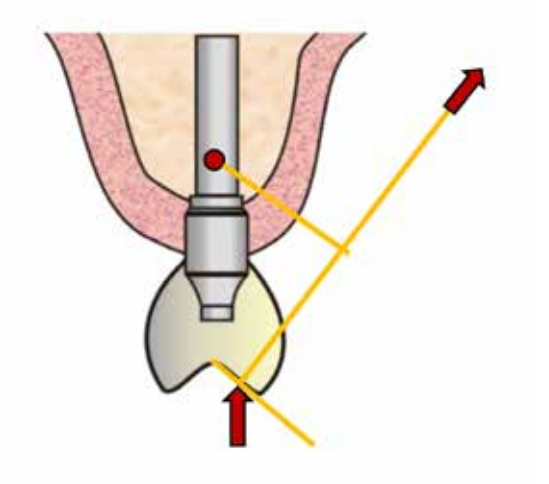
If the cusp incline is now reduced (Fig. 2), the force remains the same, but the distance from the force vector line to the pint of rotation is reduced, thus reducing the torque: a 10 x reduction in cusp incline can result in a 30% reduction in torque.

Fig. 2. A reduced cusp angle brings the force vector F closer to the point of rotation of the tooth, thus reducing the torque (after Weinberg 2001 [14]).



The same principle applies to an implant-supported crown, only this time the point of rotation is considered to be at approximately the third thread (Fig. 3).

Fig. 3. The same principle applies to an implant but the point of rotation is considered to be at approximately the third thread; it is possible this may affect marginal bone loss over time (redrawn after Weinberg 2001 [14]).



There have been a number of other papers since then that have looked at the effect of not only cusp angles but also enamel groove configuration on such aspects as the resistance of crowns to fracture and even the effect on the cervical area in terms of observed crown fractures and tooth abfraction. A seminal paper in 2011 used an analytic model to determine the influence of occlusal geometry on ceramic crown fracture by examining the role of cuspal inclines and fissure radius. [15] They regarded a fissure as effectively a notch in terms of its geometry as a notch concentrates stress around the notch tip, or in this case, the depth of the fissure. They used data from fracture load tests of a ceramic veneered premolar and the fractographic analysis of the fractured fragments (fractography is used to determine the origin and propagation of cracks, from the patterns generated). The load was applied vertically using a 4 mm diameter cylindrical bar, and found that the fracture was initiated from the occlusal fissure. Using fracture mechanics models, they were able to establish correlations with cusp angles, fissure radius and angle and the combined effects of these. Correlations were found between the fracture load and cusp angle as well as the fissure radius and angle. Fig. 4 for example shows the correlation between cusp angle and fracture load.

From this model they recommended that cusp angles should be no greater than 25° and grooves and fissures should be wide and shallow, as the fracture resistance will be affected by the combined effect of cusp angle and fissure radius which may predict the fracture resistance of all-ceramic crowns.

Similar findings were found in a finite element analysis (FEA) study using tooth enamel data [16] and again combining the effect of cusp angles and different geometries of the occlusal fissure. In this case, it again confirmed the susceptibility of natural teeth which retain their cusps, and that as teeth wear, they become more resistant to fracture, as the cusp angles lessen and the fissures widen and eventually disappear.

There is an argument that when replacing only one or two crowns in an unworn dentition that the occlusal morphology of that dentition should be retained, but that argument is based more on a perceived aesthetic need to make everything look the same; but from a functional point of view it is really not desirable, and hardly ever necessary. However, if it is considered necessary to have cusp angels of greater than 20 or 25°, then you should be using a material that will hopefully be strong enough or thick enough to resist fracture. In fact this has been tested, again using an FEA model and a simple

Fig. 4. Relationship between cusp angle and fracture load (redrawn and simplified from Sornuswan and Swain 2011 [15])

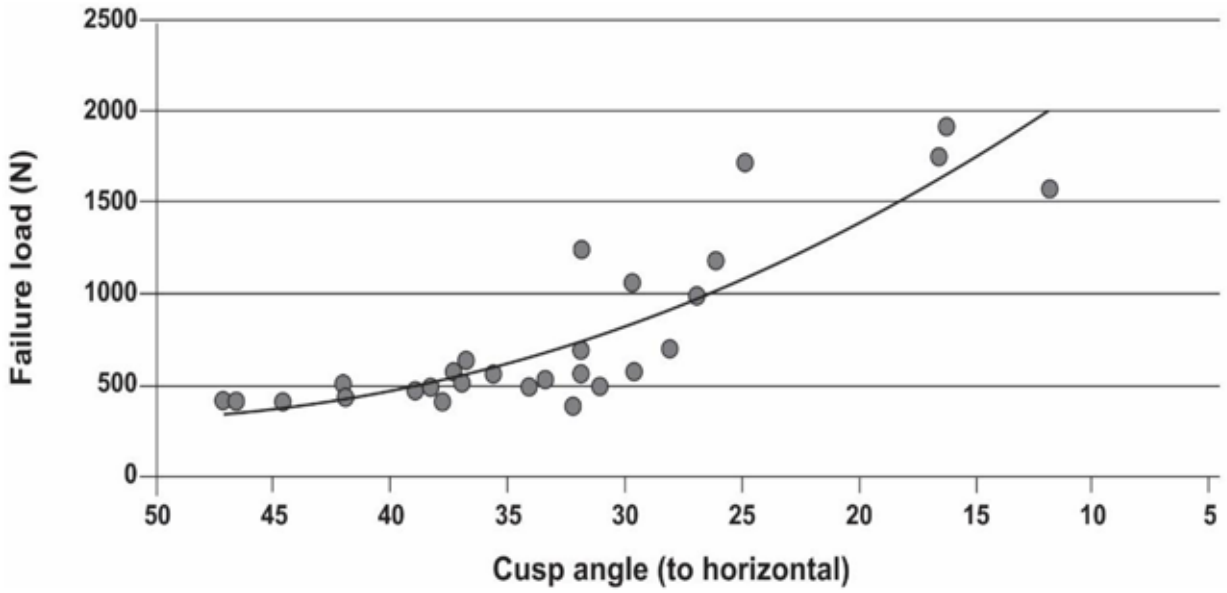
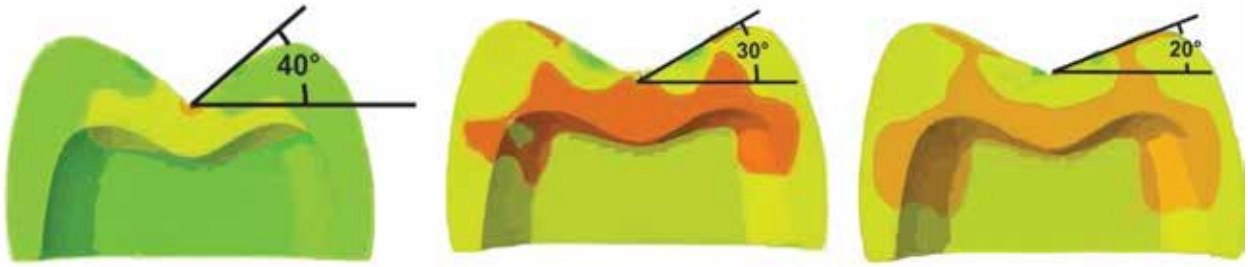


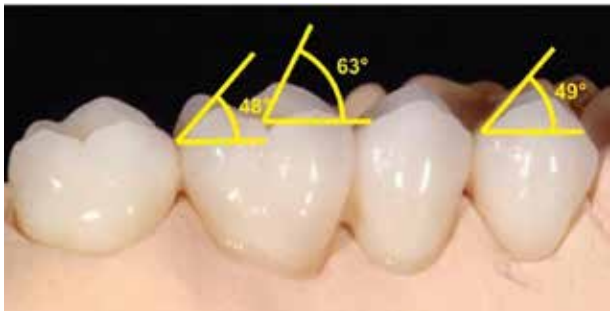
Fig. 5. Decreasing cusp angles took the stress away from the central fissure and distributed it more widely (redrawn from Shahmoradi *et al* 2020 [17]).



occlusal morphology of either a V-shape or U-shaped fissure, and varying the occlusal thickness and ceramic material. [17] The model also allowed for calculation of the stress within the material and how it changed with the changing parameters of cusp angle, fissure shape, and material. The changing cusp angles illustrated the distribution of stress very clearly as shown in Fig. 5. The steeper angles concentrated the stress in the fissure area and the flatter cusps eliminated that and distributed the stress more widely. The conclusions were again similar: for the ceramic monolithic materials, a design with a rounded occlusal notch, 20° cusp angle and medium thickness (1.5 mm occlusal) was considered optimal in terms of tooth conservation and fracture resistance.

Fig. 6. Beautiful ceramic work but will it function beautifully?

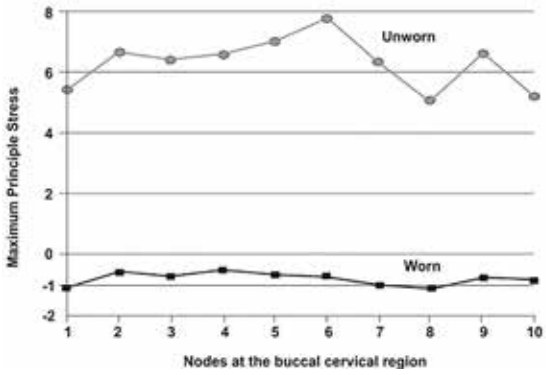
Fig. 7. The cusp angles of ceramic crowns



So when you see beautiful ceramic work such as in Fig. 6 and then measure the cusp angles as in Fig. 7, and look at the intricate occlusal fissuring, think about how this is going to function in the mouth. May look pretty, but it could be pretty liable to chipping and fracture under function.Finally, if you are not convinced, or even if you are, some additional evidence comes from the study of abfraction, or non-carious cervical lesions (NCCL). One study used a combination of FEA and strain gauges on artificial teeth, and found that oblique loads to the cusps resulted in tensile stresses in the cervical lesion and concluded that the pattern of stress coincided with the clinical appearance of an NCCL.[18] Similar findings were reported using photoelastic stress analysis. [19]

A more recent study from the world of Physical Anthropology looked at the stress distribution of unworn and worn teeth using three dimensional FEA. [20] In keeping with earlier papers of this series, the authors noted that NCCLs were seldom observed in non-industrialised societies and found that this was related to wear. Stress values calculated at the cervical region, depended on occlusal wear and the cusp inclination. In addition, they noted that with steep cusp inclines the stress distribution was not limited to the cervical area but extended to the root, and speculated that this may in part account for tooth fracture. Fig. 8 shows the tensile stress values at nodes along the buccal cervical region for the same tooth with unworn cusps and with a worn occlusal surface.

Fig. 8. Stress values at nodes along the buccal cervical area for the same tooth under occlusal load showing values for the unworn and then worn occlusal surface (redrawn from Benazzi et al 2013 [20]).



So finally (again) I hope you are now convinced that cusps, although friendly to aesthetics, are the enemy of occlusal freedom, so there needs to be an understanding of how to retain looks with freedom. To return to the title of this section, and with tongue firmly in cheek, I leave you with an alternative to the first few lines of Shakespeare's famous soliloquy:

SHAKESPEARE	ME
To be, or not to be: that is the question:	*To cusp or not to cusp: that should not be the question!*
Whether 'tis nobler in the mind to suffer	*Whether 'tis nobler in practice to suffer*
The slings and arrows of outrageous fortune,	*The chips and cracks of outrageous slopes,*
Or to take arms against a sea of troubles,	*Or to take burs against the cusps of troubles,*
And by opposing end them	*And by grinding, end them*

REFERENCES

1. Brånemark PI, Hansson BO, Adell R, Breine U, Lindström J, Hallén O, et al. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. Scand J Plast Reconstr Surg Suppl. 1977; 16: 1-132.
2. Zarb GA. Implantomania: prosthodontics at a crossroads. Int J Prosthodont. 2012; 25(2): 180-5.
3. Lindhe J, Pacey L. 'There is an overuse of implants in the world and an underuse of teeth as targets for treatment' Br Dent J. 2014; 217(8): 396-7. doi: 10.1038/sj.bdj.2014.930.
4. Giannobile WV, Lang NP. J Are Dental Implants a Panacea or Should We Better Strive to Save Teeth? J Dent Res. 2016; 95(1): 5-6
5. Zarb GA, Hobkirk JA. On Implant Prosthodontics: One Narrative, Twelve Voices – Introduction. Int J Prosthodont. 2018; 31 Suppl: s6-s8. doi: 10.11607/ijp.2018.suppl.e.
6. Lang NP, Müller F, Working Group I. Epidemiology and oral function associated with tooth loss and prosthetic dental restorations. Consensus report of Working Group I. Clin Oral Implants Res 2007; 18 Suppl 3: 46–9 doi: 10.1111/j.1600-0501.2007.01437.x.
7. Goodacre BJ, Goodacre SE, Goodacre CJ. Prosthetic complications with implant prostheses (2001-2017). Eur J Oral Implantol. 2018; 11 Suppl 1: S27-S36.
8. Pieralli S, Kohal RJ, Rabel K, von Stein-Lausnitz M, Vach K, Spies BC. Clinical outcomes of partial and full-arch all-ceramic implant-supported fixed dental prostheses. A systematic review and meta-analysis. Clin Oral Implants Res. 2018; 29 Suppl 18: 224-236. doi: 10.1111/clr.13345.
9. Papaspyridakos P, Bordin TB, Natto ZS, El-Rafie K, Pagni SE, Chochlidakis K, et al Complications and survival rates of 55 metal-ceramic implant-supported fixed complete-arch prostheses: A cohort study with mean 5-year follow-up. J Prosthet Dent. 2019; 122(5): 441-449. doi: 0.1016/j.prosdent.2019.01.022.
10. Papaspyridakos P, Bordin TB, Kim YJ, El-Rafie K, Pagni SE, Natto ZS et al. Technical Complications and Prosthesis Survival Rates with Implant-Supported Fixed Complete Dental Prostheses: A Retrospective Study with 1- to 12-Year Follow-Up. J Prosthodont. 2020; 29(1): 3-11. doi: 10.1111/jopr.13119.
11. Abarca M, Van Steenberghe D, Malevez C, Jacobs R. The neurophysiology of osseointegrated oral implants. A clinically underestimated aspect. J Oral Rehabil 2006; 33: 161–9. doi: 10.1111/j.1365-2842.2005.01556.x.
12. Kim Y, Oh T-J, Misch CE, Wang H-L. Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Implants Res. 2005; 16(1): 26-35. doi: 10.1111/j.1600-0501.2004.01067.x.
13. Weinberg LA. The biomechanics of force distribution in implant-supported prostheses. Int J Oral Maxillofac Implants 1993; 8(1): 19-31.
14. Weinberg LA. Therapeutic biomechanics concepts and clinical procedures to reduce implant loading. Part I. J Oral Implantol. 2001; 27(6): 293-301. doi: 10.1563/15481336(2001)027<0293:TBCACP>2.3.CO;2.
15. Sornsuwan T, Swain MV. Influence of occlusal geometry on ceramic crown fracture; role of cusp angle and fissure radius. J Mech Behav Biomed Mater. 2011; 4(7): 1057-66. doi: 10.1016/j.jmbbm.2011.03.014
16. Wan B, Shahmoradi M, Zhang Z, Shibata Y, Sarrafpour B, Swain M, et al. Modelling of stress distribution and fracture in dental occlusal fissures. Sci Rep. 2019; 9(1): 4682. doi: 10.1038/s41598-019-41304-z.
17. Shahmoradi M, Wan B, Zhang Z, Wilson T, Swain M, Li Q. Monolithic crowns fracture analysis: The effect of material properties, cusp angle and crown thickness. Dent Mater. 2020; 36(8): 1038-1051. doi: 10.1016/j.dental.2020.04.022.
18. Palamara D, Palamara JE, Tyas MJ, Messer HH.Strain patterns in cervical enamel of teeth subjected to occlusal loading. Dent Mater. 2000; 16(6): 412-9. doi: 10.1016/s0109-5641(00)00036-1.
19. Kuroe T, Itoh H, Caputo AA, Konuma M. Biomechanics of cervical tooth structure lesions and their restoration. Quintessence Int. 2000; 31(4): 267-74.
20. Benazzi S, Nguyen HN, Kullmer O, Hublin J. Unravelling the Functional Biomechanics of Dental Features and Tooth Wear. PLoS ONE 2013; 8(7): e69990. doi:10.1371/journal.pone.0069990

HELPS **REBUILD** AND **STRENGTHEN** **ACID DAMAGED ENAMEL**

SENSODYNE PRONAMEL

No.1 **DENTIST RECOMMENDED BRAND** FOR SENSITIVE TEETH*

Pronamel optimised formulation:[1,2]

- High fluoride availability
- No polyvalent metal ions
- Neutral pH
- No phosphates
- No SLS‡
- Low abrasivity

Specialised Enamel Protection
Rebuilds, Restores, Refreshes

‡Sodium lauryl sulphate; *Expert Performance Tracking 2020

References: **1**. Mason SC. *J Clin Dent* 2009, 20(6):175-177. **2**. Layer TM. *J Clin Dent* 2009, 20(6):199-202.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a5

The Role of Community Health Workers in Oral Health Promotion and the Impact of their services in Sub-Saharan Africa: *A Systematic Review*.

SADJ June 2022, Vol. 77 No. 5 p284 - p293

MA Khan[1], BO Okeah[2], EL Mbivnjo[3], E Kisangala[4], AW Pritchard[5]

ABSTRACT

Oral ailments are largely preventable but remain a significant public health concern afflicting nearly half the global population. These conditions account for 220 years of life lost per 100,000 people and about US$500 billion in health-related expenditures. Sub-Saharan Africa bears a significant burden of oral health problems thus exerting additional pressure on the scarce human resources for health. Community healthcare workers (CHWs) could be potentially utilised to bridge the shortage of oral health professionals in sub-Saharan Africa, hence, this systematic review that seeks to explore their current roles in oral health and potential impact on general physical health. This review follows the PRISMA guidelines and databases searched include PubMed, Web of Science, Medline, and CINAHL published between January 2010 and December 2019. Nine studies met the study eligibility criteria. The authors of this review established that CHWs perform variable roles cutting across primary, secondary, and tertiary prevention including providing oral hygiene education, recognising common pathologies, and treating oral lesions, administration of tooth extractions, dental pain management, and referral for advanced care. Although this could potentially improve oral health, our review did not establish the extent of the specific impact on general physical health of patients and the burden of oral condition.

Author affiliations:
1. **Mohammed Azhar Khan:** Unit B, 10 Barnard Road, Sherwood, Durban 4091, South Africa; Orcid": https://orcid.org/0000-0003-1812-8611
2. **Bernard Ojiambo Okeah:** School of Medical & Health Sciences, Bangor University, LL57 2DG, Bangor, Gwynedd, Orcid: 0000-0002-2797-3377
3. **Etheldreda Leinyuy Mbivnjo:** Biaka University Institute of Buea, Address: P.O. Box 77 Buea, Cameroon; Orcid ID: 0000-0002-2640-5693
4. **Ephraim Kisangala:** Health Service and Population Research Department, Institute of Psychiatry, Psychology & Neuroscience, King's College London, UK, Orcid: 0000-00028466-8723
5. **Aaron Wyn Pritchard:** School of Medical & Health Sciences, Bangor University, Address: LL57 2EF Gwynedd, United Kingdom; Orcid ID: 0000-0003-4000-7170

Corresponding author: Mohammed Azhar Khan
Dr. M A Khan Dental Practice,
Address: Unit B, 10 Barnard Road, Sherwood, Durban 4091, South Africa;
Email: mazhar015@gmail.com

Author contributions:
1. Mohammed Azhar Khan: 20%
2. Bernard Ojiambo Okeah: 20%
3. Etheldreda Leinyuy Mbivnjo: 20%
4. Ephraim Kisangala: 20%
5. Aaron Wyn Pritchard: 20%

INTRODUCTION

"Oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, convey a range of emotions through facial expressions with confidence and without pain, discomfort, and disease of the craniofacial complex[1]". Oral health is an important aspect of an individual's life, influencing general health/well-being, psychological, physiological and social functioning [1]. Oral health is dynamic (subject to changes in an individual's expectations, perceptions, experiences and adaptability to conditions) and occurs along a continuum that is subject to the attitudes and values of individuals and communities [1].

Many diseases associated with poor oral health, like tooth decay (caries), are largely preventable; yet remain the most prevalent conditions affecting about half of the global human population [2]. Oral diseases are also responsible for the loss of more than 220 healthy life years per 100,000 people [3]. In addition, it is estimated that more than US $500 billion was spent globally on managing oral diseases in 2015 [4]. This amount of money represents a significant strain on the rural populations living where the greatest burden of oral diseases exists and the resource envelope is thin [2,5]. In rural Sub Saharan Africa (SSA), the population experiences significant barriers that threaten the promotion of oral health [6,7].

These include scarcity of healthcare professionals with knowledge and skills in oral health [6], long distances to and high costs of accessing oral health services [6], ignorance of oral care [8] and unhealthy cultural practices and beliefs [9].

There is therefore a need for community-led public health intervention such as the use of community health workers (CHWs) that utilises a preventative approach to tackle the problem. There has also been advocacy for training of CHWs to increase the coverage of oral health programs and address the shortage of trained oral health professionals available to work at the community level[10]. The implementation of CHWs program can provide a triple benefit to the society including prevention of diseases, promotion of good health practices and

basic curative services to the members of the community [11]. The prospect of early identification and referral of HIV-related oral lesions in CHW led programmes could be key to determining antiretroviral treatment failure [12]. The new framework for oral health definition emphasises access to care as a determining factor and highlights the moderating effect of cultural factors on an individual's self-evaluation of their oral health [1]. Also, CHWs have been shown to improve the provision of culturally competent healthcare services[1] and access to healthcare[14]. Considering the above, we conducted a systematic review of the literature to explore the roles of CHWs in promoting oral health in SSA and the effectiveness of their interventions.

OBJECTIVES

1. To assess the roles of CHWs in oral health in SSA.
2. To determine the impact of oral health services provided by CHWs.

METHODOLOGY

This systematic review was conducted in accordance with the PRISMA guidelines [15, 16]. Electronic database searches were carried out to identify articles for review. The databases that were searched were PubMed, Web of Science, Medline, and CINAHL. MeSH search terms were used to complete the database searches and retrieved articles were assessed for eligibility using the PICOS (Population, Intervention, Comparator, Outcome, Study design) framework as outlined in Table I.
The Medical Subject Heading (MeSH) terms were matched with phrases from the PICO framework in Table I and included in the search together with free text terms. MeSH terms are a library of medical headings that are used by the PubMed database to categorise research articles. Free text terms are synonyms, abbreviations and alternative spellings of the terms used in Table II. This list was compiled by the researchers and is displayed in Table II.

Table I: PICOS Framework

Population	Sub-Saharan Africa
Intervention	Oral Health services provided by Community Health Workers
Comparator	None
Outcome	Improvement in physiological functioning Burden or oral health conditions
Study designs	All study designs

Updating searches

A database search to update results was carried out before the final analysis stage was completed. The initial database search took place in February 2020 while the final analysis of papers was completed in September 2020. An e-mail alert was set up with PubMed, Web of Science and Medline to ensure that the researchers are notified of new articles that would have shown up in the initial search.

A final search was run in December 2021 to ensure that relevant newly published articles are not missed from the review.

Managing references

Database search results were screened by title for inclusion independently by two researchers and stored electronically as an easier way to access articles electronically. The selected articles were exported to the researchers Mendeley account, checked for duplicated studies and stored for further screening.

Inclusion and exclusion criteria

Studies were assessed against the inclusion criteria namely language, population location, type of publication, year of publication, and country of study. Peer reviewed journal articles that were available in English, on study populations residing in SSA, and published between 2000 and 2019 were included. The inclusion and exclusion criteria are outlined in Table III.

Abstract-only documents were not included in the systematic review as the details published in the full paper may differ from those in the abstract. There were no ongoing studies that matched all the other inclusion criteria found during the literature search.

Table II: Keywords for database search

Sub Saharan Africa	Oral Health	Intervention	Community Health Workers	Effect
Africa	Oral conditions	Initiative	Community Health Worker	Result
Southern Africa	Oral disease	Treatment	Community Health Extension Worker	Outcome
East Africa	Oral disorders	Therapy	Lay Health Worker	Impact
West Africa	Oral health	Programme(s)	Community Health Assistant	Efficacy
Sub-Sahara	Oral healthcare	Outreach	Village Health Worker	Contribution
	Oral pathology	Scheme(s)	Village Health Team(s)	Acceptability
	Mouth diseases	support	Village Health Volunteer(s)	Receptiveness
	Dental diseases	Health information	Community Oral Health Workers	
	Dental health	Health provision	Community Health Outreach	
	Mouth health	Health education	Outreach volunteer	
	Dental conditions	Health promotion	Health volunteer	
		Screening	Community volunteer	
			Health support volunteer	
			Community helper	
			Rural health volunteer	

Table III: Inclusion and exclusion criteria	
Inclusion Criteria	Exclusion Criteria
English language	Non-English language
Peer reviewed journal articles and grey literature	Opinion pieces/editorials
Published between 2000 – 2019	Other year of publication other than 2000-2019
Sub-Saharan African country	Country other than Sub-Saharan Africa

Previous systematic reviews were excluded from this study to avoid replicating the findings of previous systematic reviews. Opinion pieces and editorials were also excluded from this systematic review. The study selection was reported using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flowchart. PRISMA was developed to provide researchers with a transparent manner of reporting study selection[16].

Data extraction

Data extraction was conducted to capture all necessary information from the studies identified from the selection process. The data extraction form was designed to record necessary information that relates to the topic and objectives of the study. This included the general identifying facts about an article such as the name of the researcher carrying out the data extraction, the date of data extraction, a code identifying the article, author name, article title, citation, type of publication, country where study was published/carried out and funding. Other details recorded during the data extraction process related to the characteristics of the study and population including aims and objectives of the study, study design, the inclusion and exclusion criteria, and comparators used. Furthermore, the form captured the setting of the intervention and any differences between the intervention and control groups.

Risk of bias (RoB)

The reviewers completed a risk of bias assessment using the corresponding RoB checklists produced by the US National Heart Lung and Blood Institute (https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools). Only one study[19] was of low quality; four studies were of moderate and the remaining four studies were of high quality. These are denoted in Table IV.

Analysis of findings

Subgroup analysis was based on the type of service provided (primary, secondary, tertiary preventive and curative or combination), and by programme aim/goal. The impact of CHWs services was assessed using the core elements of the novel definition for oral health care[1] as improved physiological or psychological function or as a reduction in disease or condition status (severity). Disease reduction was measured as decrease in the burden (prevalence, incidence, morbidity/mortality) of any priority oral health condition: tooth decay and cavities (dental caries); gum (periodontal) diseases; oral cancers; noma; oral manifestations of HIV and AIDS; oro-facial trauma from accidents and violence; cleft lip and palate [17]. An improvement in the oral health related quality of life was also used in measuring programme effectiveness [18].

RESULTS

Selection of studies

The PRISMA flow diagram in figure 1 outlies the process followed during the selection of studies for this review.

This review included nine studies from different countries namely Cameroon [19, 20], Gambia [21], South Africa [22–24], Kenya [12], Zimbabwe [25], and Uganda [26]. The study designs used across the included studies varied and included case control[12], cross-sectional[19,20,22,23], prospective observational[21], experimental[25,26], and qualitative[24] study designs. Due to the diverse nature of the study designs, targeted population, settings, interventions, and outcomes, a meta-analysis was excluded and results analysed through narrative synthesis.

Results synthesis

Various personnel providing oral health services across sub-Saharan African countries met the criteria for inclusion as community health workers. Based on studies conducted in Cameroon, Uganda, and South Africa, personnel providing oral health services at the community have been referred to as traditional healers [19, 20, 22,23,26,27]. Additional titles used to refer to these personnel include community health workers in Kenya[12], community oral health workers in Gambia[21], caregivers[22] and oral health promotion officers in South Africa [24]. There was no standardised pre-service training for CHWs on oral healthcare, hence, they had diverse qualifications, training, and scope of their roles. A total population of 215 CHWs were involved across five studies [19,20,22,23,26] while the remainder of the studies did not specify the numbers of CHWs involved in provision of the oral health services [12, 21,24,25,27].

Training of CHWs

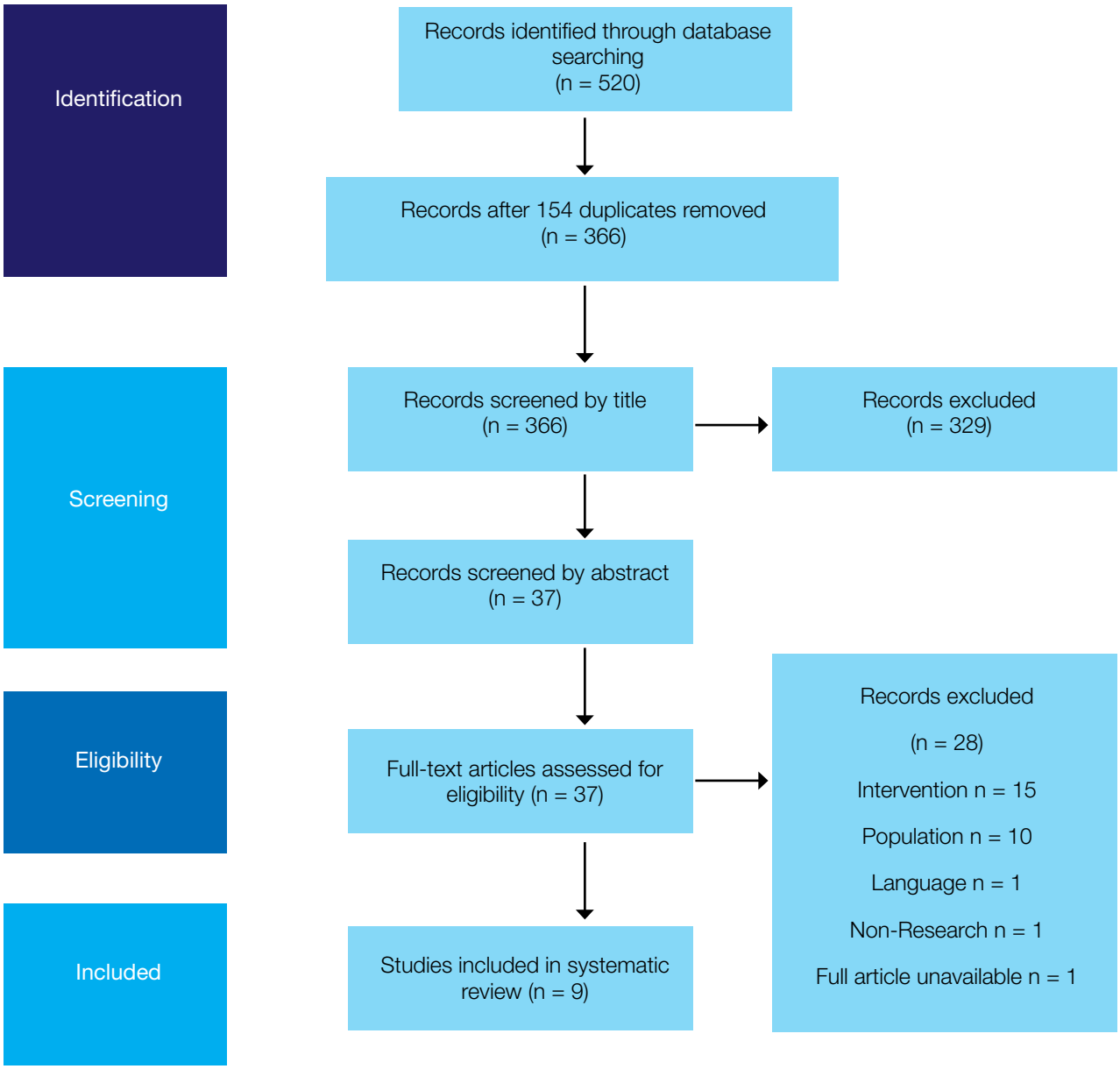
CHWs training and/ or level of education varied across the included studies with 77.8% of the interventions involving some formal training while 22.2% lacked a formal training component. The studies [12,19–22,24,25] with a training component prior to the CHWs performing their roles aimed at improving the knowledge and skills of CHWs in undertaking oral health interventions whereas the remaining studies [7, 11] only observed the behaviour, knowledge, and practices without a training intervention for the CHWs. Only four studies specified the training duration for the CHWs prior to their roles and this ranged from a day up to 90 days [21,22,25,26]. The training for the CHWs was delivered through workshops that entailed focus group discussions, demonstrations including the use of pictorials, and role plays.

The largest (79.87%) improvement in the knowledge of CHWs on common health conditions was reported from a workshop training intervention involving traditional healers in Cameroon[20]. Improvement in CHWs knowledge on common oral conditions was also reported by a Kenya-based study that trained CHWs on recognizing oral lesions associated with HIV infection[12] and a Uganda-based study whereby traditional healers participated in FGDs and workshops on false teeth "ebino" extractions [26] but this improvement was not specified in absolute proportions [12,26].

Roles performed by CHWs in oral health.

The findings of this review indicate that CHWs perform a wide range of roles in oral health spanning across

Figure I: Selection of studies



the three levels of disease prevention namely primary [23–26], secondary[12,22,23] and tertiary prevention [19–21,23,27] as shown in Figure II and Table IV. The roles undertaken by CHWs generally include screening, diagnosing, treating common dental problems (e.g., oral candidiasis, dental caries, oral lesions, ulcers, Karposis Sarcoma, etc), pain management, atraumatic restorative treatment, teeth extractions, providing health education, basic oral hygiene services, and referring patients for advanced dental services.

Primary prevention

A Zimbabwe-based experimental study involved school teachers who were trained on prevention and treatment of dental caries and periodontal disease, dental fluorosis, and emergency tooth care at school with emphasis on plaque control through the use of the toothbrush and chewing stick in combination with fluoridated toothpaste [25]. Subsequently, the trained teachers organized regional oral health workshops with 965 school children who were then followed-up in subsequent years to assess for plaque accumulation[25]. Another study involved 46 traditional healers and 1874 local women in Uganda who participated in focus group discussions and an education session on extraction of false teeth "ebino"[26]. The causes, management, and alternatives to "ebino" extractions were also discussed through role plays, dialogues, and pictorials.

The third study involved ten health promotion officers in South Africa who went through a formal training session at Wits University on a revised health promotion curriculum before being subjected to qualitative telephone interviews [24]. The revised training curriculum was aimed at integrating oral health literacy in the activities of health promoters in the Gauteng region of South Africa [24]. A study based in South Africa assessed the knowledge, attitudes and practices of 83 traditional healers with regards to their oral health interventions [23]. This was a multi-level prevention intervention that entailed

Table IV: CHWs roles

Reference	Study design/ Methods	Country	Population/ setting	No. of CHWs	CHWs role	Service type
(12)**	Case control	Kenya	CHWs	Not specified	Assessing patients. Identifying high-risk patients. Referrals for HIV testing.	Secondary
(20)*	Cross-sectional	Cameroon	Traditional healers	21	Diagnosing Treating common dental illnesses, Referring patients for advanced dental services.	Tertiary
(21)**	Prospective Observational	Gambia	Community Oral Health Workers (COHWs)	Not specified	Performing ART under supervision	Tertiary
(22)*	Cross-sectional	South Africa	Traditional Healers (THs) Caregivers	32 17	Recognize oral lesions. Oral hygiene (tooth brushing) skills	Secondary Primary
(25)***	Experimental	Zimbabwe	School teachers	Not specified	Facilitating oral health workshops	Primary
(19)*	Cross-sectional design	Cameroon	Traditional healers	16	Tooth extractions	Tertiary
(26)**	Pre-, intervention, and follow-up Qualitative	Uganda	Traditional healers Local women	46 1874	Management of ebino 'false teeth'	Primary
(24)**	Qualitative	South Africa-	Health promotion officers	10	Improving oral health literacy	Primary
(23)*	Cross-sectional descriptive	South Africa	Traditional healers	83	Recognising oral conditions Treatment of com-mon conditions Referral of patients Health education	Primary Secondary Tertiary

* - High quality study, ** - Moderate quality study, *** - Low Quality study

primary, secondary, and tertiary prevention activities. The traditional healers provided health education to their patients on tooth brushing, diagnosed common oral conditions, and provided appropriate treatments using “muti” (traditional medicine). Furthermore, the traditional healers also referred the patients for advanced management for their oral conditions [23].

Secondary prevention

A case-control study based in Kenya involved CHWs trained on the recognition of oral lesions associated with HIV infection [12]. In turn, the trained CHWs would undertake patient assessment within community settings based on the patient’s histories and presenting complaints [12]. Subsequently, the CHWs identified high-risk patients and referred them appropriately for further testing [12]. Another study in South Africa also focussed on the oral manifestations of HIV infections where 32 traditional healers and 17 caregivers were part of a focus-group discussion on oral lesions[22]. The study participants completed a pre- and post-training survey on recognizing oral lesions associated with HIV based on A4-size photographs. In addition, the researchers also assessed the competence of the participants in oral hygiene (tooth brushing skills) [22].

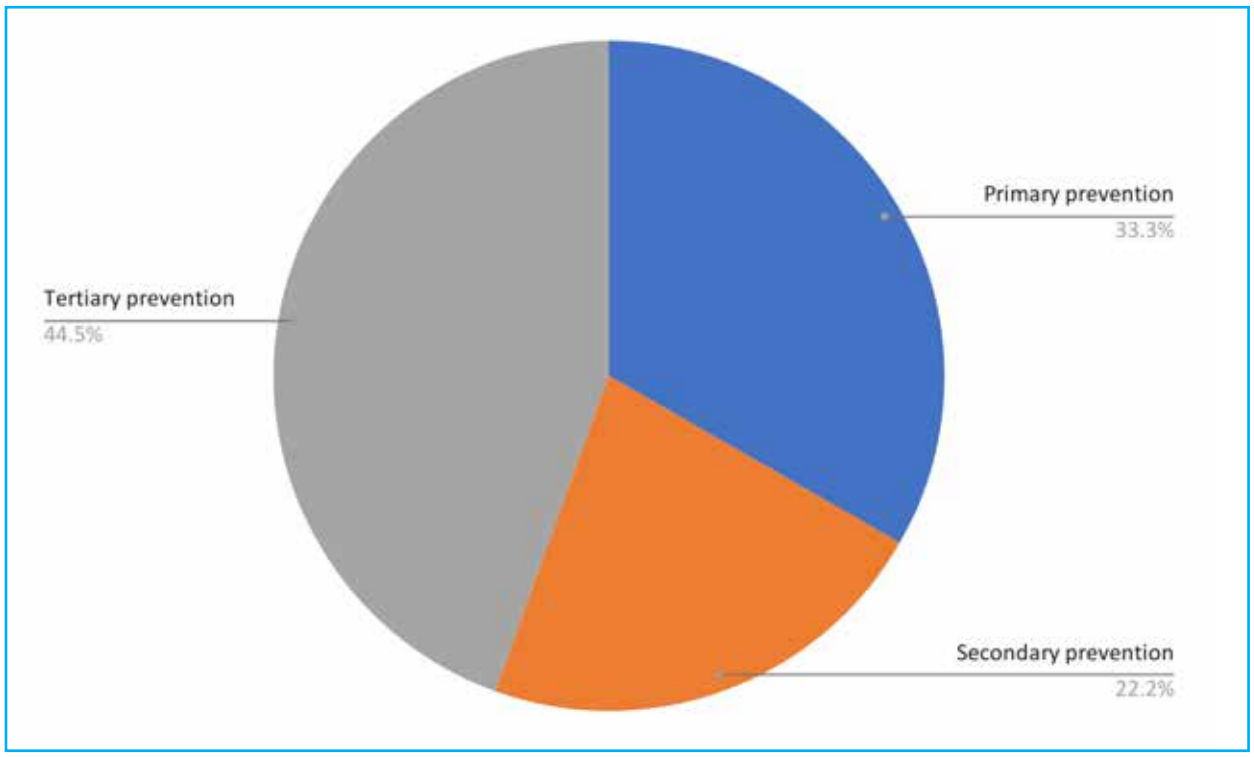
Tertiary prevention

A cross-sectional study assessed the knowledge and practices of [21] traditional healers in north-west Cameroon following a training workshop on diagnosing, treating, and referring patients with common oral problems [20]. A follow-up session after three months assessed the knowledge and practices of these traditional healers functioning as CHWs in diagnosing dental caries, oral candidiasis, aphthous ulcers, Kaposi's sarcoma, and oral cancers as well as the treatments they offered and the associated costs [20]. Another study based in Cameroon examined the practices of 16 traditional healers regarding tooth extractions in a sample of 150 patients [19]. The researchers observed the traditional healers while collecting herbs, applying on the patient's tooth, extracting the tooth, conducting observations post-tooth extraction, and providing post-op instructions [19]. The traditional healers were then asked to complete a questionnaire on the anatomy of the tooth, post extraction instructions, management of complications and prevention of infection [19]. The researchers also administered questionnaires to patients immediately after undergoing treatment [19]. In Gambia, community oral health workers (COHWs) were trained for three months on atraumatic restorative treatment (ART) and supervised to provide the treatments [21]. The ARTs were performed by groups of 10 COHW trainees, and patient outcomes after twelve months compared with ARTs performed by groups of 7 experienced COHWs or 2 dentists [21].

Impact of CHWs interventions

The researchers examined various outcomes to determine the impact of CHWs interventions in oral health. The specific outcomes across the studies included CHWs knowledge on common oral conditions, patients screened for oral ailments, patients referred, common oral conditions recognised by CHWs, oral health literacy, patients treated, pain management, patients with complications, preference for CHWs

Figure II: Roles of CHWs in oral health



services, patients satisfied with CHWs services, and the burden of dental diseases. Table V summarises the key outcomes as reported across the included studies and these formed the basis for assessing the impact of the roles performed by CHWs in the oral health of the service users.

A study on the knowledge, diagnostic, and treatment practices of CHWs in Cameroon reported a 69% preference and 67.3% satisfaction with services offered by traditional healers due to ease of accessibility and low cost compared to conventional dental services [20]. Similarly, 60% of patients preferred to have their teeth extracted by traditional healers in Cameroon with an estimated 93.3% patient satisfaction and only 4.7% of the patients reporting complications afterwards[19]. A Kenyan-based study reported an improvement in the number of patients screened for oral conditions as well as improved referral of patients for further testing[12]. Following two days training and focus group discussions, the proportion of oral lesions recognised by CHWs in South Africa based study involving traditional healers and caregivers increased by 22.4-71.4%. A Uganda-based study on management of false teeth by traditional healers and local women reported a reduction in hospital referrals for children with complications of false teeth extractions [26]. The reduction in referrals in this study was desirable because the rampant "ebino" extractions contributed to a high number of admissions for complications from the procedures undertaken by traditional healers and local women [26].

A training intervention on ART reported no significant differences in ARTs performed by a group of 10 community oral health worker trainees and a comparative group of seven experienced community oral health workers. There was no significant difference in plaque accumulation amongst school children over four years after participating in an oral health workshop facilitated by school teachers in Zimbabwe compared to the control group [24]. A knowledge and practices assessment for 83 traditional healers based in South Africa revealed that half of their clients presented with various complaints namely tooth aches, oral candidiasis, and swollen gums [22]. Subsequently, 90% of them could correctly identify dental caries, gingivitis and oral candidiasis on A4 sized photographs while approximately 82% of the traditional healers referred their patients for advanced treatment in public health facilities [22]. Following the intervention, the study reported an improvement in the recognition of oral lesions by traditional healers and an 84% improvement in the referral of patients for further specialised treatment [22].

DISCUSSION

Summary of evidence

Our review established that oral health services at community level in sub-Saharan Africa are provided by various groups of personnel namely traditional healers, health promotion officers, caregivers, or simply community healthcare workers. We categorised all the aforementioned personnel as CHWs in accordance with a recent systematic review that defined a CHW as a paraprofessional or lay person who understands the local culture, might have received some form of training and provides basic health services within their community [28].

Notably, we found no uniformity in the level of training, qualifications, experience, and the roles undertaken by the CHWs based on the included studies. In more than three quarters of the studies, persons undertaking the roles of CHWs in oral health had some form of training leading to their roles. The findings of this review further revealed that the roles undertaken by CHWs in oral health span across all the levels of disease prevention namely primary, secondary, and tertiary prevention.

Table V: Outcomes of CHWs interventions

References	(12)	(20)	(21)	(23)	(22)	(25)	(19)	(16)	(24)
No. of CHWs	Not available	21	Not specified	83	49	Not specified	16	46	Not specified
Intervention	Training	Training	Training	None	Training/FGDs	Training	None	Training/ FGDs	Training
Intervention duration (days)	Unavailable	Unavailable	90	Unavailable	2	3	Unavailable	<1	Unavailable
CHWs roles									
Screening for oral diseases	✓								
Diagnosing common conditions		✓		✓	✓				
Treating common conditions	✓	✓		✓					
Pain management									
ART			✓						
Tooth extractions							✓	✓	
Health education					✓	✓			✓
Basic oral hygiene				✓	✓				
Referral	✓	✓						✓	
Follow-up (in months)	Not specified	3	12	Not specified	<1	48	Not specified	18	Not specified
Outcomes									
CHWs knowledge (%)	↑	↑ 79.87%	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	↑	Unavailable
Patients screened	↑	N/A	N/A	Unavailable	Unavailable	N/A	Unavailable	Unavailable	N/A
Referred patients	↑	Unavailable	N/A	84%	Unavailable	N/A	62.5%	↓	Unavailable
Conditions recognised	Unavailable	Unavailable	N/A	↑	↑ 22.4-71.4%	N/A	Unspecified	Unspecified	N/A
Oral health literacy	N/A	N/A	N/A	Unspecified	N/A	↑	Unspecified	Unspecified	↔
No. or % of Patients treated	Unavailable	Unavailable	131	Unspecified	N/A	N/A	Unavailable	Unavailable	N/A
Pain control effectiveness	N/A	N/A	N/A	Unavailable	N/A	N/A	Unspecified	Unspecified	N/A
Patients with complications (%)	Unavailable	Unavailable	Unspecified	Unspecified	N/A	N/A	4.7%	Unavailable	N/A
Preference for CHWs services (%)	Unavailable	69%	Unavailable	Unspecified	N/A	N/A	60%	Unspecified	N/A
Patient satisfied with CHWs services (%)	Unavailable	67.3%	Unavailable	Unspecified	N/A	N/A	93.3%	Unspecified	N/A
Burden of oral diseases	Unavailable	Unavailable	Unavailable	Unavailable	Unspecified	↔	Unavailable	↓	Unspecified

Legend: ↑- Increase, ↓ - Decrease, ↔- Unchanged

The primary prevention roles performed by CHWs in oral health include providing oral health education on oral hygiene, tooth brushing skills, organising workshops to promote oral health literacy, managing false teeth. The secondary prevention roles performed by community healthcare workers in SSA countries include assessing patients' histories, screening, and recognising oral lesions and referring high-risk patients for further testing and/ or treatment. In tertiary prevention, the reviewed evidence shows that CHWs perform dental extractions, atraumatic restorative therapy under supervision, and providing pain relief for patients with dental problems. The CHWs also play a role in referring patients who require advanced dental interventions to dental specialists in the formal

healthcare service. We also observed that CHWs could potentially play a role in promoting oral health literacy through health education which might have an influence on overall health outcomes [24, 25].

The impact of the CHWs interventions were assessed using the key outcomes of included studies to determine whether there was an improvement in the physiological or psychological functioning of patients or a reduction in the burden and severity of oral conditions. According to the reviewed evidence, CHWs interventions appear to improve access to screening, diagnostic, and treatment services for oral conditions. However, due to the limited number of studies, we could not determine the lasting impact of these improvements on oral health or to what extent they influence the overall burden of oral conditions in the respective study settings. Improvements in the referral of patients for advanced management reported across two studies ranged between 62.5% and 84%. The researchers further observed that training of CHWs could potentially improve their diagnostic skills as reported in one study where CHWs recognised an additional 22.4-71.4% of oral lesions following a two-day training through focus group discussions [22].

We also observed a higher (60-69%) preference for CHWs services in comparison to the formal dental services and a resultant 67.3%-93.3% satisfaction for services provided by CHWs [19,20]. The higher preference for CHWs services was motivated by their closer proximity within the community, the cost, and effectiveness of their services as perceived by the community members in comparison to the formal dental health service providers. The rate of complications reported from CHWs interventions appears to be low (4.7%) but this was only reported in one study where traditional healers performed tooth extractions [19]. It is not clear based on the reviewed evidence to ascertain the impact of CHWs interventions on the severity of the oral conditions they managed or the physiological functioning of their patients.

Practice and research implications

The roles played by CHWs with respect to oral health and hygiene are considerably varied between countries and contexts. Their scope may include providing oral hygiene education, through to diagnosing common pathologies, and treating oral lesions. In some circumstances trained provision of tooth extractions, pain management, and referral for advanced care are functions of CHWs reported across included studies.

Such remit may have a significant impact on oral health and on the burden of oral conditions. Although we could not establish the extent to which these services impacted the general physical health of patients and the overall burden of diseases, scientific evidence shows that such services significantly improve people's overall quality of life [29, 30]. Similarly, a study based in Brazil examined the effectiveness of a CHW program on oral health promotion and reported improvements in oral health knowledge, tooth-brushing practices, self-efficacy in oral hygiene, and utilisation of existing dental services [31]. Despite this evidence, there is still need for more robust studies to better understand the specific impact of the oral health services provided by CHWs including on the physiological functioning of the service users as well as the overall burden of oral health conditions in SSA. It may also be worth exploring measures that could be applied to standardise the quality of oral health services provided by CHWs in SSA.

Considering the reviewed evidence, CHWs could provide a readily available pool of workers that can be capacitated to improve access to oral health services in resource limited settings. Our findings suggest that screening for oral conditions, diagnosis of common dental ailments, and basic treatment services for oral problems could potentially benefit from strengthening the services provided by CHWs. We observed an increase in the detection of oral lesions and referrals for advanced management following a training intervention for CHWs [12, 19, 22] but could not ascertain the statistical significance of these increases. This finding is consistent with recent evidence from a cross-sectional study based in India which revealed that trained CHWs were able to consistently diagnose oral lesions in comparison with an onsite specialist [32]. Sub-Saharan African countries have acute shortages for healthcare workers including dental specialists [33]. In some instances, populations travel long distances to access the limited dental services translating into huge out-of-pocket healthcare costs and wastage of time in search of essential services further exacerbating health inequalities. CHWs have already shown greater promise for bridging the chronic health human resources challenges based on their application across other services including provision of anti-retroviral treatments (ART) for HIV/AIDs, diabetes, and malaria interventions [34, 35] and could be beneficial in providing oral health services.

The findings of our review show that there is considerable heterogeneity in terms of the role and function and expectation of CHWs with reference to oral healthcare provision. Current research evidences that in those contexts where CHWs are most comprehensively trained, they may be equipped with skills to perform essential dental procedures including tooth extractions, and simple pain relief (following a period of formal training and supportive supervision). We observed that CHWs were able to effectively provide atraumatic restorative therapy without complications for the service users following a three months training programme[21]. As such, capacity building the CHWs to provide quality oral health services could help overcome accessibility, affordability, and acceptability barriers to dental health services in impoverished and marginalised communities. This is further reinforced by a pilot study that demonstrated a higher acceptability for CHWs oral interventions amongst Chinese Americans [36]. Our findings also revealed a higher preference for and satisfaction with CHWs services owing to their proximity within communities and affordability of their services. In certain communities, CHWs may be the only accessible healthcare provider, hence, an invaluable resource for bridging the disparities in oral health services by providing culturally competent oral health services [37].

Limitations

This review retrieved a small number of studies which were diverse in their study designs and settings. Consequently, the researchers could not ascertain the impact of CHWs interventions, and neither are the findings generalizable.

REFERENCES

1. Glick M, Williams DM, Kleinman D V., Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. Am J Orthod Dentofac Orthop. 2017 Feb;151(2):229–31.
2. WHO. Oral health [Internet]. World Health Organisation. 2018. Available from: https://www.who.int/health-topics/oral-health#tab=tab_1
3. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, et al. Global burden of oral conditions in 1990-2010: A systematic analysis. J Dent Res. 2013;92(7):592–7.
4. Fonseca EP da. Oral Health Challenges: Global Burden of Disease as Information Resource for Policy-Making and Health Situation Analysis. Dent Case Rep. 2018 Feb;2(1).
5. Skillman SM, Doescher MP, Mouradian WE, Brunson DK. The challenge to delivering oral health services in rural America. Vol. 70, Journal of Public Health Dentistry. 2010.
6. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. Vol. 83, Bulletin of the World Health Organization. World Health Organization; 2005. p. 661–9.
7. Barnett T, Hoang H, Stuart J, Crocombe L. The relationship of primary care providers to dental practitioners in rural and remote Australia. BMC Health Serv Res. 2017 Aug 1;17(1):1–13.
8. Chhabra N, Chhabra A. Parental knowledge, attitudes and cultural beliefs regarding oral health and dental care of preschool children in an Indian population: A quantitative study. Eur Arch Paediatr Dent. 2012 Apr;13(2):76–82.
9. Swati J, Ashish S, Basavaraj P, Hansa K, Khushboo S, Shilpi S. Assessing the influence of culture on oral health-a review. J PEARLDENT. 2014 Jan;2:1–8.
10. Smit DA, Barrie RB, Louw AJ. The burden of dental caries in the Western Cape and a recommended turn-around strategy. S. Afr. dent. j. [Internet]. 2017 Sep [cited 2022 Apr 17] ; 72(8): 360-365. Available from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0011-85162017000800005&lng=en. http://dx.doi.org/10.17159/2519-0105/2017/v72no8a3
11. Ministry of Health - Uganda. Ministry of health Community Health Extension Workers Strategy in Uganda. 2016. p. 64.
12. Koyio LN, Van der Sanden WJM, Van der Ven A, Mulder J, Creugers NHJ, Merkx MAW, et al. A community-based oral health promotion model for HIV patients in Nairobi, East District in Kenya: a study protocol. J Public health Res. 2013 Jun;2(1):5.
13. Handtke O, Schilgen B, Mösko M. Culturally competent healthcare – A scoping review of strategies implemented in healthcare organizations and a model of culturally competent healthcare provision. Todd CS, editor. PLoS One [Internet]. 2019 Jul [cited 2020 Feb 1];14(7):e0219971. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6667133/
14. Perry HB, Zulliger R, Rogers MM. Community Health Workers in Low-, Middle-, and High-Income Countries: An Overview of Their History, Recent Evolution, and Current Effectiveness Keywords. Annu Rev Public Heal. 2014;35:399–421.
15. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev [Internet]. 2015 Dec 1 [cited 2019 Jul 24];4(1):1. Available from: https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/2046-4053-4-1
16. Liberati A, Altman DDG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions. PLoS Med [Internet]. 2009 Jul 21 [cited 2019 Jul 11];6(7):e1000100. Available from: https://insights.ovid.com/bmj/bmjd/2009/07/250/prisma-statement-reporting-systematic-reviews-meta/24/00002591
17. WHO Regional Office for Africa. World Health Organization. Int Organ [Internet]. 1960;14(1):212–4. Available from: https://www.afro.who.int/
18. Baiju R, Peter E, Varghese N, Sivaram R. Oral health and quality of life: Current concepts. J Clin Diagnostic Res. 2017 Jun 1;11(6):ZE21–6.
19. Agbor AM, Naidoo S, Mbia AM. The role of traditional healers in tooth extractions in Lekie Division, Cameroon. J Ethnobiol Ethnomed. 2011 May 30;7.
20. Agbor AM, Naidoo S. Knowledge and practice of traditional healers in oral health in the Bui Division, Cameroon. J Ethnobiol Ethnomed. 2011 Jan 15;7.
21. Jordan RA, Gaengler P, Markovic L, Zimmer S. Performance of Atraumatic Restorative Treatment (ART) depending on operator-experience. J Public Health Dent. 2010 Jun;70(3):176–80.
22. Rudolph MJ, Ogunbodede EO, Mistry M. Management of the oral manifestations of HIV/AIDS by traditional healers and care givers. Curationis [Internet]. 2007 [cited 2020 Oct 6];30(1):56–61. Available from: http://curationis.org.za/index.php/curationis/article/view/1051
23. Lewis HA, Rudolph MJ, Mistry M, Monyatsi V, Marambana T, Ramela P. Oral health knowledge and original practices of African traditional healers in Zonkizizwe and Dube, South Africa. SADJ [Internet]. 2004 [cited 2020 Oct 31];59(6). Available from: https://europepmc.org/article/med/15457910
24. Molete MP, Daly B, Hlungwani TM. Oral health promotion in Gauteng: A qualitative study. Glob Health Promot [Internet]. 2013 [cited 2020 Oct 6];20(1):50–8. Available from: http://www.sagepub.co.uk/journalsPermissions.navDOI:10.1177/1757975913476906http://ped.sagepub.com
25. Frencken JE, Borsum-Andersson K, Makoni F, Moyana F, Mwashaenyi S, Mulder J. Effectiveness of an oral health education programme in primary schools in Zimbabwe after 3.5 years. Community Dent Oral Epidemiol. 2001;29(4):253–9.
26. Jamieson L. Using qualitative methodology to elucidate themes for a traditional tooth gauging education tool for use in a remote Ugandan community. Health Educ Res [Internet]. 2006 [cited 2020 Oct 6];21(4):477–87. Available from: https://academic.oup.com/her/article/21/4/477/573165
27. Braimoh OB, Umanah AU. Basic package of oral care: a veritable tool for promotion of primary oral health care by community health officers. Odontostomatol Trop [Internet]. 2014 [cited 2020 Oct 6];37(147):51–6. Available from: https://europepmc.org/article/med/25975068
28. Olaniran A, Smith H, Unkels R, Bar-Zeev S, van den

Broek N. Who is a community health worker? - A systematic review of definitions. Vol. 10, Global Health Action. Co-Action Publishing; 2017.
29. Svensson L, Hakeberg M, Wide U. Dental pain and oral health-related quality of life in individuals with severe dental anxiety. Acta Odontol Scand [Internet]. 2018 Aug 18 [cited 2021 Feb 11];76(6):401–6. Available from: https://www.tandfonline.com/doi/full/10.1080/00016357.2018.1473892
30. Tjakkes GHE, Reinders JJ, Tenvergert EM, Stegenga B. TMD pain: The effect on health related quality of life and the influence of pain duration. Health Qual Life Outcomes [Internet]. 2010 May 2 [cited 2021 Feb 11];8(1):1–8. Available from: https://link.springer.com/articles/10.1186/1477-7525-8-46
31. Frazão P, Marques D. Effectiveness of a community health worker program on oral health promotion. Rev Saude Publica. 2009;43(3):463–71.
32. Birur Np, Gurushanth K, Patrick S, Sunny S, Raghavan S, Gurudath S, et al. Role of community health worker in a mobile health program for early detection of oral cancer. Indian J Cancer [Internet]. 2019 Apr 1 [cited 2021 Feb 11];56(2):107–13. Available from: http://www.indianjcancer.com/text.asp?2019/56/2/107/257547
33. Willcox ML, Peersman W, Daou P, Diakité C, Bajunirwe F, Mubangizi V, et al. Human resources for primary health care in sub-Saharan Africa: Progress or stagnation? [Internet]. Vol. 13, Human Resources for Health. BioMed Central Ltd.; 2015 [cited 2021 Feb 11]. p. 76. Available from: http://human-resources-health.biomedcentral.com/articles/10.1186/s12960-015-0073-8
34. Hermann K, Van Damme W, Pariyo GW, Schouten E, Assefa Y, Cirera A, et al. Community health workers for ART in sub-Saharan Africa: Learning from experience - Capitalizing on new opportunities [Internet]. Vol. 7, Human Resources for Health. BioMed Central Ltd.; 2009 [cited 2021 Feb 11]. p. 1–11. Available from: https://link.springer.com/articles/10.1186/1478-4491-7-31
35. Kisia J, Nelima F, Otieno DO, Kiilu K, Emmanuel W, Sohani S, et al. Factors associated with utilization of community health workers in improving access to malaria treatment among children in Kenya. Malar J [Internet]. 2012 Dec 30 [cited 2021 Feb 11];11(1):248. Available from: https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-11-248
36. Northridge ME, Wu Y, Troxel AB, Min D, Liu R, Liang LJ, et al. Acceptability of a community health worker intervention to improve the oral health of older Chinese Americans: A pilot study. Gerodontology [Internet]. 2020 Dec 27 [cited 2021 Feb 11];ger.12522. Available from: https://onlinelibrary.wiley.com/doi/10.1111/ger.12522
37. Mobula LM, Okoye MT, Ebony Boulware L, Carson KA, Marsteller JA, Cooper LA. Cultural competence and perceptions of community health workers' effectiveness for reducing health care disparities. J Prim Care Community Heal [Internet]. 2015 Jan 1 [cited 2021 Feb 11];6(1):10–5. Available from: http://journals.sagepub.com/doi/10.1177/2150131914540917

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a6

Diagnosis and treatment of a maxillary lateral incisor with two root canals. A case report.

SADJ June 2022, Vol. 77 No. 5 p294 - p298

JD Torres-Mantilla [3]

ABSTRACT

Although endodontic treatment has shown high success rates, the factors involved in the failure cases are still being studied. In this sense, the complexity of interradicular anatomy may lead to inadequate instrumentation and the persistence of etiological factors related to apical periodontitis and endodontic failure. The present case report illustrates the occurrence, diagnosis and nonsurgical endodontic treatment of a maxillary lateral incisor with two canals. A 24-year-old Peruvian woman was referred complaining of darkening of the upper front tooth. After clinical examination, the patient was diagnosed with necrotic pulp and asymptomatic apical periodontitis. Still, radiographic examination revealed a disruption in the canal continuity, leading to a suspicion of unusual root canal morphology in the maxillary lateral incisor. By taking radiographs from different angles, according to the technique described by Clark, the presence of two independent canals was verified. Since most cases of endodontic failure are due to untreated canals, a predictable endodontic therapy must achieve the removal and neutralisation of etiologic factors related to periapical infiltration. The occurrence of additional root canals requires a correct interpretation of radiographic images to detect these variants and take the necessary considerations for proper endodontic treatment.

Keywords

Maxillary lateral incisor, separate apical foramen, two canals, morphological root canal anomalies.

INTRODUCTION

Academic literature reports a 90% success rate of endodontic treatment.[1-3] Several studies attribute the high predictability of root canal treatment to removing and neutralising the agents involved in periapical infiltration[4]. For instance, Hoen and Pink[5] found a 42% occurrence of missed canals in teeth selected for nonsurgical retreatment. These results are consistent with the investigations indicating untreated canals and defects in obturation as the most significant causes of failure.[6-9]

The study of internal root anatomy has allowed setting standard patterns regarding the number and configuration of root canals.[10-17] In that sense, among maxillary teeth, the lateral incisors are typically described as single-rooted, with one canal, slightly flattened mesiodistally and with a disto-palatal orientated low curvature. [10,15,18] Although morphological root canal abnormalities of the maxillary lateral incisors are uncommon, [19-21] variations are frequently associated with “dens in dente”, palatal grooves, gemination or fusion. [10,22,23] Besides, some reviews have informed a 3% incidence of two canals.[10,16]

As well as a thorough knowledge of the root anatomy, a detailed examination of the crown and preoperative radiographs are necessary to detect root canal anomalies. [13-17] An accurate treatment plan must include all present canals to achieve endodontic success. [1-9] This article describes a maxillary lateral incisor with two canals managed by nonsurgical endodontic treatment.

CASE REPORT

A 24-year-old Peruvian woman was referred to the Department of Endodontics at Carlos Lanfranco La Hoz hospital, Lima, Peru, for root canal treatment on the right maxillary lateral incisor. The chief complaint of the patient was “darkening of the upper front tooth”. Medical history was noncontributory. Clinical examination revealed no extraoral abnormalities and a leaked palatal restoration. Response to both percussion and the cold test was negative. Mobility was within regular patterns (grade 1 according to the Miller index), while palpation and periodontal probing depth (2mm) evidenced neither alteration of adjacent soft tissues nor periodontal pockets. The adjacent teeth were clinically healthy and typically shaped at the crown. Radiographic examination revealed a periradicular radiolucency. Also, unusual root canal morphology suggesting two canals was suspected.

The patient was diagnosed with pulp necrosis and asymptomatic apical periodontitis. After obtaining informed consent, nonsurgical endodontic treatment was planned over two sessions, using Calcium hydroxide as an intracanal medication. The entire procedure was performed under 3.5x magnification.

The restoration was removed under local anaesthesia (2% Lidocaine with 1:80000 epinephrine), and the pulp chamber was accessed. After removing the superficial necrotic tissue and cleaning the chamber with 5% sodium

Author affiliations:
José Diego Torres Mantilla: Institution: Department of Endodontics, Carlos Lanfranco La Hoz Hospital. Saenz Peña avenue n/n 6. Puente Piedra. PC: 15118. Lima. Perú. Perú. ORCID: 0000-0003-4733-3489

Corresponding author: José Diego Torres Mantilla
Department of Endodontics, Carlos Lanfranco La Hoz Hospital.
Tel: 011-51-992052955
E-mail address: diegotm548@gmail.com

Figure 1. Preoperative radiograph. Unusual root canal morphology suggesting two canals in the maxillary lateral incisor.

hypochlorite, palatal and buccal canal entrances were identified. Under rubber dam isolation, the canals were accessed using hand files 10 (C-pilot, VDW). Working length was determined using an Apex Locator (ProPex Pixie, Dentsply) and controlled radiographically (Fig 2). Although radiographic control showed both canals converging, a 2mm difference in working length was recorded. A superposition was suspected considering palatal and buccal localisation of the entrances. In order to determine the accurate measurement of canals, another radiograph was taken at a severe distal angulation, and the presence of two independent canals could be confirmed.

A glide path was created employing hand files until a 15 flexofile instrument was fitted loosely at working length in each canal and then a rotatory nickel-titanium file (Proglider, Dentsply). The canals were cleaned and shaped using constant irrigation of 5% sodium hypochlorite 3 mm before working length and reciprocating movement files (Wave One Gold, Dentsply) up to a 035 .06 file. Both canals had independent foramina (Fig. 3). A paste of Calcium Hydroxide (Calcifar-P, Eufar) was used as intracanal medication, and the access cavity was sealed with Zinc Polycarboxylate cement.

The final session was three weeks later. Calcium Hydroxide was removed from the canals with ultrasonic activation of 17% EDTA and 5% sodium hypochlorite. After controlling the working length radiographically, the canals were dried with paper points and obturated with non-standardised gutta-percha points (Fig. 4). A resin-based cement (AH plus, Dentsply) was used as the root canal sealer. Each of the canals was obturated employing the Tagger's hybrid technique. The tooth was provisionally restored, placing a lining glass ionomer cape at the bottom of the chamber and a composite covering. The patient was advised to get prosthetic rehabilitation.

DISCUSSION

Dental literature describes lateral maxillary incisors as a single-rooted tooth with one root canal in 100% of cases,[10-17] despite some morphological studies have found a 3% incidence of two canals.[10,16] Although this anatomical variant is infrequent,[10,16,17] some case reports provide enough indications to note the presence of more than one root canal, which must be considered during the endodontic therapy to avoid untreated canals. [17,19-21]

The root anatomical variations in maxillary lateral incisors are attributed to specific developmental defects: fusion, gemination, "dens in dente", and palatal groove. [10,22,23] Therefore, identifying the aetiology of the abnormality is crucial to developing an appropriate treatment plan. [17,22,23] Dental fusion is a type of anomaly characterised by two independent tooth buds that fuse during crown development, resulting in the formation of a tooth with double crowns and two root canals associated with a single root each. [17,21] Likewise, dental gemination consists of a single tooth divided during formation, resulting in two crowns with one root. Clinically both the fusion and the germination show alteration in the shape of the crown. [19,24] “Dens in dente” is the invagination of the enamel organ within the dental papilla before proper calcification. Although a small fossa may appear on the palatal surface, the diagnosis is usually made by noticing a radiopaque image expanding the affected root to create the appearance of a tooth inside another tooth.[17,23,24] For its part, the palatal groove is a developmental disorder

Figure 2. Radiographic working length control. Apparently both canals converge in one single exit, but the apical locator records a different lenght for each canal.

Figure 3. Radiographic working length control after instrumentation. A slightly angled radiograph shows two independent foramina.

in which a deep groove begins in the area of the central fossa and extends apically over the root surface.[17,23] Typically, the groove determines the appearance of palatal periodontal pockets, endo-periodontal lesions and surgical complemental treatment is required.[22] In the present case, clinical examination showed a regular pattern in the shape of the maxillary lateral incisor, the number of teeth and the absence of invaginations and periodontal pockets. Besides, the radiographic image was compatible with one single root: regular-sized, normal proportioned and one continuous unique periodontal ligament space. This analysis dismissed the aforementioned developmental defects, leading to a diagnosis of two canals in one single root.

Radiographic analysis is decisive for the identification of additional canals. [11,12,14,18] Angled radiographs allow a clear interpretation of the direction and continuity of the canals. [17,20] Usually, additional root canals in the maxillary incisors join at the level of the apical third to end in a single foramen (Vertucci type II)[10,16,17.] In the present case, each canal ended in an independent foramen (Vertucci type IV) (Fig. 3-4). The apical locator recorded a difference of 2mm between each canal, which indicated the presence of two separate foramina. The CBCT can be an essential help in detecting variations in the number and orientation of root canals.[11-14,18,20] Even though it was not possible to access a CBCT for the present case, the usage of the buccal object rule (SLOB rule) described by Clark supplemented the limitation. Taking radiographs from different angles

Figure 4 4a: Orthograde radiograph shows both canals superposed, creating an image of joined canals at the apical third. 4b. Distal angled radiograph shows the real orientation of buccal and palatal root canals; both of them with independent foramina.

verified the independence of each canal. Even so, in cases where morphological alterations in the root canals are suspected, the use of a CBCT should be part of the protocol for endodontic treatment planning.

Several case reports demonstrate that most root canals in lateral incisors are located in palatine and buccal.[19,20] In the present case, the use of 3.5x magnification and the flooding of the pulp chamber facilitated the location of the buccal canal entrance. Magnification has improved various endodontic procedures, leading to improve outcomes.25 It is utterly beneficial for proper exploration in small pulp chambers and narrow canals.

The relationship between anatomical alterations and treatment protocols is not entirely clear.[10,22,23] Alterations of form such as fusion, gemination, "dens in dente", or palatal groove require individual therapeutic approaches concerning the singular disposition of the pulp chamber or the specific depth measurement of invagination in every single case.[17,19,22,23] However, the variation in the number of canals does not affect the shaping, cleaning and obturation procedures required for periapical healing or prevention of apical periodontitis.[17-21] Both canals were managed following the usual protocol for pulp necrosis in the present case. Only the curvature degree of the apical third was a consideration to use a system of reciprocating files along with preflaring.

In the systematic reviews founding variations in the number of root canals, the population under study is non-Caucasian and from a heterogeneous ethnicity.[10,11,12,16] The cause of two root canals in the maxillary incisors may be due to an alteration of the normal development of the Hertwig epithelial sheath.[24] Furthermore, some studies have related gender and ethnicity to morphological alterations of inter-radicular anatomy.[13,14,16] This article reports the incidence of a maxillary lateral incisor with two canals, in a single root and with two independent foramina. The patient was a female native of Peru, whose population is characterised by marked ethnic heterogeneity.

CONCLUSION

In conclusion, deep knowledge of the dental anatomy is necessary to detect possible alterations of the internal root anatomy and treat them during endodontic therapy. In case of finding an alteration of the root anatomy, it would be necessary to determine its aetiology and the use of CBCT or angled radiographs to make an appropriate treatment plan. According to their curvature, permeability and pulp and periapical diagnosis, additional canals should be treated through regular protocols. Also, studies should be conducted on the morphological variability of the internal root anatomy considering ethnicity and gender.

Conflicts of interest

The author has no conflict of interest to declare.

REFERENCES

1. Friedman S, Abitbol S, Lawrence HP. Treatment outcome in endodontics: the Toronto Study—phase 1: initial treatment. J Endod. 2003; 29(12):787–93.
2. Setzer FC, Boyer KR, Jeppson JR, Karabucak B, Kim S. Long-term prognosis of endodontically treated teeth: a retrospective analysis of preoperative factors in molars. J Endod. 2011; 37(1):21–5
3. Siqueira JF. Reaction of periradicular tissues to root canal treatment: benefits and drawbacks. Endod Topics. 2005; 10(1):123–47.
4. Gomes BPFA, Pinheiro ET, Jacinto RC, Zaia AA, Ferraz CCR, Souza-Filbo FJ. Microbial analysis of canals of root-filled teeth with periapical lesions using polymerase chain reaction. J Endod. 2008; 34(5):537–40.
5. Hoen MM, Pink FE. Contemporary endodontic retreatments: an analysis based on clinical treatment findings. J Endod. 2002(12); 28:834–6.
6. Song M, Kim H, Lee W, Kim E. Analysis of the Cause of Failure in Nonsurgical Endodontic Treatment by Microscopic Inspection during Endodontic Microsurgery. J Endod. 2011;7(11):1516-19.
7. Khan M, Rheman K, Saleem M. Causes of Endodontic Treatment Failure-A Study. Pakistan Oral & Dental Journal 2010; 30(1):232-6.
8. Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects. Eur J Dent. 2016;10(1):144–147.
9. Olcay K, Ataoglu H, Belli S. Evaluation of Related Factors in the Failure of Endodontically Treated Teeth: A Cross-sectional Study. J Endod. 2018;44(1):38-45.
10. Cohen S, Hargreaves KM, Berman LH. Cohen's Pathways of the Pulp. 10th ed. St. Louis, MO: Mosby; 2010.
11. Martins, J. N. R., Marques, D., Mata, A., & Caramês, J. Root and root canal morphology of the permanent dentition in a Caucasian population: a cone-beam computed tomography study. Int Endod J. 2017; 50(11): 1013–1026.
12. Estrela, C, et al. Study of Root Canal Anatomy in Human Permanent Teeth in A Subpopulation of Brazil's Center Region Using Cone-Beam Computed Tomography - Part 1. Braz Dent J. 2015; 26(5): 530-536.
13. Pan, J., Parolia, A., Chuah, S. R., Bhatia, S., Mutalik, S., & Pau, A. Root canal morphology of permanent teeth in a Malaysian subpopulation using cone-beam computed tomography. BMC oral health. 2019; 19(1): 14.
14. Martins JN, Marques D, Silva EJNL, Caramês J, Versiani MA. Prevalence Studies on Root Canal Anatomy Using Cone-beam Computed Tomographic Imaging: A Systematic Review. J Endod. 2019 Apr;45(4):372-386.
15. Ahlbrecht CA, Ruellas ACO, Paniagua B, Schilling JA, McNamara JA Jr, Cevidanes LHS. Three-dimensional characterization of root morphology for maxillary incisors. PLoS One. 2017 Jun 8;12(6): e0178728. doi: 10.1371/journal.pone.0178728. eCollection 2017.
16. Sert S, Bayirli G. Evaluation of the Root Canal Configurations of the Mandibular and Maxillary Permanent Teeth by Gender in the Turkish Population. J Endod. 2004; 30(6): 391-8.
17. Ahmed HM, Hashem AA. Accessory roots and root canals in human anterior teeth: a review and clinical

considerations. Int Endod J. 2016 Aug;49(8):724-36.
18. Park PS et al. Three-dimensional analysis of root canal curvature and direction of maxillary lateral incisors by using cone-beam computed tomography. J Endod. 2013; 39(9):1124-9.
19. Romano N, Souza-Flamini L, Lima I, Gariba R, Miranda A. Geminated Maxillary Lateral Incisor with Two Root Canals. Case Rep Dent. 2016; 3759021. doi: 10.1155/2016/3759021.
20. Elbay M, Kaya E, Elbay Ü&, Sarıdağ S, Sinanoğlu A. Management of two-rooted maxillary central and lateral incisors: A case report with a multidisciplinary approach involving CAD/CAM and CBCT technology. J Pediatr Dent. 2016;(4):51-4.
21. Saberi, E., Bijari, S., & Farahi, F. Endodontic Treatment of a Maxillary Lateral Incisor with Two Canals: A Case Report. Iran Endod J. 2018; 13(3), 406–408.
22. Kishan KV, Hegde V, Ponnappa KC, Girish TN, Ponappa MC. Management of palato radicular groove in a maxillary lateral incisor. J Nat Sci Biol Med. 2014; 5(1):178–181.
23. Barzuna M. Dens in dente: anomalía dental difícil de tratar. reporte de un caso clínico. Rev. Cient. Odontol. 2013; 9(2): 35-38.
24. Sapp P, Eversole L, Wysocki G. Contemporary Oral and Maxillofacial Pathology 2nd. ed. Ámsterdam, MO: Mosby; 2004.
25. Low JF, Mohd Dom TN, Baharin SA. Magnification in endodontics: A review of its application and acceptance among dental practitioners. Eur J Dent. 2018; 12(4): 610–616.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a7

Bilateral Radicular Cyst – *A Rare Case Presentation*

SADJ June 2022, Vol. 77 No. 5 p299 - p301

S Karpagavalli[1], S Subramanian[2], V Vaishnavi[3], G Sivadas[4]

ABSTRACT

Radicular cyst usually originates as a sequel to a periapical inflammatory process following an injury. This report presents a case of radicular cyst with "bilateral involvement" of permanent central incisors with an atypical radiographical finding and pathological picture that has been discussed. An extensive review of radicular cyst with rarity as seen in the present case was studied. Further importance on treatment with a long term following up of the patient was noted. A sound knowledge regarding the rarity of this lesion is necessary to aid in early diagnosis with an appropriate treatment plan for general practitioners.

Key words

Bilateral radicular cyst, inflammatory cyst, cell rests of malassez, cholesterol clefts

INTRODUCTION

Radicular cysts is the most common inflammatory epithelial cysts occurring in 7-54% of all jaw cysts.[1] Synonymously, this lesion is termed by inflammatory periapical cyst, dental cyst and root end cyst. Varied etiologies like dental caries-pulp necrosis, trauma, tooth fracture, improper restoration, infection and long term chronic periapical granuloma may result in the formation of this radicular cyst.[2] Frequently, these asymptomatic lesions are diagnosed on routine clinical and radiographic examination.[3]

These lesions are afterward confirmed on pathological examination correlating to the preexisting radiographic and clinical aids by the clinician. The purpose of this article is to report the occurrence of a relatively rare case of radicular cyst involving two adjacent teeth exhibiting an atypical radiographic and histopathological appearance. This article also highlights the etiopathogenesis, clinical, radiographic and histopathology picture, with various modes of treatment.

Author affiliations:

1. **Shanmugasundaram Karpagavalli:** (MDS) Prof & Head, Dept. of Oral Medicine & Radiology, Seema Dental College & Hospital, Rishikesh, Uttarakhand.
2. **Sathasiva Subramanian:** (MDS) Prof & Head Dept. of Oral Medicine & Radiology , Faculty of Dental Sciences, Sri Ramachandra University, Chennai, Tamil Nadu.
3. **Vedam Vaishnavi:** (MDS) Senior Lecturer, Faculty of Dentistry, AIMST University, Malaysia.
4. **Ganapathy Sivadas:** (MDS) Senior Lecturer, Faculty of Dentistry, AIMST University, Malaysia.

Corresponding author:
Dr.Vaishnavi Vedam
Senior Lecturer (Oral Pathology), Faculty of Dentistry, AIMST University, Malaysia Ph No: +60 1764 47 178
Email: vaishnavivedam@gmail.com

Author Contributions:

1. Shanmugasundaram Karpagavalli: 25%
2. Sathasiva Subramanian: 25%
3. Vedam Vaishnavi: 25%
4. Ganapathy Sivadas: 25%

CASE PRESENTATION

A twenty-six-year-old female reported with a complaint of mobile upper front teeth for the past two years. Her history revealed that she suffered trauma to these teeth during a bicycle accident sixteen years earlier, following which she noticed fractures of these teeth. The patient was symptomatically treated with medications in a local hospital, but eventually the teeth started to discolor and pus drained from apical fistulae. On intraoral examination, there was a soft, fluctuant non-tender diffuse swelling in relation to the discolored mobile upper central incisor teeth (Fig. 1). Pus discharge in the periapical aspect of the same teeth was also noticed. There were no other abnormalities seen.

Vitality test of the maxillary central incisors was negative. Fine needle aspiration (FNAC) collected 0.5 ml of straw-colored fluid, presumed to be pus with blood content. Radiographs (intraoral periapical radiograph and standard maxillary occlusal radiograph) revealed an osteolytic radiolucency which was well-delineated around the roots of the teeth, and had a radio-opaque sclerotic border (Fig. 2). Based on the history as well as the clinical-and laboratory findings, a provisional diagnosis of an infected radicular cyst associated with the fractured upper central incisors was made. Then, preoperative recommendations and laboratory blood tests (complete blood count and activated partial thromboplastin time (APTT) was

Fig. 1: Pre-operative intraoral view showing swelling and sinus opening in the periapical aspect of maxillary right and left central incisors

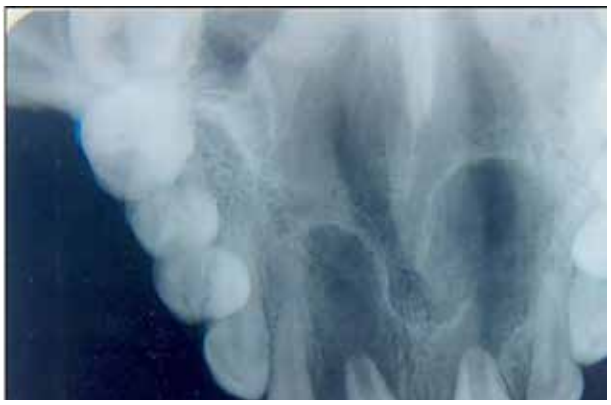


Fig. 2: Standard maxillary occlusal radiograph showing the extent of radiolucency in the periapical aspect of teeth 11 and 21.

performed before the surgical intervention. Treatment consisted of cyst enucleation and extraction of the upper central incisors followed by suturing and wound care. The specimens were fixed in 10% formalin and sent for routine microscopic examination to confirm the provisional diagnosis of a radicular cyst.

Histologic examination of both tissue specimens exhibited similar picture: a cystic lumen lined by varying thickness of non-keratinized stratified squamous epithelium with an arcading appearance (Fig. 3). The surrounding connective tissue capsule was severely infiltrated by chronic inflammatory cells, Rushton bodies, foam cells, cholesterol clefts, and numerous blood capillaries and extravasated RBCs (Fig. 4). These findings confirmed the diagnosis of radicular cyst. No complication or residue was seen on a 2–year follow-up.

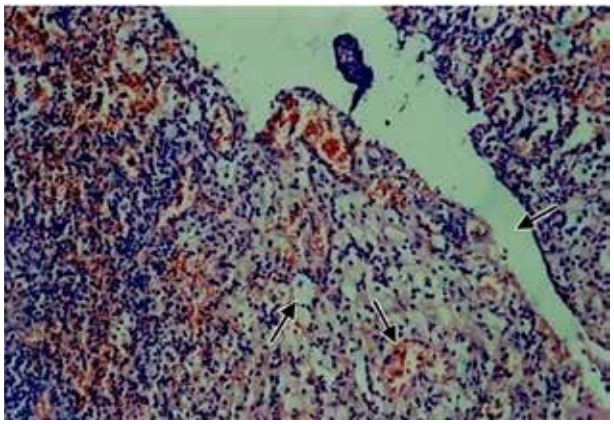


Fig. 3: Microscopic image of the lesion exhibiting the cystic lumen with surrounding inflammatory tissue with engorged blood vessels and chronic inflammatory lesion with evidence of numerous macrophages (H and E stain; Low Power)

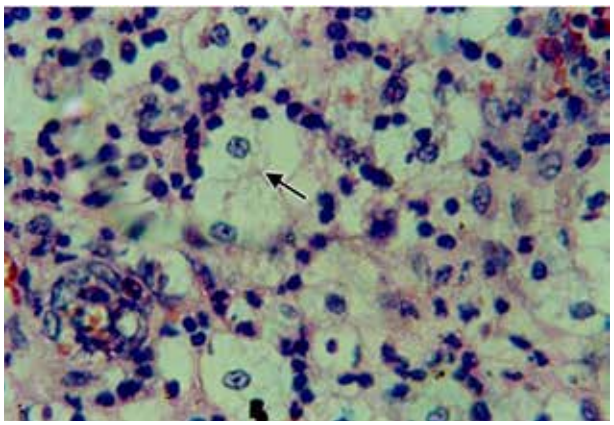


Fig. 4: Microscopic image of the lesion exhibiting the cystic lumen with surrounding inflammatory tissue with engorged blood vessels and chronic inflammatory lesion with evidence of numerous macrophages (H and E stain; High Power)

DISCUSSION

Radicular cysts are one of the frequently seen jaw cysts in the oral and maxillofacial region. Demographically, these lesions occur in the third to fourth decades of life with a slight male predominance (3:2). Most of the radicular cysts are found in the maxilla, especially around incisors and canines (3:1).[4] The prevalence rate varies between 8.7% to 37.7% of all chronic inflammatory lesions.[5] Radicular cysts slowly increase in size to eventually cause cortical plate expansion, which is characterized by egg-shell crackling. Pain is possible if the lesion becomes secondarily infected.

Radio graphically, radicular cysts may mimic a Dentigerous cysts, Odontogenic keratocysts, and Odontogenic tumors such as Ameloblastoma, Pindborg tumor, Odontogenic fibroma, and Cementomas.[7] The common signs of radicular cysts are buccal cortical plate expansion, well defined radiolucency, thin reactive cortex and displacement of adjacent permanent teeth. The radiographical picture in our case resembles the literature findings, but with a slightly varied presentation. This case represents two separate radiolucent lesions involving permanent maxillary right and left central incisors with each lesion surrounded by a separate well-defined radio-opaque border.

The etiopathogenesis of radicular cysts still remains controversial. Various theories have been proposed, such as epithelial colonization, epithelial cavitations, and microabscess formation.[8] Among them, the most accepted theory suggests that the accumulated epithelial cells of the existing periapical granulomas undergo degeneration and necrosis due to the decreased vascularization resulting in a central area of the cyst surrounded by the arcading pattern of proliferating epithelium. These lesions start proliferating from the epithelial remnants of cells of Malassez (periodontal ligament), the sinus lining or lining of fistulous tracts depending on various sites of occurrence.[9]

The pathogenesis of cysts has been described in three phases. Initially, the epithelial cell rests of Malassez begin to proliferate as a direct result of the inflammation and are subsequently altered by bacterial antigens, epidermal growth factors, metabolic and cellular mediators. Predominantly, these lesions present with prostaglandins (PGs), interleukin-1 (IL-1), Il-3, IL-4, IL-6, interferon (IFN), tumor necrosis factor-alpha (TNF-α), and transforming growth factor-alpha (TGF-α) and chemokines - RANTES, IP-10, and MCP-1as chemical mediators for epithelial proliferation.[10] In the second phase, a cavity is formed, lined by epithelium and in the third phase, the cystic growth due to osmosis is evident. This cystic growth and expansion occur due to the release of histamine, hydrolytic enzymes (matrix metalloproteinases) and bone-resorbing factors. In our present case, the traumatic incident with chronic inflammatory lesion at the periapical aspect of central incisors evoked a stimulation of epithelial rests

of malassez. Continued activation of the inflammatory mediators had resulted in enlargement of the lesion to the present state.

On histopathological examination, a cystic lumen lined by epithelium is seen. The epithelium varies from the most common non-keratinized stratified squamous epithelium to varying degrees of columnar ciliated epithelium or muco-secretory cells (maxillary sinus or the nasal cavity). The cystic wall exhibits peculiar features of an abundant degree of inflammation (T-cells and B-cells), macrophages, Rushton bodies, cholesterol clefts, and an endothelial response. The present case matches this microscopic appearance. The uniqueness of the present case lies in the pathologist's opinion as to the separate enucleated tissues adjacent to the permanent maxillary right and left central incisors exhibits a similar histopathology picture.

Treatment of all odontogenic cysts include complete local surgical excision, decompression, marsupialization (large lesions, lesions close to vital structures) and finally extraction of the offending teeth. Also, over a 2-year follow up, no malignant transformation was noticed. In such lesions, patients and clinicians combined effort is needed for success of treatment.

CONCLUSION

The present case report demonstrates a radicular cyst invading the periapical region maxillary anterior teeth in a unique manner. The radio graphical appearance and a similar pathology picture of the two separate cysts adjacent to each other could be used as an interesting data due to its rarity. Although radicular cysts appear as common cystic lesions of the jaws, a sound knowledge of this atypical presentation of bilateral radical cyst should be at the back of the clinician mind to set apart the aggressiveness of this lesion. It is mandatory for all the pathologists to have an in depth knowledge about the lesion and also other lesions which have similar presentations, in order to correctly diagnose the lesion.

Acknowledgements: None

Conflicts of interest

The author has no conflict of interest to declare.

REFERENCES

1. Toomarian L, Moshref M, Mirkarimi M, Lotfi A, Beheshti M. Radicular cyst associated with a primary first molar: A case report. J Dent (Tehran). 2011;8(4):213-217.
2. Cawson RA, Odell EW dan Porter S. Cawson's Essential of Oral Pathology and Oral Medicine 7th Ed. Edinburgh: Churchill Livingstone, 2002; 103-108.
3. Saquete R, Brasileiro BF, Rabello M. Radicular cyst in maxilla. Clinic surgical case report. 2009; 182-191.
4. Radicular and residual cysts. Mervyn Shear & Paul Speight. Cysts of the Oral and Maxillofacial Regions. Fourth edition Wiley-Blackwell Publishers 2007; 123 -142.
5. Pekiner, Filiz Namdar et al. "Clinical and radiological features of a large radicular cyst involving the entire maxillary sinus." Journal of Marmara University Institute of Health Sciences 2 (2012): 31-36.
6. Stuart C. White, Michael J. Pharoah. Oral Radiology Principles and Interpretation 8th edition Mosby Publishers 2019; 387-410.
7. Adel B, Kawthar S, Souha B. Extensive periapical cyst in the maxillary sinus 'a case report'. International dental journal of student's research: case report. 2012; 1:14-24.
8. Venkateshwar G, Girotra C, Mandlik G. Extensive radicular cyst of the mandible: a rare case report. International Journal of Medical Dentistry 2013; 1:71-75.
9. Muglali M, Komerik N, Bulut E, Yarim GF, Celebi N, Sumer M. Cytokine and chemokine levels in radicular and residual cyst fluid. J Oral Pathol Med 2008; 37:185-9.
10. Hayashi M, Ohshima T, Ohshima M. Profiling of Radicular Cyst and Odontogenic Keratocyst Cytokine Production Suggests Common Growth Mechanisms. J Endod 2008; 34:14 –21.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a8

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

SADJ June 2022, Vol. 77 No.5 p302 - p305

Prof V Yengopal, Dean, Faculty of Dentistry, University of the Western Cape, University of the Western Cape

INTRODUCTION

At the 74th session of the World Health Assembly held from 24 May to 1 June 2021, the World Health Organisation (WHO) approved a landmark resolution on oral health. The resolution recognized the global burden of oral diseases and their associations with other conditions, urging Member States to address shared risk factors, enhance the professional capacity of oral health professionals to deliver consistent and quality care, and to include oral health in universal health coverage (UHC) benefit packages. It also requested WHO to develop a global strategy and action plan on oral health with 2030 targets, among other follow-up actions. In support of this resolution, the FDI and International Association for Dental Research (IADR) urged Member States to adopt the proposed resolution and strengthen its implementation by:

1. Addressing orofacial clefts, access to affordable fluoridated toothpaste, and community-based fluoridation where relevant, as advised by the updated DG's report.
2. Promoting dental research to strengthen evidence on prevention, oral health disparities, oral disease associations with other NCDs such as diabetes, heart disease, stroke, kidney disease, mental and neurological disorders, chronic respiratory diseases, and cancers; and research into full alternatives to dental amalgam, being affordable and accessible.
3. Meaningfully engaging people living with oral diseases, oral health professionals, national dental associations, and other civil society organizations in oral health programmes.
4. Ensuring that future processes, such as the proposed resolution on Diabetes and the upcoming 2023–2030 NCD implementation roadmap, integrate and align with the resolution on Oral health.

In light of this acknowledgement of the link between oral health and general health, the next few series of evidence based in clinical practice columns will review the evidence of the link between diet and general health and diet and oral health.

1. Meat consumption and risk of ischemic heart disease: A systematic review and meta-analysis

There is uncertainty regarding the association between unprocessed red and processed red meat consumption and the risk of ischemic heart disease (IHD), and little is known regarding the association with poultry intake. The aim of this systematic review and meta-analysis was to quantitatively assess the associations of unprocessed red, processed meat, and poultry intake and risk of IHD in published prospective studies.

METHODOLOGY

Nine electronic databases and the reference lists of included articles, systematic reviews and meta-analyses were used as sources of potential papers for inclusion for this review. The search terms for this review included beef (including hamburger), lamb, veal, goat, pork, horse meat, mutton, venison, boar, hare, rabbit, game, sausage, ham, bacon, pastrami, deli/luncheon meat, nuggets, chicken, turkey, geese, and duck; IHD, coronary heart disease or coronary artery disease (includes angina pectoris, myocardial infarction (MI) [fatal and/or non-fatal. No language restrictions were applied.

Two authors reviewed the titles and abstracts of all articles and included studies that met the following criteria: 1) prospective cohort design, 2) peer-reviewed (except if uploaded on preprint servers), 3) available in full-text, and 4) assessed the relationship between 1(+) meat types and IHD. The meat types included were unprocessed red meat, processed meat, and poultry. Where no composite unprocessed red meat estimate was given, estimates for single meat type (e.g. beef) were used if these were distinctively separate from processed meat.

If more than one unprocessed red meat type was provided (e.g. pork and beef), both were used in separate analyses. Processed meat was defined as a composite by studies without restrictions to the definition. Poultry included either only unprocessed poultry or poultry including processed poultry, whichever was reported. The authors excluded prospective studies based on broader dietary patterns (e.g. vegetarian diets, data-derived dietary patterns, dietary

Prof V Yengopal: *BChD, BScHons, MChD, PhD*, Dean, Faculty of Dentistry, University of the Western Cape, South Africa.
ORCID Number: 0000-0003-4284-3367
Email: vyengopal@uwc.ac.za

indices) if they did not report single meat item results and studies that investigated total meat or other meat types only. Where two or more studies were based on the same cohort, the study with the largest number of cases was included. Any disagreement was resolved through discussion.

Three authors extracted the study information independently. Where multiple outcomes were reported within one study, the outcome that provided the largest case numbers was used; where separate estimates were available for men and women, these were pooled in the meta-analyses

The three authors also assessed the risk of bias using the Newcastle-Ottawa Quality Assessment Scale for cohort studies by assigning one point each for 1) study representativeness (only counting population based-cohorts), 2) using a validated tool of dietary assessment, 3) adjusting for at least age, sex, smoking, physical activity and some measure of socioeconomic status (e.g. income, occupation, education), 4) ascertaining or verifying outcome information using record linkage, and 5) having over two years of total follow-up to reduce the risk of reverse causality. Studies were considered high quality if they met at least 4 of the 5 criteria.

Fixed-effects models were used to calculate summary relative risks (RRs) and 95% confidence intervals (CIs) for dose-response meta-analyses.

RESULTS

From the initial search where more than 2170 records were identified for potential inclusion, a total of 13 cohort studies including 1,437,989 individuals and 32,630 cases were included. The studies were conducted in Asia (n = 3), the US (n = 4), Australia (n = 1), Europe (n = 4), and for one multi-country cohort in the Americas, Asia, Africa and Europe. Most studies included predominantly middle-aged or older adults at baseline. The maximum follow-up time ranged from 6–30 years. Meat intake categories varied, with unprocessed red meat intake in the lowest intake category ranging from 0–25 g/day and in the highest from 10–141 g/day; processed meat from 0–10 g/day to 9–78 g/day; and poultry from 0–12 g/day to 22–68 g/day

Unprocessed red meat intake and IHD

The summary RR of IHD for each 50 g/day intake of unprocessed red meat consumption was 1.09 (95% CI, 1.06 to 1.12), based on 16 estimates from 12 studies. Simply put, there was a 9% increased risk of developing IHD among those individuals who consumed an average of 50 g/day of unprocessed red meat compared to those that did not.
Processed meat intake and IHD

The summary RR of IHD for each 50 g/day intake of processed meat was 1.18 (95% CI 1.12 to 1.25), based on 12 estimates from ten studies. There was a 18 % increased risk of developing IHD among those individuals who consumed an average of 50 g/day of unprocessed red meat compared to those that did not.

Poultry intake and IHD

The summary RR of IHD for each 50 g/day intake of poultry was 1.02 (95% CI 0.97 to 1.07), based on 14 estimates from ten studies. Since the 95% CI crossed the line of no effect (RR=1), it can be concluded that there is no association between poultry intake at 50g/day and IHD.

CONCLUSIONS

This large meta-analysis of meat intake and IHD risk shows that unprocessed red and processed meat might be risk factors for IHD. This supports public health recommendations to reduce the consumption of unprocessed red and processed meat intake for the prevention of IHD.

Implications for practice

These results imply that oral health professionals need to consider the health benefits/risks of the different food groups when giving dietary advice to their patients to promote better oral/general health. The advice for moderation when consuming red meats (processed and unprocessed) and alternatively choosing poultry as a healthier option seems sensible.

REFERENCE

1. Papier K, Knuppel A, Syam N, Jebb SA, Key TJ. Meat consumption and risk of ischemic heart disease: A systematic review and meta-analysis, Critical Reviews in Food Science and Nutrition, 2021; DOI: 10.1080/10408398.2021.1949575

www.sada.co.za / SADJ Vol. 77 No. 5

2. Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies

Vegetarian diet, defined as a dietary profile characterized by abstention from consuming meat and meat products, poultry, seafood and flesh from any other animal, is experiencing a considerable popularity in the general population in many parts of the world. [1] In the recent years though, due to popular culture and famous sporting icons adopting this diet, veganism is also attracting thousands of followers worldwide. The vegan diet is characterised by the total exclusion of any animal-derived substance from the daily food intake. Dino and colleagues (2017)[1] reported on a comprehensive systematic review with meta-analysis of all cross-sectional and cohort studies hitherto published in order to obtain an estimate of the association between vegetarian, vegan diets, and multiple health outcomes, including risk factors for chronic diseases, risk of all-cause mortality, incidence and mortality from cardio-cerebrovascular diseases, total cancer and specific types of cancer.

METHODOLOGY

The review question was structured using the following elements—Population of interest (P); Intervention (I); Comparisons (C); Outcome (O); and Time frame (T)—namely, the PICOT format. For this study Setting (S) was also included. A structured search strategy was developed and run through Medline, Embase, Scopus, The Cochrane Library, and Google Scholar. Additional searches were conducted by scanning references of the identified articles, reviews and meta-analyses. The search was limited to human studies. When multiple articles for a single study were present, we used the latest publication and supplemented it, if necessary, with data from the most complete or updated publication. Eligible studies included any observational study conducted in humans (i.e., cross-sectional studies, case-control, nested case-control, or case-cohort design) that reported a measure of association (such as hazard ratios or incident rate ratios for prospective studies) between vegetarian or vegan diet, assessed by questionnaires, and risk factors for chronic degenerative diseases [body mass index (BMI), total cholesterol, LDL cholesterol, HDL-cholesterol, triglycerides, blood glucose], risk of all-cause mortality, incidence and mortality from cardiocerebrovascular diseases, total cancer and specific types of cancer, confirmed by medical records or registry linkage. The decision to include studies was hierarchical and initially made on the basis of the study title, then of the study abstract, and finally of the complete study manuscript.

Eligible studies were included if they met the inclusion criteria for study design, study population (clinically healthy subjects 18 years old), exposure (vegetarian diet, defined as a diet excluding meat and meat products, poultry, seafood and flesh from any animal; vegan diet, defined as a diet that omit all the animal-derived products), reference group (omnivore diet, defined as a diet consuming all types of foods including meat and meat-products, poultry, seafood and flesh from any animal), outcome and statistics (sufficient data to allow calculation of differences between individuals consuming a vegetarian or a vegan diet and those consuming an omnivore diet).

Two reviewers independently extracted data from all the studies fulfilling the inclusion criteria and any disagreement was resolved by consensus. The methodological quality of the trials included was assessed using elements of the Newcastle-Ottawa Scale (NOS) for assessing risk of bias in observational studies. Review Manager (RevMan, version 5.3) was used to pool data for each risk factor and outcome of interest. The authors conducted pooled analyses using the generic inverse variance method with random-effects weighting. For cross-sectional studies, the weighted mean differences (WMD) was calculated between the subjects following vegetarian or vegan diet and those following an omnivore diet with 95% confidence intervals (CIs). With regard to prospective studies, pooled results were reported as relative risks (RRs) and presented with 95% CIs. $P < 0.05$ was considered statistically significant.

RESULTS

Overall, a total of 108 articles were finally included in the meta-analysis.

Cross-sectional studies

The overall analysis comprised a total number of 56,461 vegetarians and 8,421 vegans compared with 184,167 omnivorous and the mean age varied widely, ranging from 18 to 81 years old. The risk-of-bias assessment for each cross-sectional study included in the meta-analysis reported a low risk of bias only in 2 studies, whereas in the others a moderate-to high risk was present. At the overall analysis, vegetarian diet was significantly associated with lower BMI (-1.49), serum total cholesterol (-28.16 mg/dL), LDL-cholesterol (-21.27 mg/dL), HDL-cholesterol (-2.72 mg/dL), serum triglycerides (-11.39 mg/dL), and blood glucose levels (-5.08 mg/dL) with respect to omnivores. Similarly, vegan diet reported significantly lower BMI (-1.72), serum total cholesterol (-31.02 mg/dL), LDL-cholesterol (-22.87 mg/dL), and blood glucose levels (-6.38 mg/dL), but nonsignificant lower HDL-cholesterol and triglycerides with respect to omnivores.

Prospective cohort studies

The overall analysis for all the different clinical outcomes comprised a total number of 72,298 vegetarians followed for a period ranging from 4.1 to 21 years. One study included only women and 8 studies included men and women. The risk of-bias assessment for the included study reported a low risk of bias in 4 studies and a moderate risk for the remaining.

The association between vegetarian diet and all-cause mortality included 66,018 vegetarians and 8,216 deaths and was found to be nonsignificant (P = 0.24) with an RR of 0.94 (95% CI 0.86 to 1.04) and a significant heterogeneity (I 2 D 83%; P < 0.001).

For vegans and all-cause mortality, the risk ratio was 0.88 (RR 0.88, 95% CI 0.75 to 1.02; P = 0.42) and similar non-significant association was found.

No significant association (P = 0.07) was also found among vegetarians when incidence and/or mortality from cardiovascular diseases were taken as a unique outcome (RR 0.93, 95% CI 0.86 to 1.00). However, when incidence and/or mortality from ischemic heart disease were analyzed separately, vegetarian diet was found to be significantly (p < 0.001) associated with the outcome, with a reduced risk of -25% (RR 0.75, 95% CI 0.68 to 0.82), while nonsignificant (P =0.39) association for incidence and/or mortality from cerebrovascular disease (RR 0.93, 95% CI 0.78 to 1.10) was observed. With regard to incidence of total cancer, meta-analytic pooling under a random-effects model showed significant (P = 0.002) lower risk of cancer among vegetarians (RR 0.92, 95% CI 0.87 to 0.98) and vegans (RR 0.85 95% CI 0.75 to 0.95). Finally, by analyzing different localizations of cancer, nonsignificant reduced risk of incidence of breast cancer (RR 0.94, 95% CI 0.84 to 1.06), as well as mortality from colorectal (RR 0.90, 95% CI 0.76 to 1.05), breast (RR 0.94, 95% CI 0.56 to 1.58), prostate (RR 0.90, 95% CI 0.63 to 1.29) and lung (RR 0.86, 95% CI 0.62 to 1.19) cancer was reported when vegetarians were compared to omnivores.

CONCLUSIONS

The authors attempted to give some answers to common questions such as: are the vegetarian and vegan diets associated with a protection against cardiovascular and cancer disease? From the analysis of the studies available in the literature it was determined that a significant protection against ischemic heart disease and cancer is present in vegetarian subjects, but that this protection is not significant for overall mortality, cardio and cerebrovascular diseases when compared to omnivores. In addition, vegan diet seems to be associated with a lower rate of cancer incidence in general but this result must be interpreted with caution, because of the very small sample size and the low number of studies evaluating this aspect.

Implications for practice

A key function or oral health professionals is to provide dietary advice to patients. It is important that we are aware of the evidence (quality and quantity) of the health benefits of following a vegetarian or vegan diet so that our advice to our patients is not contradicted by other health professionals such as doctors or nutritionists.

REFERENCE

1. Dinu M, Abbate R, Gensin GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies, Critical Reviews in Food Science and Nutrition, 2017; 57: 3640-3649.

.

CPD questionnaire on page 312

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.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a9

Exploring Modern Virtue Ethics in the Context of Oral Healthcare

SADJ June 2022, Vol. 77 No. 5 p306- p309

HD Miniggio[1]

INTRODUCTION

Virtue ethics is established as one of the dominant ethical theories that has application for healthcare practice, including oral health. Attributed to the ancient Aristotelian concepts of living a deeply fulfilled life, virtue ethics draws attention first and foremost, to the significance of character traits, or virtues in the process of ethical decision-making. This focus on character, contrasts with duty-based ethical theories such as deontological ethics (with a primary concern on duties) the principles of biomedical ethics (with a central focus on the principles and the obligations derived from these) and consequentialist ethics (with a primary focus on the consequences of actions).[1]

From a traditional virtue ethics viewpoint, one can evaluate what an appropriate course of action would be in a particular situation. This is achieved by understanding what an individual who has cultivated a virtuous character would be expected to do in a similar situation, coupled with an appreciation of the essential conditions needed to achieve a fulfilled life.[1-4] In recent years, there is increasing interest and regard (in healthcare ethics literature, including oral healthcare) for the types of professional virtues that healthcare practitioners should develop and exercise in their interaction with patients; these professional virtues are also valuable in guiding the ethical decision-making process.[1-3] This interest in virtue ethics is further motivated by the realisation that character cannot be detached from ethical discourse in healthcare provision.[5-7]

However, it seems that the features that make traditional virtue ethics valuable, have also created the impression that this theory is not as effective at providing action-guidance in resolving ethical dilemmas encountered in healthcare provision, as duty-based ethical theories.[5-8] Motivated by this misguided perception of the lack of action-guidance of traditional virtue ethics approaches, a variety of appealing modern forms of virtue approaches, have been put forward. These modern virtue approaches aim to provide a correlation between considerations of virtue (and related virtuous behaviour), vice (and related vicious behaviour) and considerations of right or wrong actions.[1,8]

Given the significance of the development and exercise of virtues in the oral healthcare practitioner-patient relationship, it is surprising that modern virtue approaches do not form an integral component of ethics discourse in oral healthcare. Currently, ethical discourse in the oral healthcare context is still dominated by the four principles of biomedical ethics.

Originally advanced by Tom Beauchamp and James Childress, this approach is appealing as it provides an accessible guide to resolving ethical dilemmas specifically encountered in healthcare provision; these dilemmas are resolved by a process of specifying and balancing the four principles of respect for autonomy, beneficence, non-maleficence, and justice in ethical decision-making.[9] The principle which is determined to carry the greater weight in the particular ethical dilemma, then serves as an action-guiding principle to be followed by the healthcare practitioner.[9] Although these ethical principles represent useful starting points in ethical deliberations, virtue ethics makes further demands on healthcare practitioners. These demands include the development of practical wisdom[a] and the cultivation and exercise of a set of professional virtues that assist healthcare practitioners to manage the nuances characteristic of ethical decision-making in their interaction with patients.[1,8]

In this article, I aim to evaluate whether modern virtue ethics approaches, can provide adequate action guidance in the context of oral healthcare provision and claim that it can. Such an evaluation is significant given that the action-guiding capacity of virtue ethics is not well represented in current ethics literature pertaining to oral healthcare provision.

To achieve this aim, this article is structured as follows. I begin with a brief overview of the modern virtue-based approach that Rosalind Hursthouse and Julia Annas advance, while acknowledging that other authors[b] also advance modern virtue accounts. To this end, I present the several noteworthy features associated with Hursthouse's virtue approach and show how virtue ethics provides adequate action-guidance through virtue rules. I then present the noteworthy virtue elements put forward by Annas, with specific focus on the relevance of virtue ethics in the context of healthcare practice which is characterised by specific aims from which well-established duties, expected from healthcare practitioners, arise.

Author affiliations:
1. Hilde D Miniggio: *BDS* (UMF, Cluj-Napoca), *MScMed* (Bioethics and Health Law) (Wits), *PGDip* (Health Sciences Education) (Wits), Senior Lecturer, Department of Oral & Maxillofacial Pathology, Oral Microbiology & Oral Biology, Sefako Makgatho Health Sciences University, South Africa. ORCID number: 0000-0003-2003-0306

Corresponding author: Hilde D. Miniggio
Department of Oral & Maxillofacial Pathology, Oral Microbiology and Oral Biology, Sefako Makgatho Health Sciences University, South Africa,
Email: hilde.miniggio@smu.ac.za

[a] The word practical wisdom is translated from the Latin word phronesis and is otherwise known as discernment.[9]
[b] Modern virtue-based approaches are proposed by the following authors: Michael Slotes's agent-based approach, Linda Zagzebski's exemplirist virtue theory. Christine Swanton and Liezl van Zyl advance similar agent-based virtue accounts.

I conclude that virtue rules provide adequate demands for right behaviour, virtue ethics accommodates duties and is a helpful action-guiding tool in assisting oral healthcare practitioners in resolving ethical dilemmas encountered in oral healthcare provision. Lastly virtue ethics is valuable in encouraging the development of virtuous character in oral healthcare practitioners.

Modern virtue ethics approaches

Virtue ethics has an interesting history dating back to the Athenian time of Plato and Aristotle, although Aristotle is generally considered the founder of virtue ethics. This theory was overshadowed by the more popular duty-based ethical theories in the 1950's, but has since been restored as a valuable contender to deontology and consequentialism.[8] As Hursthouse and Pettigrove explain, scholars in the field began to recognise that these popular duty-based theories fail to:

> *Pay attention to a number of topics that had always figured in the virtue ethics' tradition—the virtues themselves, motives and moral character, moral education, moral wisdom or discernment, friendship and family relationships, a deep concept of happiness, the role of the emotions in our moral life and the fundamentally important questions of what sort of person I should be and how we should live.*[8]

A virtue is defined by Edmund Pellegrino as "the most ancient, durable, and ubiquitous concept in the history of ethical theory…because one cannot completely separate the character of a moral agent from his or her acts, the nature of those acts, the circumstances under which they are performed, or their consequences".[5] In the context of healthcare provision, it is helpful to think of a virtue as a character trait or quality that enables someone to carry out their duties or functions adequately, thereby enabling them to be good in a specific role, for example good in the role of a healthcare practitioner.[10] The professional virtues that have been designated as important in the oral healthcare practitioner-patient relationship are, amongst others, "compassion, trustworthiness, integrity, discernment and conscientiousness".[9]

It is important to note that although the primary focus of virtue ethics is on the virtues that individuals should develop and exercise, this does not suggest that "only virtue ethicists attend to virtues, any more than it is to say that only consequentialists attend to consequences or only deontologists to rules".[8] This signifies that each of the normative ethical theories will evaluate (as part of the ethical decision-making process) the pertinent aspects associated with the duties within a specific role, the consequences of the various courses of actions as well as the role that character plays in the process; what distinguishes them is the central focus of each theory.[1,8] It comes as no surprise then, that aspects of character and virtues have also been incorporated in modern deontological approaches, the principle-based approach as well as modern consequentialist approaches.[8] However, proponents of duty-based ethical theories seem to be concerned that by focusing primarily on character or by being agent-based, virtue ethics may lose sight of the more practical aspects of right and wrong action and duties.[1,9] The concern is usually presented as follows:

> *If virtue ethics is 'agent-centred rather than act-centred, concerned with 'What sort of person should I be' rather than 'What sorts of action should I do?' (with 'Being rather than Doing'), if it concentrates on the good or virtuous agent rather than on right action and what anyone, virtuous or not, has an obligation to do; how can it be a genuine rival to utilitarianism and deontology? Surely ethical theories are supposed to tell us about right action, i.e., about what sorts of act we should do.*[1]

Several virtue ethicists, amongst others, Rosalind Hursthouse and Julia Annas have provided eloquent counter arguments to the claim that virtue ethics provides insufficient action-guidance and have addressed the concern that virtue ethics may overshadow duties. Hursthouse for example, shows how virtue ethics uses a similar methodology for guiding virtuous behaviour or right action as the rival normative theories. She explains that a specific virtue is useful in providing "a prescription- do what is honest, charitable, generous"; conversely a vice is useful in providing "a prohibition- do not do what is dishonest, uncharitable, mean".[1] In this way, virtue and vice provide virtue-rules, or V-rules as she calls them, and these V-rules in turn, guide behaviours and actions.[1]

Hursthouse further illustrates that even though the focus is on virtue and vice in the form of character development, this does not mean that the theory does not take into consideration duties, principles, or consequences.[1] She also points out that the procedure used in the ethical decision-making process in virtue ethics and for example, deontology, is similar.[1] Both normative theories offer an initial indeterminate premise as follows. The first premise offered by deontology starts by considering that "an action is right iff it is in accordance with a correct moral rule or principle"; while the first premise in virtue ethics begins by considering that "an action is right iff it is what a virtuous agent would characteristically (i.e. acting in character) do in the circumstances".[1] Both of these premises do not, at this initial stage, offer sufficient direction for how one should act and both need further supplementation with a second premise.[1] The second premise for deontology is "a correct moral rule (principle) is one that…".[1] At this stage the second premise can be completed by a set of rules that are "laid down for us by God, or is universalizable/ a categorical imperative".[1] Similarly, the second premise provided by virtue ethics is "a virtuous agent is one who has, and exercises, certain character traits, namely, the virtues" and "a virtue is a character trait that…".[1] At this stage the second premise is similarly completed by either a set of possible virtues or by specifying that a virtue is "a character trait that a human being needs for eudaimonia, to flourish or live well".[1]

The outcome of this process of supplementation and specification in both normative theories, results in the establishment of a principle or rule for deontology versus the establishment of a virtue-rule in the case of virtue ethics.[1] In a similar manner to the action-guidance that emanates from a duty or a principle, virtue-rules make demands that translate into right action or virtuous behaviour.[1,11] For example, from a virtue ethics perspective, the justification for the virtue of honesty is not found in the fact that lying is prohibited by a specific moral duty, but rather that lying

would be dishonest and dishonesty is a vice; a virtuous moral agent would identify lying as such, and would refrain from that sort of behaviour.[1] In other words, the virtue of honesty is able to guide action in that it demands that the individual should "respond to this situation honestly, rather than dishonestly or indifferently".[11] In this way, virtue ethics answers the question 'what should I do?' and V-rules in the form of virtue and vice place strong demands for correct action and behaviour on individuals.[1,11] Thus the concern that by focusing on character development, virtue ethics is unable to provide adequate action-guidance is unfounded. Regarding the concern that virtue ethics may overshadow duties, Annas shows us that virtues are compatible with duties, particularly those well-established and accepted duties within the context of specific professions[11]. Some examples of such professions that she offers are, amongst others, law, and healthcare practice.[11] She explains that the role of virtue ethics in these contexts can be understood in the following manner:

> *The field in question (such as law or medicine)[c] is already established by certain institutions and the roles that these create within them. This is just the point that if I am a judge, for example, I already occupy a role which brings with it certain duties and obligations. Virtues can play more than one role when applied to the field, but it is not called on to create the duties or to serve instead of them: these are already there, as parts of the field within which ethical issues arise, with virtue applied to the field to provide resolution or explanation. The field of law, for example, is already established, with its institutions and its roles, such as that of a judge. It's within this framework that questions can be raised about virtue and vice.*[11]

Virtue ethics is, in this way helpful in assisting individuals within a well-established role, for instance in a role as a healthcare practitioner, in ensuring ethical practice and the achievement of the aims of that profession. Otherwise stated, a healthcare practitioner may perform her basic duties within the specific role that she occupies; while performing her duties she may "be patient and sympathetic, or impatient and unsympathetic, to a patient's account of his symptoms and general problems".[11] Annas further states that "one way of putting this point is to say that virtues of a good doctor are not just virtues at the general level, but virtues as specified within the framework of a given profession".[11]

Lastly, it is interesting to note that "virtue is a matter of degree" and from a virtue-based perspective a distinction is made between what is called a "full or perfect virtue and "continence" or strength of will".[1] In this respect, "the fully virtuous do what they should without a struggle against contrary desires; the continent have to control a desire or temptation to do otherwise".[1] Importantly, an individual or a healthcare practitioner who may not have developed a fully virtuous character as yet, is still able to make decisions and display behaviours that count as virtuous.[4]

Thus, virtue ethics provides adequate action guidance that is comparable to the other ethical theories with the additional benefit of guiding the development of good character in healthcare practitioners.[1,11]

Implications for oral healthcare

Within a modern virtue ethics theory, the professional virtues that have been identified as important for healthcare practitioners to acquire and exercise, make strong claims for action in the context of oral healthcare provision. From the various professional virtues, in the remaining section, I limit my focus on the virtue of compassion and integrity in highlighting the value of virtue in the context of oral healthcare.

The virtue of compassion refers to a character strength that is concerned with the wellbeing of others or an "orientation of the self toward the other".[12] Compassion makes a strong claim on the healthcare practitioner to have "an active regard for another's welfare with an imaginative awareness and emotional response of deep sympathy, tenderness and discomfort at another's misfortune or suffering".[9] The virtue of compassion entails that oral healthcare practitioners are motivated to respond compassionately and not be apathetic to the oral healthcare needs of individual patients and community of patients.

The virtue of integrity is a character trait which presupposes the possession of both the character trait of authenticity as well as honesty.[12] This virtue makes a strong claim on oral healthcare practitioners in respect to speaking "the truth but more broadly presenting oneself in a genuine way and acting in a sincere way; being without pretense; taking responsibility for one's feelings and actions".[12] Acting in a sincere manner is important in maintaining the trust in the oral healthcare practitioner-patient relationship and in respecting the dignity and autonomy of patients. One manner of maintaining authenticity and honesty within the oral healthcare-practitioner patient relationship is by providing truthful information to patients that allows them to make informed decisions regarding their dental treatment. Jorge Garcia considers that "enabling or facilitating (that is, ensuring) a patient's agency by providing her information and securing her consent is a principal mode of the physician's respecting her patient as a person capable of and entitled to self-direction".[6] He further states that "the duty of respecting the particularities of the relationship between each patient-and-physician pairing likewise is a principal way for the physician to treat her patient as unique, unrepeatable, irreplaceable, inexhaustible, infinite, and unfathomable in her personhood".[6]

From a virtue ethics perspective, becoming a good oral healthcare practitioner demands striving for excellence and expertise in technical skills and knowledge; further to that, it requires the development of excellence in character and exercising the specific professional virtues within the relationship with patients and communities of patients. The refinement and the continued exercise of the professional virtues of compassion, trustworthiness, integrity, discernment, and conscientiousness will advance the oral health needs of patients and assists oral healthcare practitioners in fulfilling their duties within

[c] My addition in brackets.

the well-established roles within the profession. It follows that, the ethical duties of oral healthcare practitioners, including the duty to provide informed consent to patients, find a natural home in a modern virtue ethics approach.

CONCLUSION

The aim of this article was to evaluate whether modern virtue ethics can provide adequate guidance in the context of oral healthcare provision. I have shown that by means of virtue rules or V-rules, this theory provides strong requirement for right action or behaviour and virtue ethics accommodates the various duties of oral healthcare practitioners.[1,11]

Importantly, the strength of virtue ethics is that, apart from an evaluation of the various duties, consequences and expected behaviours from oral healthcare practitioners, this theory also calls attention to the development of a virtuous character which requires wisdom and internal motivation and could enrich the ethical discourse in oral healthcare provision.

In conclusion, the value of virtue ethics in oral healthcare can be summarised as follows, being a good oral healthcare practitioner entails being motivated to acquire and sustain excellence in skills and knowledge; this should be coupled with the development of good character and the exercise of professional virtues within the oral healthcare practitioner-patient relationship. This in turn, will advance the oral health needs of each patient as well as communities of patients. Accordingly, a good oral healthcare practitioner "must not only possess skills but be *motivated* properly to use them".[6]

Acknowledgements:
I would like to thank Prof. T. Metz for his valuable contribution in the structuring of the elements of the introduction of this article.

REFERENCES

1. Hursthouse, R. On virtue ethics. Oxford: Oxford University Press, 1999.
2. Pellegrino ED. The internal morality of clinical medicine: a paradigm for the ethics of the helping and healing professions. J. Med. Philos 2001; 26(6): 559– 79.
3. Gardiner P. A virtue ethics approach to moral dilemmas in medicine. J. Med. Ethics 2003; 29(5): 297–302.
4. Garcia JLA. Virtues and principles in biomedical ethics. J. Med. Philos: A Forum for Bioethics and Philosophy of Medicine 2020; 45(4–5): 471–503.
5. Pellegrino ED. Toward a virtue-based normative ethics for the health professions. Kennedy Inst. Ethics J 1995; 5(3): 253–77.
6. Garcia JLA. The physician-to-patient relationship in virtues-based ethical analysis. Life & Learning XXIII 2017; 225: 41.
7. Shea M. Principlism's balancing act: why the principles of biomedical ethics need a theory of the good. J. Med. Philos 2020; 45(4–5): 441–70.
8. Hursthouse R, Pettigrove G. Virtue ethics in E.N. Zalta (ed.) The Stanford Encyclopedia of Philosophy. Stanford: Stanford University, 2018: 1-20.
9. Beauchamp TL, Childress JF. Principles of Biomedical Ethics. New York: Oxford University Press, 1979.
10. Spielthenner, G. Virtue-based approaches to professional ethics: a plea for more rigorous use of empirical science. J. Moral Philos 2017; 16(1): 15–34.
11. Annas, J. Applying virtues to ethics (Society of Applied Philosophy Annual Lecture 2014). J. Appl. Philos, 2015; 32(1):1-14.
12. Peterson C, Seligman M.E.P. Character strengths and virtues: a handbook and classification. New York: American Psychological Association, 2004.

http://dx.doi.org/10.17159/2519-0105/2022/v77no5a10

Maxillofacial Radiology 200

SADJ June 2022, Vol. 77 No.5, p310 - p311

S Nel[1], C Smit[2]

CASE

A 23-year-old female patient presented with diffuse swelling causing intermittent pain involving the left side of the face that had been present for over 10 years. Extra-oral examination revealed expansile lesions in the maxilla and mandible, that appeared mixed radiolucent-radiopaque on panoramic radiography. The maxillary lesion resulted in opacification of the maxillary sinus. The left side of the mandible presented with trabecular bony changes and larger radiolucent areas (Figure 1). Cone-beam computed tomography (CBCT) imaging revealed ground-glass opacification and significant expansion involving the majority of the skull bones on the left with selected bones also affected on the right-hand side. The frontal, temporal, parietal, sphenoid, ethmoid, maxillary, zygomatic bones and mandible were all affected (Figure 2).

Figure 1: Panoramic radiograph showing tooth displacement and ground-glass lesions involving the left maxilla and mandible.

INTERPRETATION

Fibrous dysplasia (FD) is a rare disorder that results in normal bone being replaced by fibro-osseous tissue.[1,2] Post-zygotic substitution mutations of the guanine nucleotide-binding protein (GNAS) gene is responsible for the development of this disorder.[3] Mosaic mutations result in the dysregulated overproduction of cyclic adenosine monophosphate (cAMP) in bone marrow stromal cells, leading to increased proliferation and differentiation of functionally impaired osteoprogenitor cells.[4] This leads to weak, deformed bone; prone to fracture. Varying degrees of mosaicism give rise to a wide clinical spectrum that varies between asymptomatic to severe disabling cases.[1]

FD can present as single lesions (monostotic) where the GNAS mutation occurred in postnatal life. However, if the mutation occurs during embryonic development it can affect multiple bones (polyostotic).[4] When the maxilla is affected, it is referred to as craniofacial FD, due to the involvement of numerous close approximated bones. FD commonly affects the maxilla and presents radiologically with expansion and a ground-glass opacification of the affected bone.[2]

Polyostotic FD occurs in conjunction with extra-skeletal diseases and may be associated with Jaffe-Lichtenstein

Author affiliations:
1. Sulette Nel: *BChD, MSc (Odontology)*. Department of Oral Pathology and Oral Biology, University of Pretoria. ORCID: 0000-0002-0802-079X
2. Chané Smit: *BChD, MSc (Maxillofacial and Oral Radiology)*. Department of Oral Pathology and Oral Biology, University of Pretoria. ORCID: 0000-0003-4047-6356

Corresponding author: Chané Smit
Department of Oral Pathology and Oral Biology, University of Pretoria.
Tel +27 (0)12 319 2311
Email: chane.smit@up.ac.za

Authors contribution:
Sulette Nel: 50%
Chané Smit: 50%

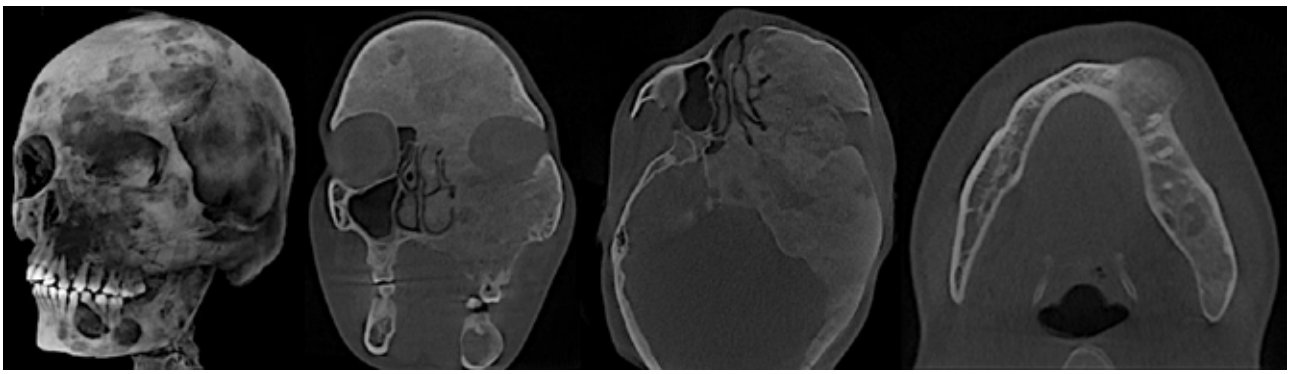


Figure 2: CBCT images showing the extent of involvement of the skull bones. Localised areas of increased expansion were noted in the maxilla and mandible with a mixed density that forms part of the spectrum of polyostotic fibrous dysplasia.

syndrome, McCune-Albright syndrome, or Mazabraud syndrome. Patients with Jaffe-Lichtenstein syndrome present with additional associated hyperpigmented (café-au-lait) skin lesions.[5] McCune-Albright syndrome presents with café-au-lait skin lesions and endocrine disorders (gonadotropin-independent sexual precocity).[4] Mazabraud syndrome is characterized by the involvement of intramuscular myxomas.[6]

In this case, the patient presented with swelling that led to facial asymmetry and tooth displacement as a result of significant expansion of the affected bones. Radiologically, early FD presents as a radiolucent lesion, but over time it develops a homogeneous ground-glass appearance that blends into the surrounding bone.[2] These features are highly characteristic of FD and a strong presumptive diagnosis can be made, but ultimately histologic confirmation is required. In polyostotic FD it is important to rule out additional endocrine disorders to optimise patient treatment. Contouring of the affected bone is required in some cases and surgery can be done for cosmetic improvement. This should however be delayed for as long as possible or until the patient has reached adulthood, as FD usually stabalises with skeletal maturation.[6]

REFERENCES

1. Hartley I, Zhadina M, Collins MT, Boyce AM. Fibrous Dysplasia of Bone and McCune-Albright Syndrome: A Bench to Bedside Review. Calcif Tissue Int. 2019;104(5):517-29.
2. El-Mofty SK. Fibro-osseous lesions of the cranio-facial skeleton: an update. Head Neck Pathol. 2014;8(4):432-44.
3. Hopkins C, de Castro LF, Corsi A, Boyce A, Collins MT, Riminucci M, et al. Fibrous dysplasia animal models: A systematic review. Bone. 2022;155:116270.
4. Weinstein LS. G(s)alpha mutations in fibrous dysplasia and McCune-Albright syndrome. J Bone Miner Res. 2006;21 Suppl 2:P120-4.
5. Miranda PG, Henriques JCG, Paulo LFB, Guedes C, Mitri FF, Silva CJ. Jaffe-Lichtenstein Syndrome Associated with a Simple Bone Cyst: Unprecedented Rare Case Report. Braz Dent J. 2020;31(5):557-61.
6. Baumhoer D. Bone-Related Lesions of the Jaws. Surg Pathol Clin. 2017;10(3):693-704.

CPD questionnaire on page 312

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.

www.sada.co.za / SADJ Vol. 77 No. 5

CPD questionnaire

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

GENERAL

Demography and COVID-19 Symptoms of South African Oral Health Workers in an Academic Hospital

1. Select the CORRECT answer. The prevalence of staff members who were infected with COVID-19 from the Hospital was:
   A. 26.6%
   B. 54.4%
   C. 17.5%
   D. 22.4%
   E. 21.6%

2. Which of the following options is CORRECT. A certain number of staff members received post-test counselling after being infected with COVID-19.
   A. 24.
   B. 54
   C. 17
   D. 22
   E. 21

3. Choose the CORRECT option. Many participants (76.1%) believed that they contracted the virus at _____.
   A. Public transport
   B. Work
   C. Home
   D. Visiting doctors /clinics/hospitals
   E. All of the above

The accessibility to oral health services in Lesotho's public health sector

4. Which of the following options is CORRECT. Lesotho is governed by:
   A. A Constitutional Monarchy
   B. The South African Government
   C. An Independent Republic
   D. Great Britain as a colony
   E. None of the above

5. Select the CORRECT answer. In 2016 the ratio of dentists in the population of Lesotho was
   A. 1:2000
   B. 1:8900
   C. 1:66,666
   D. 1:124,000
   E. 1:152,000

6. Select the CORRECT answer. The proportion of the Lesotho population that resides in rural, mountainous areas is:
   A. 30%
   B. 40%
   C. 50%
   D. 60%
   E. 70%

Buccal corridor changes in orthodontically treated extraction and non-extraction Class 1 patients

7. Which of the following answers is CORRECT. From a total of 871 patient records collected on the Dolphin program how many records met the inclusion criteria?
   A. Forty records
   B. wenty records
   C. Seventy-one records
   D. Two records
   E. None of the above

8. Select the CORRECT answer. What is the mean age of participants?
   A. 12.5
   B. 14
   C. 17.5
   D. 20.5
   E. None of the above

9. Choose the CORRECT option. What study methods did this study employ?
   A. Retrospective record-based
   B. Randomized control Trial
   C. Cohort study
   D. Longitudinal study
   E. None of the above

10. Select the CORRECT answer. According to this study in terms of gender who was in the majority?
    A. Females
    B. Males
    C. Females and males alike
    D. No gender specified

The Role of Community Health Workers in Oral Health Promotion and the Impact of their services in Sub-Saharan Africa: A Systematic Review

11. Choose the CORRECT answer. How many studies were included in this systematic review:
    A. 366
    B. 9
    C. 37
    D. 520

12. Which answer is CORRECT. What percentage of primary prevention was carried out by Community Health Workers (CHWs)?
    A. 44.5%
    B. 78.5%
    C. 33.3%
    D. 22.2%

Diagnosis and treatment of a maxillary lateral incisor with two root canals. A case report.

13. Which of the following answers is CORRECT. Mention the intraoral radiographic technique used to determine the relative position of two objects in the oral cavity using projectional dental radiography
    A. Buccal Object rule
    B. Bramante´s technique
    C. Waters' view
    D. CBTC

14. Select the CORRECT answer. The description of "a developmental disorder in which a deep groove begins in the area of the central fossa and extends apically over the root surface" corresponds to
    A. Dens in dente
    B. Fusion
    C. Gemination
    D. Palatal groove

15. Choose the CORRECT option. The description of "the invagination of the enamel organ within the dental papilla before the calcification of the tissues" corresponds to
    A. Dens in dente
    B. Fusion
    C. Gemination
    D. Palatal groove

Bilateral Radicular Cyst – A Rare Case Presentation

16. Select the CORRECT answer. A 12-year-old female patient presents with an unerupted right maxillary canine. Radiographs demonstrate a unilocular radiolucency encompassing the root of the right maxillary central incisor with evidence of right maxillary impacted canine. History reveals a patient fall at the age of 5 years. Which one of the following is the most likely diagnosis?
    A. Odontogenic keratocyst
    B. Radicular cyst
    C. Gingival cyst
    D. Lateral periodontal cyst
    E. Dentigerous cyst

17. Choose the CORRECT option. Which one of the following is the most common site for the occurrence of a Radicular cyst?
    A. Maxillary anteriors
    B. Maxillary premolars
    C. Mandibular anteriors
    D. Mandibular premolars
    E. Maxillary molars

18. Which of the following options is CORRECT. The cell of origin for 'Radicular cyst' is
    A. Rests of serres
    B. Rests of malassez
    C. Rests of dental lamina
    D. Rests of reduced enamel epithelium
    E. Oral epithelium

Evidence Based Dentistry

19. Choose the CORRECT answer. Which one of the following is NOT an example of a processed meat?
    A. Vienna sausage
    B. Russians
    C. Salami
    D. Steak

20. Which of the following statements is INCORRECT. In the Dino review, which of the following statement is not correct
    A. vegetarian diet was significantly associated with lower BMI (-1.49)
    B. vegetarian diet was significantly associated with lower LDL-cholesterol
    C. vegetarian diet was significantly associated with lower HDL-cholesterol
    D. vegetarian diet was significantly associated with lower serum triglycerides

ETHICS: Exploring Modern Virtue Ethics in the Context of Oral Healthcare

21. Choose the CORRECT answer. One of the following represents a perceived disadvantage of traditional virtues-based approaches:
    A. It is considered to be too reliant of rules and correct action
    B. It is considered unable to direct right action
    C. It is considered unable to evaluate character
    D. It is considered unable to evaluate relationships
    E. None of the above

22. Select the CORRECT option. Modern virtue-based approaches guide actions by:
    A. Considering what a virtuous healthcare practitioner would do in a similar situation
    B. Considering the role and duties of the healthcare practitioner within a specific relationship
    C. Considering the virtue rules in the form of virtue and vice
    D. All three
    E. Only ii and iii

CPD questionnaire

23. Which of the following is CORRECT. One of the following represents an advantage of modern virtue-based approaches:
    - A. It is able to guide action by means of virtue rules
    - B. It is able to guide actions by means of principles
    - C. It is able to guide action by means of rules
    - D. It is able to guide action by balancing benefits and risks

24. Select the CORRECT answer. Rosalind Hursthouse shows that virtue ethics shares the following similarities with duty-based ethics in the ethical decision-making process:
    - A. Both theories offer an evaluation of virtue and vice
    - B. Both theories offer an evaluation of duties as their first premise
    - C. Both theories offer an evaluation of what a virtuous individual would do in a similar case
    - D. Both theories offer an open-ended first premise that requires further supplementation
    - E. None of the above

25. Choose the CORRECT answer. One of the following represents a disadvantage of the principled-based approach:
    - A. It is unable to guide action in ethical decision-making
    - B. It does not place sufficient emphasis on rules in ethical decision-making
    - C. It is unable to provide a user-friendly guide in ethical decision-making
    - D. It does not place sufficient emphasis on character in ethical decision-making
    - E. All of the above

Instructions to authors

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

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

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

We shall be obliged if your submission is prepared respecting all the details listed in these Instructions. This facilitates our process and ensures more rapid responses to you. Please use and submit the Checklist for Authors suplied on page 250 for confirmation. Thank you.

Submission Enquiries

The Editorial Assistant Mr Dumi Ngoepe
Email addresses: sadj@sada.co.za/editor@sada.co.za
For submission instructions kindly refer to the "Submission instructions" page.

Language

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

Clinical Research

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

Clinical Trials

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

Authors

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

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

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

Title

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

Abstract

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

Text

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

Length of the article

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

Illustrations/graphics/photographs

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

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

Continuing Professional Development

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

References

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

Journal references should appear thus:

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

Book references should be set out as follows:

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

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

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

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

Declaration

All sources of funding, possible financial interest/s or incentives in products or services mentioned in the article must be disclosed. Authors are kindly requested to read and sign the attached declaration on page 318.

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

Ethics

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

Conflict of interest

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

Copyright

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

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

Submission

The paper should be submitted in one file including all Tables and Figures and their accompanying Legends Figures should also be submitted separately file in JPEG. format.

Please submit the paper in electronic format in Word along with separate Figures in JPEG. format to: sadj@sada.co.za and to neil.wood@smu.co.za, accompanied by a covering letter and the Declaration on page 318 signed by the author(s).

Galley proofs

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

Editorial Policy

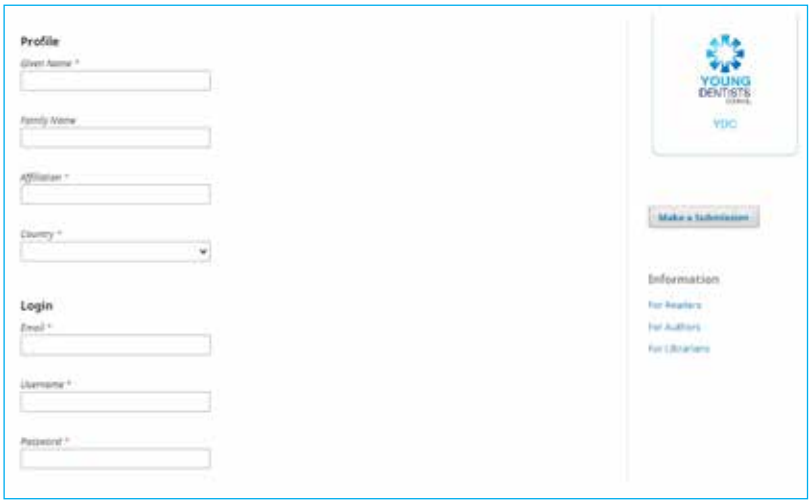
Authors may also wish to refer to the Editorial Policy of the SADJ available on the SADA website.

Enquiries

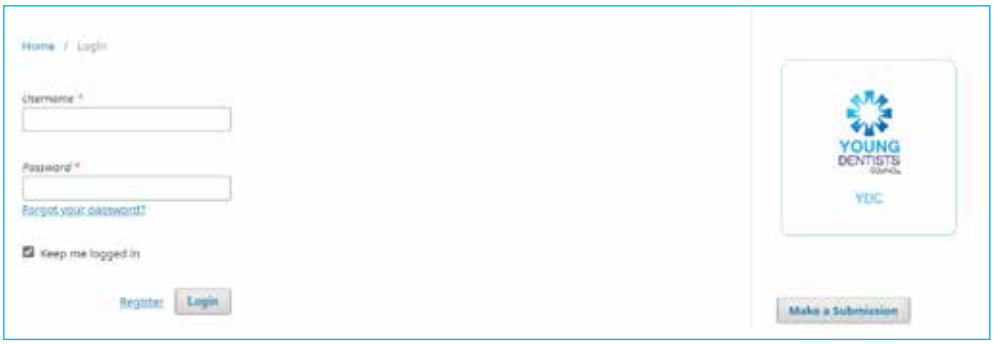
Enquiries regarding Journal matters can be directed to Mr Dumi Ngoepe, Editorial Assistant, at SADA headquarters on: Tel: +27 (0)11 484 5288, Fax: +27 (0)11 642 5718, Email: sadj@sada.co.za

Submission Instructions

To submit a new paper to SADJ, do as follows:
1. If this is your first time using this platform, please Register by completing the online form (once off):
https://journals.assaf.org.za/index.php/sadj/user/register



2. Once registered, make sure you are still logged in (Login every time you want to submit a new paper):
https://journals.assaf.org.za/index.php/sadj/login



3. Click on **Make a new submission.** on the righthand side of the page. Please ensure that the article is anonymized/ No names on the submitted article

4. Familiarize yourself with the Author Guidelines. Then click on **Make a new submission.**

5. Follow the 5 steps as part of the wizard, until the last screen. You will receive a confirmation email once successfully submitted, and the Journal Manager/Editor will be notified.

If you are struggling on how to load/submit kindly email Dumi Ngoepe at SADA on sadj@sada.co.za for assistance.

NOTE: Incomplete submissions will be returned to the authors and will not be considered for peer-review until complete

Declaration by Author/s

TITLE

_____

_____

_____

AUTHOR/S

_____

_____

_____

I/We, the undersigned confirm and declare that:

1. This manuscript is my/our original work and I am/we are the owner/s of this manuscript and possess rights of copyright.
2. I/we confirm that this manuscript has not been published previously and it is not currently considered for publication elsewhere. Has this article been submitted to any other journal and if so, has it been rejected?

   YES ☐ NO ☐
3. For no consideration or royalty, I/we hereby assign, transfer and make over to SADA all the rights of copyright, which have or will come into existence in relation to this manuscript.
4. I/we waive in favour of SADA or any successors in title any moral rights which may be vested in me/us.
5. The manuscript does not constitute an infringement of any copyright and I/we indemnify SADA against all loss or damage, from any cause arising which SADA may sustain as a result of having been granted copyrights to the manuscript.
6. The research has been approved by the Ethics Committee of my/our institution/s or the Ethics Committee/s of other accredited research facilities.
7. I/we have disclosed in my/our Acknowledgments all sources of funding, possible financial interest/s or incentives in products or services mentioned in the paper.

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

Author's Checklist

1	Have you read the Instructions to Authors?
2	Are you submitting electronically?
3	Have you provided all author information including first names, affiliations, qualifications, positions held, Department and Institution, ORCID number, contact details?
4	Is the first author under the age of 35 on submission of the article?
5	Have you provided all details of the Communicating Author?
6	Have you submitted questions for the CPD section? (four or five multiple choice, one correct answer)?
7	Have you submitted details of the contribution of each author... can be percentage or descriptive... or both?
8	Have you confirmed the status of your paper in terms of any Conflict of Interest?
9	Have you submitted the Clearance Certificate number when Ethical permission has been required to undertake research or to publish data?
10	Does the paper adhere to the format requested in Instructions to Author?
11	Are the references quoted according to Journal policy, both in the text and in the list of references?
12	Have all authors signed the Letter of Submission?

NOTES

Smalls advertising and placement procedure

www.sada.co.za

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

QUICK FACTS: SADJ E-Journal

- SADJ features 10 issues per annum.
- SADJ is the official voice for the South African Dental Association.
- SADJ available online at: www.sada.co.za.

QUICK FACTS: www.sada.co.za

The official web portal of the voluntary Association known as The South African Dental Association (SADA)

- Registered users >9 180
- Annual page views >1 284 716
- Average monthly page views >107 059
- Annual users >359 525
- Average monthly users >29 960

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

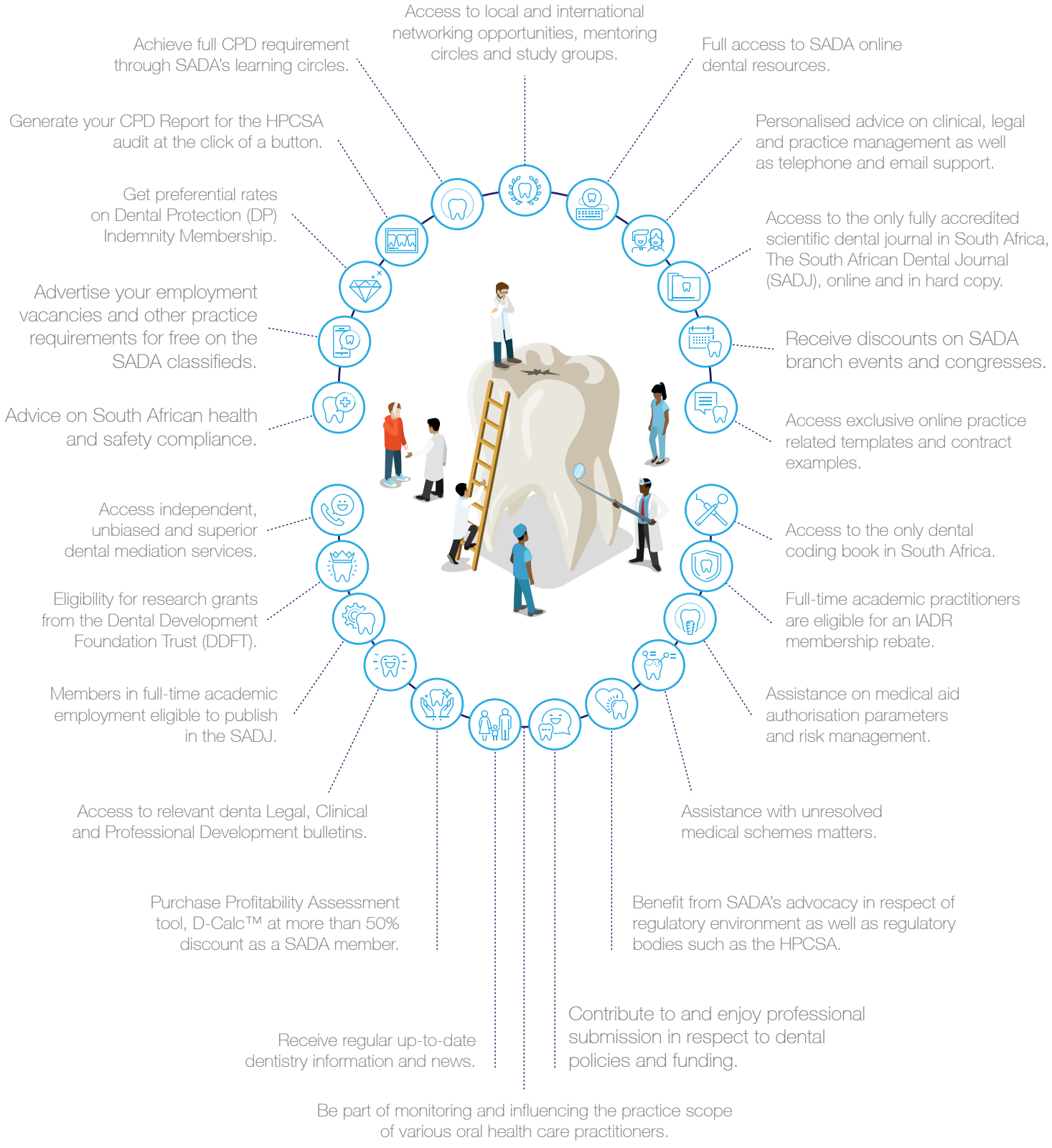
SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

www.sada.co.za

BENEFITS OF JOINING SADA

SADA supports its members throughout their time in the profession - from their time as students in the field, straight through their professional careers, and into retirement.

Our members benefit from the below advantages, amongst others.



SADA
The South African Dental Association **(SADA)** NPC

visit our website at www.sada.co.za for more information.

HELPS **REBUILD** AND **STRENGTHEN ACID DAMAGED ENAMEL**

No.1 **DENTIST RECOMMENDED BRAND** FOR SENSITIVE TEETH*

SENSODYNE PRONAMEL

Specialised Enamel Protection
Rebuilds, Restores, Refreshes

*Expert Performance Tracking 2020