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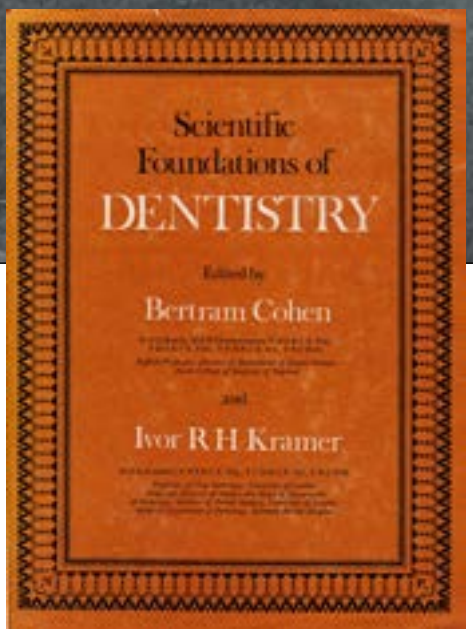
Prof Bertram Cohen CBE in uniform during the Second World War



Prof Bertram Cohen CBE

A South African dentist who achieved worldwide recognition for his outstanding contributions to oral pathology, Professor Bertram Cohen was the first Nuffield Research Professor at the Royal Colleges of Surgery, England.

He served in the Second World War in the South African Medical Corps. A fine start to a life of service.

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Our Front Cover for this Issue...

The theme for the Front Cover of the South African Dental Journal this year provides for some historical figures, some characters illuminating dental history and some important achievements in South African Dental history. The May issue draws focus to a highly distinguished Dentist born in South Africa.
Read more on page 171.

Prof Bert Cohen

A South African dentist who achieved worldwide recognition for his outstanding contributions to oral pathology, Professor Bert Cohen was the first Nuffield Research Professor at the Royal Colleges of Surgery, England. He served in the Second World War in the South African Medical Corps. A fine start to a life of service.

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Prof Bertram Cohen CBE

A South African dentist ascended in 1960 to an appointment as the first Nuffield Research Professor of Dental Science at the Royal College of Surgeons of England, a position he was to hold for more than two decades.

He had qualified at Wits in 1942 and was to lead a life of service and great academic distinction, *vide* the list of degrees: BDS Witwatersrand 1942, HDD RCS Edin 1947, MSD Northwestern 1948, DDS Witwatersrand 1959, FDS RCS 1961, FFD RCSI 1964, FRCPPath 1965, FDS RCS Edin 1967, DDSc Newcastle 1981, FRCS 1984.

Born and schooled in Johannesburg, Bert Cohen registered at Wits in the Faculty of Dentistry, became President of the Dental Students Society, played first team squash and cricket, conducted research into oral disease and on graduation enlisted in the South African Medical Corps.

He served in Egypt and Italy during the Second World War. There is an account of how a sparrow settled on his shoulder …and remained ensconced there for five full days! Perhaps the bird sensed something unusual about the man. Certainly Bert went on to achieve high accolades in the profession.

Prof Bertram Cohen on the banks of the Arno, near Florence, during the Second World War. A small bird settled on his shoulder and stayed there for five days, prompting the locals to name him 'Captain Uccellino', or 'Little Bird'. Image Source: https://www.theguardian.com/education2014/apr/10/bert-cohen-obituary.

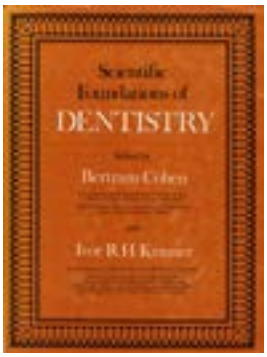
After returning to South Africa he was appointed to the full time staff at Wits, where he lectured with distinction and conducted research... but only for six months as he earned a scholarship to Northwestern University, USA where he gained a Masters degree in Dental Science in 1948.

Back at Wits as a senior lecturer, Bert Cohen continued his academic enterprise in lecturing and in securing grants to sustain his research. He chaired the Scientific Programme committee of the International Conference of the Dental Association and then in 1954 was awarded a Cecil John Adams memorial travelling fellowship which he took up at Hammersmith Hospital in London. There he conducted research in salivary gland function and bone pathology.

Bert Cohen did return again to South Africa but he was destined for further recognition… and by 1957 held appointment as the Leverhulme Research Fellow in Oral Pathology at the Royal College of Surgeons in the United Kingdom. He recognised that fundamental research in dental pathology must be based upon the principles of general human pathology.

That was his guiding concept and his contributions to research on head and neck cancers were outstanding, recognised in 1983 by his post-retirement appointment on the Tumour Panel of the Imperial Cancer Research Fund. Honoured in 1982 by the Queen, he was elevated to Commander of the British Empire (CBE).

Professor Cohen held the accolades of the profession as a highly skilled diagnostic oral pathologist in head and neck cancer. His consuming interest and a major contribution was in dental caries, his objective being the development of an effective vaccine …sadly not yet achieved... but the impact of his work on caries and on periodontal disease has been immense. In 1976 he co-edited Scientific Foundations of Dentistry, a book with contributions from 60 prominent scientists, surely a recognition of the respect in which he was held worldwide.



Scientific Foundations of Dentistry, co-edited by Prof Bertram Cohen in 1976.

It may not be surprising that a man of such enterprise had wide interests in art and literature, distinguishing himself when, using radiological techniques, he identified the authenticity of a Holbein painting. Indeed, in 1980, Bert Cohen delivered a lecture on “A tale of two paintings” dealing with the provenance of two Holbein paintings belonging to the Company of Barbers and the Royal College of Surgeons.

Professor Cohen passed away in 2014, aged 95. Described as a “brilliant, unusual, commanding man”, he was a supreme professional and his record confers accolades on the country of his birth and education, South Africa.

Story Source: https://www.the guardian.com/education2014/apr/10/bert-cohen-obituary.

COVID-19: An opportunity for oral healthcare to define its own future in South Africa?

SADJ May 2020, Vol. 75 No. 4 p172

NH Wood

The responsibilities of the dentist and of other oral healthcare professionals can be broadly explained as the prevention, diagnosis and treatment of the diseases and disorders of the hard and soft tissues of the mouth, in order to improve the overall well-being of a person and/or community. This responsibility extends beyond the single individual to involve the collective as a profession, and is without any hesitation, essential. One common thread in the questions that I frequently see raised in discussions involving professional bodies, is one where practitioners raise concern for the protection of their staff, for their families, and their patients and communities from COVID-19; but almost always it has the connection to income protection. By and large, when the hands of dentists are idle, they do not earn. This has placed the practices and livelihoods of many of our colleagues and friends under considerable strain.

The national lockdown is not all negative for most industries. Instead, many organisations and companies have been forced to enter the 4th industrial revolution because of COVID-19.

However, the national lockdown (now at level 4 to curb the spread of SARS-CoV-2) has dentistry and oral healthcare facing many challenges while we are trying to keep up with the numerous changes in our work environment. A more immediate and obvious change is the impact on information technology and communication systems, and another is the influence on our infection control procedures and policies.

As healthcare professionals in the time of COVID-19, we still have responsibilities towards our patients, communities and peers. Many patients will struggle with access to any form of oral healthcare, with some only having access to those clinics and practices able to provide basic care to alleviate pain and sepsis. In addition to the vital interventions directed to manage pain and sepsis, oral healthcare professionals have an important role to play in primary healthcare, such as screening for diabetes, for hypertension, and even in tobacco-intervention.

We are also faced with equity issues of those vulnerable communities such as the elderly, the poor, and the disabled with regard to access to dental care. It is now up to us to continue to find revolutionary ways to bring oral healthcare services and information to all of our patients, irrespective of their background and location.

In addition to planning for income protection of our peers and colleagues, consolidating strategies to deliver much needed oral healthcare to all our communities must also be considered for this difficult time. These should include delivery-of-care strategy alongside costs-coverage and the provision of PPE and other essential materials. Advances in healthcare technology and improvements in equipment and material technology certainly improves access, ease and efficiency of service delivery; but does this necessarily imply an increase in cost to the operator and/or the patient? Studies will be needed to provide us with definite answers and directions to obtain longer-term solutions, even for the post-Covid future. We are yet to see the sequalae of this unusual situation, both in terms of oral health outcomes in our population due to selected service provision, and of the lack of income of oral healthcare professionals.

Dental education is also being closely scrutinized. As practicing professionals, we have access to webinars, online seminars and discussions for our continued professional development. However, our universities are compelled to provide more creative solutions to facilitate online teaching and learning. Although still in development, novel ways for clinical skills-transfer is currently a globally-focussed topic, as is the financial impact on dental training in the current milieu. Clinical exposure for purposes of training of our undergraduate and postgraduate students is limited to the extreme, and concern for the 2020 academic year is deepening.

I am hopeful that, with the impeding reform of national healthcare, decision- and policy-makers will use this opportunity to take this into consideration, and to include the dental and oral health societies and representative bodies in their planning processes. I would like to remind you to access the SADA resources available to all our members. Specifics and regular updates during the lockdown can be found at https://www.sada.co.za/clinical-resources/ with a list of accessible documents intended to guide us through this COVID-19 maze.

Thank you for your continued support and I give you this May issue of the SADJ.

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

Personal protective equipment under and after COVID-19 need a rethink

SADJ May 2020, Vol. 75 No. 4 p173

KC Makhubele

Today as I write this article, it is with the backdrop of the speech On Thursday, the 23 April wherein President Cyril Ramaphosa announced that the country would resume economic activity in a phased approach from 1 May.

He said "...We have developed an approach that determines the measures we should have in place based on the direction of the pandemic in our country. As part of this approach, there will be five coronavirus level (1-5). What we are facing is a pandemic, all countries affected have approached it differently. We applaud the Government of SA in the timely and considered manner in which they are managing the pandemic."

But one has to ask - or at least this question has crossed many people's mind - what will the world look like when it emerges from the life of lockdowns, quarantine and isolation and the rampant ravages of COVID-19? What will South Africa look like? Close to our heart, how will dentistry look like?

The choices that are being made now and the political outcomes that will follow are critical to determining South Africa's future. Therefore, predicting what will happen after the pandemic is difficult, not least because we have little information about how long the outbreak and restrictions will last.

As a rare event, we have limited historical evidence even with the learning from the Spanish flue; as an unexpected event, little thought has been given to how to deal with it - when our Minister of Finance made his budget recently, he had no idea what would hit South Africa. We have to all readjust our contribution to life in the "new" and "reconfigured "country.

The pandemic will last longer and its effects felt long after it has disappeared. The issue of high-level hygiene is amongst the issues that will be high on the mind of dentistry more than any other health care sectors. It is in this light that I am urging third-party funders to alter their fees without delays and unnecessary long-drawn discussions, to account for the increasing cost of personal protective equipment that dentists are using to protect themselves, their staff and patients.

These organisations should adjust their benefit programs either the maximum allowable fees for all procedures or allow a standard fee per date of service per patient to accommodate the rising costs of PPE. SADA is currently working on guidelines that should have been published at the publication of this article.

To step up the protection of patients, staff and themselves, and the new SADA guidelines, dentists will have to procure a huge amount of PPE and these requirements will without a doubt increase the overhead for every dental practice. These anticipated increases in overhead were not taken into account in the fees in place before the pandemic. I also feel very strongly that third-party funders should not bundle the fee for temporary procedures performed or extraoral imaging conducted during the pandemic with the payment for the permanent procedure that may be submitted in the future. It will be inappropriate for any third-party benefit program to unfairly place the cost burden on dentists by disallowing or bundling charges for PPE on the pretext that the payment for additional required PPE is included in the payment for any other procedure billed for the visit.

The above factors may create an environment that may be unsustainable for dental practices. I, therefore, call upon our partners to pay special attention to these consequences and support payment for PPE as we all strive to keep our patients and communities of South Africa healthy. There is also discussion underway for dentists to join the public national fight against the Coronavirus and there is a chance that some of the dental practices may be converted into COVID-19 testing centres. This adds more weight to have this discussion and a solution sooner than later.

> If everyone is moving forward together, then success takes care of itself. - Henry Ford

This is not a fight that one profession can fight alone, it requires joint efforts, it requires all stakeholders, it requires foresight and it requires us to put the health of the communities above all else.

Notice of Amendment:
20th Annual General Meeting (AGM) of
The South African Dental Association NPC (SADA)

Amended Notice is hereby given that the 20th Annual General Meeting (AGM) of the South African Dental Association (SADA) will be held on **Wednesday, 17 June 2020 at 18h00** at the SADA Head Office, 31 Princess of Wales Terrace, Parktown, Johannesburg (opp. Sunnyside Hotel) pending the lifting by that date of the lockdown restrictions and prohibition of gatherings due to COVID-19. If these restrictions are not lifted, the meeting will be conducted entirely by electronic communication due to the COVID-19 pandemic and requirements of social distancing, which will be facilitated from the SADA head office above or contracted providers.

In the event that SADA is required to conduct the AGM entirely by electronic communication due to restrictions of movement and gatherings, we will provide necessary information in order to enable members, or their proxies, to access the available medium or means of electronic communication (link to join the electronic meeting).

Members are advised that they must have access to a computer or smart device or dial up facility in order to join the online meeting. In view of extraordinary circumstances and to ensure maximum participation of voting members on resolutions tabled at an AGM, we call for early return of proxies from members who are unable to attend.

Questions from members: We are also encouraging members to raise questions prior to the AGM, thereby allowing those not in attendance, the opportunity to raise issues which can then be dealt with at the AGM or referred to National Council meeting. The questions and answers covered in the AGM will, following the meeting, be published on the Association's website.

The full Agenda and supporting document for the meeting will be sent to members and posted on the SADA website in due course.

SADA is *your* Association and your voice counts.

P Govan
Head Legal & Corporate
20 April 2020

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COVID-19: Focus on masks and respirators – Implications for oral health-care workers

SADJ May 2020, Vol. 75 No. 4 p175 - p182

R Mulder[1], N Layloo[2], S Mulder van Staden[3]

INTRODUCTION

The emergence of the novel human coronavirus (Severe acute respiratory syndrome coronavirus 2; abbreviated as: SARS-CoV-2) generally known as COVID-19 is a global health concern.[1] On 11 February 2020, the World Health Organization (WHO) named the novel viral pneumonia as "Corona Virus Disease" (COVID-19). The International Committee on Taxonomy of Viruses (ICTV) suggested this novel coronavirus be named "SARS-CoV-2" due to the phylogenetic and taxonomic analysis of this virus.[2] Thus, both terms are utilised interchangeably in the literature.

Undoubtedly, COVID-19 will change the way we practice dentistry with vast implications for Oral health-care workers (OHCW) and practice staff. Additionally, if rigorous safety protocols are not implemented based on a risk assessment outlined by the CDC, the dental practice can potentially become a nexus for disease transmission due to the high volume of aerosol production on a daily basis. Personal protective equipment (PPE), staff training and practice disinfection protocols have now especially become important in the light of the current pandemic.

This is not a fight that one profession can fight alone, it requires joint efforts, it requires all stakeholders, it requires foresight and it requires us to put the health of the communities above all else.

ORAL HEALTH-CARE WORKERS (OHCW)

OHCW face an overall elevated risk of exposure to various infectious diseases.[3] The dental setting and wide range of procedures expose the OHCW via numerous pathways to pathogenic micro-organisms (such as viruses and bacteria) that infect the oral cavity and respiratory tract of a patient.[1]

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2. **Nazreen Layloo:** Second author - 33%
3. **Suné Mulder van Staden:** Third author - 33%

Potential routes of transmission of viruses include:[4]

Contact transmission:

- Refers to infections from infected person to a susceptible individual through the transfer of virus-laden respiratory secretions. This transfer can be directly (via physical contact) or indirectly (via intermediate surfaces or objects).

Droplet transmission:

- Refers to infections transmitted by deposition of virus laden respiratory droplets expelled from an infected person onto mucosal surfaces (eyes, nose, mouth).

Aerosol transmission:

- Refers to infection via inhalation of virus laden fine respiratory droplets (aerosols) through the air. These aerosols are generated either directly from fine respiratory droplets expelled from infected person or when any aerosol generating procedure is performed on an infected person. Aerosols thus refer to particles in suspension.

Figure 1 demonstrates the potential routes of COVID-19 transmission in the dental practice. OHCW can be exposed to COVID-19 via direct and indirect transmission pathways. Direct routes of transmission include exposure to droplets and aerosols generated during dental procedures. Indirect routes of transmission include the contact of the OHCW to contaminated surfaces in the dental practice as well as exposed auxiliary staff.

The classification COVID-19 as an infectious agent being "aerosol-transmissible" has significant implications for OHCW and the type of Personal Protective Equipment (PPE) that is required.[5]

Established routes of transmission of COVID-19 in humans includes direct transmission (through cough, sneeze, droplet inhalation) and contact transmission (contact via oral, nasal and eye mucous membranes).[2] Evidence suggests that even non-symptomatic indivi-

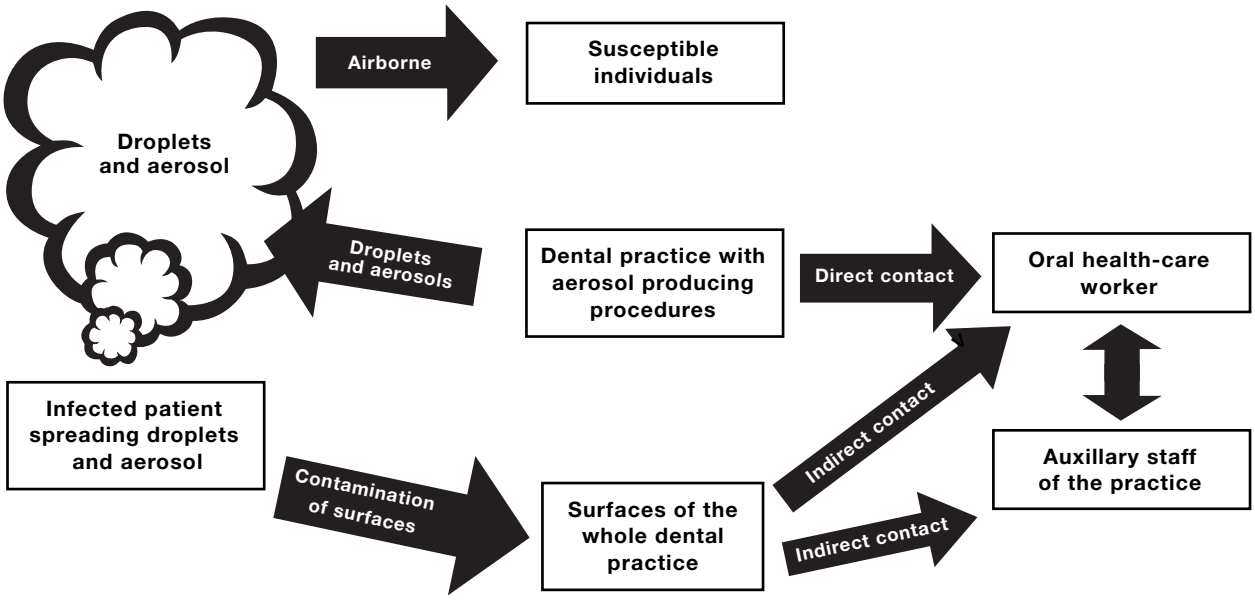

Figure 1. Adapted illustration of transmission routes of COVID-19 in the dental setting.[3]

duals can spread COVID-19 with high efficiency. Case studies from The Peoples Republic of China have also demonstrated that even after recovery from acute illness patients continued to shed high amounts of the virus.[3]

Dental practices carry a very high risk of COVD-19 transmission due to close proximity of the oral cavity and face-to-face communication with patients. The procedures conducted in daily practice causes repeated exposure of the OHCW to aerosol, blood and saliva.[2]

Studies utilizing viral culture methods have shown that Covid-19 is present in saliva samples.[6] Currently, ocular symptoms are not commonly associated with COVID-19 infection. However, analysis of conjunctival samples from confirmed cases of COVID-19, suggests that transmission is not limited to the respiratory tract and that eye exposure may be an effective pathway for the virus to enter the body.[2]

MASKS AS PART OF DAILY PPE

The utilization of the correct PPE is not only limited to the dental practitioner. The entire dental team should be equipped and trained in the use of the correct PPE and disinfection protocols. A survey under dental assistants from the Limpopo province reported that a mere 76.3% wore masks during dental procedures.[7]

For the OHCW the mask will become an essential PPE item of practice as COVID-19 continues to spread. The World Health Organisation (WHO), currently recommends that individuals who show signs of respiratory symptoms (cough and difficulty breathing) with fever, should wear a mask and seek medical attention.[8]

The world is contemplating as to whether all individuals wearing masks in public would help to flatten the curve of the spread. This is a growing concern as many countries are reportedly running out of facemasks and respirators.

Countries are adopting various strategies to drastically increase the production of this form of PPE. The question however remains: “Can a mask really protect you from catching the virus?” More importantly: “Are these masks protecting health care workers from contracting the dreaded COVID-19?” The answer to this question needs to contemplate the size of the COVID-19 virus and the level of determined filtration that masks and respirators currently offer.

It is important to note that not all masks and respirators products perform optimally in all clinical settings. Masks and respirators present only one component of PPE.

OHCW should correctly select and apply masks and respirators in the clinical environment. This require an in-depth knowledge and understanding of droplet and aerosol transmission, to place the COVID-19 pandemic into perspective.

AEROSOLS AND DROPLETS IN DAILY LIFE

Dental literature has demonstrated that many dental procedures produce aerosols and droplets that are contaminated with pathogenic micro-organisms, such as a bacteria and viruses.[9]

It is important to realise that all individuals are exposed to aerosols and droplet in daily life. Table 1 provides insight to understanding the implications of particle size of an aerosol and droplet, since particle sizes have significant implications for disease transmission.[4,5]

Both droplets and aerosols are generated during coughing, sneezing, talking and even exhaling.[4] Normal daily activities such as speaking and breathing have recorded predominant particle sizes of 1 µm, regardless of voice amplitude projected.[12,13,14]

The particles generated from coughing have a greater velocity and range between 0.57 to 0.89 µm (average

0.63 µm).[15] Sneezing reportedly produces the largest droplet with an approximate particle size of 360.1 µm.[16] Studies have demonstrated that 1 µm particles have sufficient volume to transmit diseases from one person to another. Despite their small size, however, these micron-scale particles are sufficiently large enough to carry a variety of respiratory pathogens such the measles virus (0.05-0.5 µm)[17], influenza virus (0.1-1 µm)[18] and Mycobacterium tuberculosis (1-3 µm).[19]

Recent work by Yan et al. has confirmed that significant amounts of influenza viral RNA are present in small particles (<5 µm) emitted by influenza-infected individuals during natural breathing, even without the infected individual coughing or sneezing.[20]

The risk of transmission with COVID-19 becomes apparent when the particle size ranging between 0.06 and 0.14 µm is considered.[21] Thus, COVID-19 can be considered as a 'small particle' microbe with a high potential risk of airborne transmission.

Table 1. Particle sizes and implications of transmission.

Particle size	Implications for transmission
< 5-10µm 'small particles'	This is aerosol and can be smaller than 5 µm as well.
	Aerodynamic diameter that follow airflow streamlines.
	Mainly short range transmission[4] and long range if strong air currents present.
	Readily penetrates the airways all the way down to the alveolar space (causing lower respiratory tract infections LRT).[4]
	High risk for airborne transmission.[10,11]
> 20µm 'large particles'	This splatter than can travel 15-120 cm from the patient.
	Follow a more ballistic trajectory (i.e. falling mostly under the influence of gravity – where the droplets are too large to follow inhalation airflow streamlines.
	Most likely impact respiratory epithelial mucosa surfaces or trapped by cilia before reaching lower respiratory tract (LRT).
	Associated with upper respiratory tract (URT) infections.[10,11]

AEROSOLS IN DENTISTRY

In the dental practice, aerosols are produced by equipment such as ultrasonic scalers and fast hand pieces. Aerosolised water from dental equipment can range from aerosol to splatter (0.001 µm to 50 µm). Aerosols with particles greater than 100 µm, settle quickly to the floor and other surfaces.[22] Aerosols become suspended in the air when the particle size is smaller than 50 µm.[23]

Dental lasers are included as an aerosol producing procedures due to the generation of the lasers plume. For lasers high-efficiency particulate filtration respirator to the efficiency of 99.75% at 0.1 µm have been suggested.[24] For dental lasers this would therefore be a respirator with a rating of N99, N100 or FFP3.

A Study evaluating the air quality in a dental setting with dental procedures such as extractions, air turbine with water spray and ultrasonic procedures, found that the micro-organism level in the dental surgery generally took 10-30 minutes to return to normal. This study also calculated that the practitioner and assistant was exposed to between 0.014 µl to 0.12 µl aerosolised saliva during a 15 minute peak exposure period.

Based on the results obtained, the study calculated that if a patient with Mycobacterium tuberculosis (M. tuberculosis) was treated, the practitioner could potentially have inhaled between 0.98 to 8.40 colony forming units (cfu) of M. tuberculosis, resulting in infection. Airborne M. tuberculosis is the main route of transmission generated by coughs and sneezes with droplet nuclei 1-5 µm in size.[25]

Studies have shown that COVID-19 become airborne through aerosols and droplets, generated during medical and dental procedures.[26] Dental practice generated droplets and aerosols from infected patients are likely to contaminate the whole surfaces in a dental practice.[2]

Studies investigating generated 5µm COVID-19 particles, reported that they remained viable for the duration of the 3 hour *in vitro* experiment. Further to this, COVID-19 was demonstrated to be the most stable when it remained on plastic and stainless steel surfaces, compared to copper and cardboard.

Although the COVID-19 virus reduced in virility over time, viable particles were present up to 72 hours after application to these surfaces. The half-live of aerosolised Covid-19 in the air had a virility of about 1.1 hours.[26] The problem that therefore exists with COVID-19, is the ability to settle on surfaces within the practice, where it can survive for extended periods of time.

REDUCTION OF AEROSOL

In 1963 Miller et al. demonstrated that polishing cups, air turbines with water spray and polishing restorations with a bristle brush generated particles with various levels of microbial contamination.[10]

Besides the guidelines that the Centres for Disease Control and WHO will advise in due time, OHCW can start to reduce the microbial load in the oral cavities of patients with pre-procedural mouth rinses[27], tooth brushing before the visit[28] and high volume evacuation[29] next to the aerosol generating equipment.[30]

According to "Guideline for Diagnosis and Treatment of Novel Coronavirus Pneumonia" (National Health Commission) chlorhexidine as a pre-procedural mouth rinse may not be effective to kill COVID-19. COVID-19 is vulnerable to oxidation, thus pre-procedural mouth rinses containing oxidative agents such as 1% hydrogen peroxide or 0,2% povidone are recommended to reduce the salivary load of microbes (including COVID-19 carriage).[2]

Additionally, studies have also concluded that the use of rubber dams significantly reduce the contamination to the OHCW and the surrounding dental environment.[31] Lastly disposable protective clothing and a protective face shield (as recommended by the CDC) additionally aid in the protection from splatter droplets, since droplets escape the high volume evacuation due to the air stream flowing from the dental equipment.[32]

MASKS AND RESPIRATORS

There are various masks and respirators available in the medical profession. Facial filtering protective equipment can be categorised into two broad categories, namely masks and respirators. They are fundamentally different in their intended use and the level of protection they provide.

Figure 2. An example of a mask and respirator.[33]

Surgical masks (predominantly worn in theatre) have the primary purpose of preventing biological particles in droplet form infecting the health care practitioner. The expelled droplets and aerosol generated by the practitioner (by breathing, talking, sneezing etc.) is filtered to prevent contamination of the surgical environment.[34] Surgical masks are also designed to be fluid-resistant to splash and splatter of blood and other bodily fluids during a procedure. A high quality surgical mask can filter mean particle sizes of 2.7µm.

The limitation of surgical masks are that they are not necessarily designed to seal tightly to the face, thus air can potentially leak around the edges. Hence, they do not completely reduce the exposure to airborne particles.[35]

Respirators create an effective facial seal to cover the nose and mouth, aiding in preventing inhalation of hazardous airborne particles, gases and vapours. Respirators offer varying degrees of filtration, based on their classification.

Three key criteria are required for a respirator to be effective:[36]

1. The filter materials in the various layers used in the respirator needs to be extremely effective at capturing hazardous particles.

2. The respirator needs to fit snugly around the wearers face to create and maintain an effective facial seal. This seal minimises the amount of particles that are able to enter through gaps found between the skin and the respirator.

3. The respirator needs to be put-on (don) and removed (doff) correctly.

Respirators have various descriptive criteria (letters) based on their resistance to oil. The letter in the name of the respirator rated as N, R or P. This rating is important in industry because some industrial oils can degrade the filter performance so it does not filter properly for that environment. Respirators are rated '**N**', if they are **N**ot resistant to oil, '**R**' if somewhat **R**esistant to oil, and '**P**' if strongly resistant (oil Proof).

The numerical value refers to the filtration capacity of the respirator. Therefore, a N95 respirator could also have ratings as R95 or P95 based on the industry with the same level of filtration to particles. In terms of the recommended N95, the European equivalent is FFP2 and for N99 it is FFP3.[36]

Additionally, some more expensive respirators will be approved by the National Institute for Occupational Safety and Health (NIOSH) in the United States to have the characteristics of both a respirator and a surgical mask (i.e. fluid-resistant to splash, splatter of blood and other bodily fluids) for use in theatres.

The N95 respirator provides 8-12 times more protection, than a surgical mask with exposure to particles with a size between 0.04-1.3 µm.[37]

National Institute for Occupational Safety and Health have produced valuable videos regarding PPE that can be viewed at the following online addresses:
https://www.cdc.gov/niosh/docs/video/default.html

MANUFACTURE REGULATIONS PERTAINING TO MASKS

Respirators are certified through the Centre of Disease Control (CDC) and the National Institute for Occupational Safety and Health (NIOSH) in the United States. All respirators in the United States need to comply with a complete respiratory program in accordance with the Occupational Safety and Health Administration (OSHA).[36] Each country has a performance standards to which the respirators must be produced. In South Africa, the performance standard is approved by the South African Bureau of Standards (SABS) and the National Regulator for Compulsory Specifications (NRCS) under SANS 103 38: 2009. This is the equivalent performance standard from Europe EN149: 2001.

The Respiratory Protection Standards require all health care professionals to use respirators with tight fitting face pieces. Health care professionals also need to be adequately trained in the proper use, safe doffing and disposal of these respirators and can view various videos to educate them on donning and doffing:

https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/donningdoffing.html.

Health care professionals also need to be knowledgeable on the medical conditions that provide contraindications of using respirators.[36] Heart conditions, lung disease and psychological conditions like claustrophobia could be contra-indications to those clinicians. In the United States, OSHA recommend the evaluation of the staff member by a medical practitioner with a medical questionnaire to evaluate the medical history and safety of the intended respirator for that practitioner. The questionnaire can be obtained at this link:

https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134AppC.

Furthermore, it is a requirement from OSHA that all healthcare workers are expected to perform all activities with suspected or confirmed cases of COVID-19

wearing respiratory protection. A filtering face piece such as a N95 respirator is recommended as it seals the face covering the mouth and nose. It also has the ability to remove 95% of airborne particles from the users breathing air due to the built in filter.[36]

The CE marking and the performance standard of the respirator must be visible on the respirator, as well as on the packaging. Table 2 presents detail of the standard of testing, based on the various geographical locations where the respirators were manufactured.

The Food and Drug administration in the Unites States released Table 2 on 28 March 2020 of allowed respirators against the COVID-19 pandemic for importation to the United States.

FACIAL FIT AND SEAL TESTING

An adequately fitted respirator is of utmost importance to ensure there is no leakage around the edges of the respirator. The respirator needs to seal tightly and completely on the wearer's face. It is important to follow the user instructions and follow a user seal check before entering a contaminated or sterile environment.[35]

The seal of the respirator should be evaluated by feeling for exhaled air moving past the edges of the respirator. Any area where the seal is inadequate should be investigated for facial hair and materials/cloth that may interfere with the respirator making contact with the skin.

If the wearer is unable to shave then a Powered Air Purifying Respirator (PAPR) should be considered as an alternative. Some PAPR's are designed to fit under the wearers chin or at the neck making them a suitable alternative.[35]

DONNING A PPE RESPIRATOR[38]

1. Ensure adequate hand hygiene or first layer of cloves.
2. Hold the respirator in the palm of your hand with the straps facing the floor.
3. Place the respirator on your face covering your nose and mouth.
4. Pull the bottom strap up and over top of your head, and put it behind your head below your ears.
5. Take the upper strap and put it behind your head towards the crown of your head.
6. Mould the nosepiece of the respirator over the bridge of your nose to obtain a tight seal.
7. Perform a fit check to ensure there is a good seal against the skin.

The video illustrating this procedure is available at:

https://www.cdc.gov/vhf/ebola/hcp/ppe-training/n95respirator_gown/donning_09.html

RESPIRATORS WITH VALVES

The main purpose of a respirator valve is to decrease breathing resistance during exhalation. This has no impact on the respirators ability to provide adequate respiratory protection to the OHCW. The design of the valves allows exhaled air to exit during exhalation and to tightly close during inhalation, consequently preventing any inhaled air from entering the valve during inhalation.

Due to the nature of the valve - it should not be recommended to OHCW, since exhaled particles exiting the respirator through the valve will contaminate the environment or sterile field in theatre. Thus, they are not recommended for OHCW, as they could become the nexus for local transmission.

RE-USE OF RESPIRATORS

In theory, the respirator can provide eight hours of respiratory filtration. The largest risk of cross-contamination from the respirator to the OHCW is during doffing of the respirator and then self-inoculation from surface droplets. Wearing an ear loop mask or face shield, over the respirator could protect the respirator from surface contamination. The only truly viable option to reduce the daily numbers of respirators is to don the respirator and keep it on for the duration of the clinical day, with ear loop mask replacement after every patient.

In this time of COVID-19 with a worldwide shortage of PPE, the extended use of respirators is frequent. A respirator manufacturer has conducted research on the sterilisation procedures for respirators and assessed their subsequent filtration capacity. The four main criteria for successful disinfection investigated included the following:

1). Be effective against the target organism (COVID-19).
2). Not damage the respirator's filtration.
3). Not affect the respirator's fit.
4). Be safe for the person wearing the respirator (e.g. no off-gassing of chemicals into the breathing zone).

Table 2. COVID-19 respirators imported to United States.

Jurisdiction	Made to performance standard	Acceptable product classifications	Standards / Guidance documents
Australia	AS/NZS 1716:2012	P3, P2	AS/NZS 1715:2009
Brazil	ABNT/NBR 13698:2011	PFF3, PFF2	Fundacentro CDU 614.894
Europe	EN 149-2001	FFP3, FFP2	EN 529:2005
Japan	JMHLW-2000	DS/DL3, DS/DL2	JIS T8150: 2006
Korea	KMOEL-2017-64	Special 1st	KOSHA GUIDE H-82-2015
USA / Canada	NIOSH / FDA Health Canada Licence	N95 surgical respirator	NIOSH approved
Mexico	NOM-116-2009	N100, P100, R100, N99, P99, R99, N95, P95, R95	NOM-116

The various disinfection methods assessed in this study included:

1). Ionizing radiation.
2). Ethylene oxide.
3). Ultraviolet germicidal irradiation (UVGI).
4). Microwave-generated stream (MGS).
5). Moist heat.

These disinfection methods did not completely meet the set out criteria, to be justified as successful. As of 27 March 2020, no disinfection method has met all four of these key criteria, and without all four, the method is not acceptable. 3M is now working with several major sterilization and disinfection companies and consulting with external experts to develop an effective disinfection method. 3M is working towards a solution to meet the abovementioned criteria.[39]
The CDC therefore have stated discarding recommendations for respirators, to prevent a significant risk for contact transmission, self-inoculation or reduced functionality 40:

1). Discard respirators following use during aerosol generating procedures.

2). Discard respirators contaminated with blood, respiratory or nasal secretions, or other bodily fluids from patients.

3). Discard respirators following close contact with any patient co-infected with an infectious disease requiring contact precautions in Table 2.

4). Consider the use of a cleansable face shield[41] over a respirator and/or other steps (e.g. masking patients, use of engineering controls), when feasible to reduce surface contamination of the respirator.

5). Hang used non-contaminated respirators in a designated storage area or keep them in a clean, breathable container such as a paper bag between uses.

6). To minimize potential cross-contamination, store respirators so that they do not touch each other and the person using the respirator is clearly identified.

7). Storage containers should be disposed of or cleaned regularly.

8). Clean hands with soap and water or an alcohol-based hand sanitizer before and after touching or adjusting the respirator (if necessary for comfort or to maintain fit).

9). Avoid touching the inside of the respirator. If inadvertent contact occurs with the inside of the respirator, discard the respirator and perform hand hygiene as described above.

10). Use a pair of clean (non-sterile) gloves when donning a used respirator and performing a user seal check. Discard gloves after the respirator is donned and after any adjustments are made to ensure the respirator is creating an effective facial seal.

WHO AND CDC ADVICE TO HEALTH CARE WORKERS

The WHO and CDC have published a table of recommendations to curb the spread of COVID-19 in health care facilities. This table is continuously in flux and updates are available on the websites of the CDC and WHO, as the COVID-19 pandemic is further studied and knowledge increases.

CONCLUSION

During daily dental procedures, aerosol production is often unavoidable. Due to the nature of the dental setting and current findings in the literature, it is the opinion of the authors that only N95/FFP 2 (or equivalent respirators) are recommended for OHCW during this COVID-19 pandemic.

OHCW additionally should take the steps outlined to minimise aerosol production and adhere to the current recommendations of disinfection protocols as set out by the CDC.

Declaration

The authors declare no conflict of interest.

Table 3. Transmission-based precautions and specific infection preventive and control measures as recommended by WHO and CDC for health-care facilities.[42]

Type of precautions	Rationale	Measures
Standard	To minimise the spread of infection within healthcare facilities from direct contact of contaminations	Practice hand hygiene
		Use of PPE
		Practice respiratory etiquette
		Environmental cleaning and disinfection
		Proper handling of patient care equipment and waste management
		Proper handling of needles and other sharps
Contact	To minimise the spread of infections particularly by hand-to-hand contact and self-inoculation of nasal and/or conjunctival mucosa	Proper use of PPE including disposable gloves and gowns
		Appropriate patient placement in a single room or with patient infected by some pathogen
		Limit patient movement and minimise patient contact
		Environmental cleaning and disinfection of the patient room
Droplet	To minimise the spread of respiratory infections that are transmitted predominantly via large droplets (>5μm) in short distance	Proper use of PPE including surgical mask when entering the patient's room
		Appropriate patient placement in a single room or with patient infected by same pathogen.
		Limit patient movement and ensure that patients wear surgical mask when outside their rooms.
Airborne	To minimise the spread of respiratory infections that are transmitted through inhalation of infectious aerosols (≤5μm) over a long distance	Proper use of PPE including N95/FFP2 or equivalent particulate respirator.
		Isolation of patient in single, airborne isolation infection room (AIIR).
		Limit patient movement and ensure that patients wear surgical mask when outside their rooms.

Contact, droplet and airborne precautions are considered as transmission-based precautions that should be implemented in addition to standard precautions.

Table 4. Technical details on masks and respirators

Category	Cloth masks	Surgical masks	N95 (3M) Model 1860S	N95 (3M) Model 1870+	N95 (3M) VFlex
Can be used as a medical device	No	Yes	Yes	Yes	Yes
Filter efficiency	Currently no published research available on efficacy of cloth masks.	Does not provide the wearer with a protection from inhalation of small airborne particles. Not considered respiratory protection.	≥95% of airborne particles (Both large and small).	≥95% of airborne particles (Both large and small).	≥95% of airborne particles (Both large and small).
Purpose		Used to block large particles/ droplets that may contain micro-organisms. Protects the patient from the wearer's respiratory emissions.	Reduces the wearers exposure to large droplets/ particles and smaller particle aerosols.	Reduces the wearers exposure to large droplets/ particles and smaller particle aerosols.	Reduces the wearers exposure to large droplets/ particles and smaller particle aerosols.
Face seal fit	Loose/ill-fitting.	Loose fitting.	Tight fitting, seals over mouth and nose	Tight fitting, seals over mouth and nose.	Tight fitting, seals over mouth and nose.
User seal check requirement	No.	No.	Yes – required every time its put on.	Yes – required every time its put on.	Yes – required every time its put on.
Leakage	Leakage can occur through the fabric and around the edges of the mask.	Leakage occurs around the edges of the mask between the face and mask.	When correctly put on and fitted - minimal leakage occurs.	When correctly put on and fitted - minimal leakage occurs.	When correctly put on and fitted - minimal leakage occurs.
Fluid resistance	Not fluid resistant	0.04µm-1.3 µm	Splashes at 120mm Hg. Not resistant to oil	Splashes at 160 mm Hg. Not resistant to oil.	Splashes at 80mm Hg. Not resistant to oil.
Valve/no valve	No	No	No valve	No valve	No valve
Use limitation	Non-surgical/medical. Needs to be washed frequently.	Disposable. Discard after each patient encounter.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.

Category	N99	N100	FFP2	FFP3
Can be used as a medical device	Yes	Yes	Yes	Yes
Filter efficiency	≥99% of airborne particles (Both large and small).	≥99.97% of airborne particles (Both large and small).	≥94% of airborne particles (Both large and small).	≥99% of airborne particles (Both large and small).
Purpose	Reduces the wearers exposure to large droplets/particles and smaller particle aerosols.	Reduces the wearers exposure to large droplets/particles and smaller particle aerosols.	Reduces the wearers exposure to large droplets/particles and smaller particle aerosols.	Reduces the wearers exposure to large droplets/particles and smaller particle aerosols.
Face seal fit	Tight fitting, seals over mouth and nose.	Tight fitting, seals over mouth and nose.	Tight fitting, seals over mouth and nose.	Tight fitting, seals over mouth and nose.
User seal check equirement	Yes – required every time its put on	Yes – required every time its put on	Yes – required every time its put on	Yes – required every time its put on
Leakage	Minimal leakage occurs when correctly put on and fitted.	Minimal leakage occurs when correctly put on and fitted.	Minimal leakage occurs when correctly put on and fitted.	Minimal leakage occurs when correctly put on and fitted.
Fluid Resistance	Not resistant to oil	Not resistant to oil	Strongly resistant to oil	Strongly resistant to oil
Valve/No Valve	No valve	No valve	Could be valved	Could be valved
Use limitation	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.	Should ideally be discarded after each patient or after an aerosol producing procedure. Discarded if damaged or deformed or the seal is defective. Should be discarded if it becomes contaminated with blood or other bodily fluids from patients.

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Comparison of forward and reverse single-file reciprocation for root canal instrumentation in curved mandibular molar canals - a Micro-CT analysis

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ABSTRACT

To compare (i) canal centering ability and transportation of Primary WaveOne Gold in combination with WaveOne Gold Glider with ProTaper Next X2 in combination with ProGlider using Micro-CT, and (ii) difference in final preparation times between these two preparation groups. Mesiobuccal canals of 50 mandibular first molars were used. Teeth were randomly divided into two preparation groups. Results were analysed using a one-way analysis of variance (ANOVA).

Apically, ProGlider/ProTaper Next X2 demonstrated better centering ratio values and lower transportation values compared to WaveOne Gold Glider/Primary WaveOne Gold ($p < .05$). No differences were found in the mean combined centering ratios and transportation values between groups ($p > .05$).

No statistically significant differences between the canal preparation times were found ($p < .06$). The combination of ProGlider / ProTaper Next X2 yields better results for transportation and centering ability apically compared to WaveOne Gold Glider in combination with Primary WaveOne Gold.

Keywords
Centering ability, ProTaper Next, reciprocation, transportation, WaveOne Gold.

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INTRODUCTION

Preparation and shaping of curved root canals can result in iatrogenic errors including but not limited to apical canal transportation, uncentered preparations, ledge formation, or perforation in curved canals.[1]

Advances in metallurgy have produced more super-elastic nickel titanium (NiTi) files that manufacturers claim are strong enough to resist the forces of torsion while maintaining enough flexibility to follow complicated root canal anatomy.[2]

In addition endodontic motors have undergone enhancement with regard to torque control and kinematics that are adjustable in several directions, which offer more effective and safer shaping of root canals.[3] Recently, the Root Pro CL (Medidenta, Las Vegas, USA) and E-Connect S (Eighteeth Medical, Changzou, China) endodontic motors were launched that allow clinicians to use rotary instruments in a forward reciprocating motion.

WaveOne Gold (Dentsply Sirona, Ballaigues, Switzerland) is a reciprocating root-canal shaping system manufactured from Gold-Wire and exhibits a unique alternating off-centered parallelogram-shaped cross-section and a progressively decreasing percentage taper design.[4]

The Primary WaveOne Gold instrument (PWOG) (25/07) is 50% more resistant to cyclic fatigue, 80% more flexible and 23% more efficient than its NiTi predecessor, the conventional Primary WaveOne instrument (Dentsply Sirona) manufactured from M-Wire.[5]

ProTaper Next (Dentsply Sirona) is a rotary root-canal shaping system constructed of M-Wire NiTi, making it

almost 400% more resistant to cyclic fatigue than conventional NiTi.[6] ProTaper Next (PTN) features a bilateral symmetrical rectangular cross-section, with an offset axis of rotation (except in the last 3 mm of the instrument (D0 – D3), allowing it to experience a rotational phenomenon known as precession or swagger.[7]

Contemporary single-file mechanical glide path preparation systems like the reciprocating WaveOne Gold Glider (Dentsply Sirona) and the rotating ProGlider file (Dentsply Sirona) have been introduced in recent years. The WaveOne Gold Glider (WOGG) is made from Gold-Wire while the ProGlider (PG) file is manufactured from flexible memory nickel-titanium wire (M-Wire).

Preservation of the original canal anatomy and remaining dentine thickness has been shown to improve the outcome of endodontic treatment. Micro-computed tomography (Micro-CT) has emerged as a useful analytical system that provides non-destructive and highly accurate analyses of the effects of endodontic instrumentation on root canal anatomy. Extensive information can be obtained from Micro-CT evaluation and slices can be recreated in a two- or three-dimensional plane with either simultaneous or separate assessment of internal and external structures.[8]

Reciprocating files currently available on the market are designed for use in a reverse motion. This motion employs a greater engaging counter-clockwise (CCW) angle (left-cutting) with a non-cutting disengaging clockwise (CW) angle. However, some authors suggest that reciprocating motion (RM) with a CW rotation greater than the CCW motion (forward reciprocation or right-cutting) could expand the use of conventional rotary files typically designed for continuous CW rotation.[9,10]

Yared[3] was the first to propose a canal preparation technique with a F2 ProTaper Universal (Dentsply Sirona) NiTi rotary instrument used in forward reciprocation. The study showed great potential in the reduction of the number of instruments, in minimising possible cross contamination and in alleviating operator anxiety of the possibility of instrument failure.[3]

In 2010, numerous authors[11-13] also confirmed that the forward reciprocating movement promoted an extended cyclic fatigue life of ProTaper Universal instruments (Dentsply Sirona) in comparison with conventional rotation. Gavini et al.[9] compared the Reciproc R25 file (VDW, Munich, Germany) in continuous rotation and forward reciprocation motion. The file group used in forward reciprocating motion fractured in 163,28 seconds, whereas the continuous rotation file group fractured in 357.56 seconds.[9]

The aim of this *in vitro* study was to investigate and compare root canal instrumentation of two single-glide path preparation and shaping system combinations used in RM in curved mesiobuccal root canals of extracted human mandibular molars: WOGG with the PWOG (in reverse reciprocation according to the manufacturer's instructions) and PG with the PTN X2 (in forward reciprocation, not used according to the manufacturer's instructions).

To our knowledge, no study has yet compared the preparation times, centering ability, and transportation values of WOGG/PWOG to PG/PTN used in RM in curved mandibular molar canals. The null hypothesis proposed is that there is no difference in preparation times and between forward and reverse reciprocating motion with regard to centering ability and canal transportation.

MATERIALS AND METHODS

Selection of teeth

Mesiobuccal canals of 50 human mandibular first molars, extracted for reasons unrelated to this study, were selected after obtaining written informed consent.

Teeth were stored in distilled water at 4˚C until use. The Schneider method was used to evaluate canal curvature and only previously untreated mesiobuccal root canals with curvatures between 25˚ and 35˚ and radii of equal to or less than 10 mm were used.[14]

The selected teeth were scanned (pre-instrumentation scan) using the XTH 225 ST micro-focus X-ray computed tomography system at the Micro-focus X-ray Radiography and Tomography facility (MIXRAD) at the South African Nuclear Energy Corporation (NECSA).

This system has a spatial resolution capability of 0.001 - 0.006 mm.[15] Samples were placed on a stable support and a series of sequential two-dimensional (2D) x-ray images were captured as the samples were rotated through 360°. These images were then reconstructed to generate three-dimensional (3D) volumetric representations of each tooth. Reconstruction and visualization of the Micro-CT images were done using VGStudioMax visualization software (Volume Graphics GmbH, Heidelberg, Germany).

After access cavity preparation with an Endo-Access burr (Dentsply Sirona) ensuring straight line access, the mesiobuccal canals were explored with a size 0.08 K-file (KF) and canals were negotiated to patency under a surgical microscope (Zumax Medical Co. Ltd, Suzhou, China).

Working length was determined by subtracting 0.5 mm from the length of the canal measured to the major apical terminus. The specimens were coded and randomly divided into two equal experimental groups for glide path preparation. A single operator performed the glide path preparation and shaping for each system.

All reciprocating and rotary files were operated by Root Pro CL (Medidenta) cordless endodontic motor. RC Prep (Premier, Pennsylvania, USA) was used as a lubricating agent and 3% sodium hypochlorite for canal irrigation. Each file was used to prepare one canal only before being discarded. Glide path preparation and shaping times were recorded with an electronic stopwatch.

WOGG/PWOG group

In each of the 25 canals a pre-curved stainless-steel size 0.10 KF was negotiated to working length with increasing amplitudes of 1-3 mm to ensure an initial manually re-

producible glide path. Each canal in this group was enlarged using WOGG, followed by shaping with PWOG - both in a reverse RM. Reverse RM was characterized by a CCW movement of 150° and a CW movement of 30°.

PG/PTN X2 group

In each of the 25 canals a pre-curved stainless-steel size 0.10 KF was negotiated to working length with increasing amplitudes of 1–3 mm to ensure an initial manually reproducible glide path.

Each canal in this group was enlarged using PG, followed by shaping with the X2 PTN – both in a forward RM, not according to the manufacturer's instructions. Forward RM was characterized by a CW movement of 150° and a CCW movement of 30°.

A post-instrumentation scan was taken of each sample after final shaping. The VGStudioMax software (Volume Graphics GmbH) was used to superimpose images from the final shaping scan over the images from the pre-instrumentation scan. This allowed for assessment of the canal transportation and centering ability of the two groups. The method used by Elnaghy and Elsaka[16] was used to measure canal transportation and centering ability (Fig. 1).

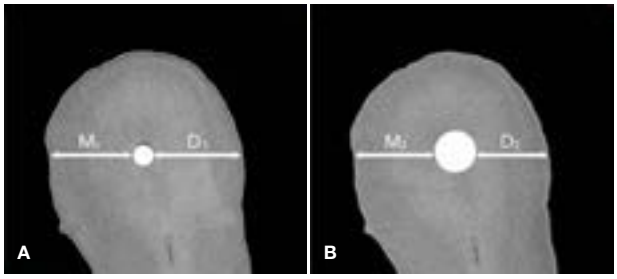

Figure 1. Cone-beam computed tomographic images indicating (A) pre- and (B) post- instrumentation measurements for determining canal transportation and centering ratio.

Centering ratio and canal transportation were measured at three different lengths from the anatomical apex of the mesiobuccal canals roots. In this study, 3 levels (3, 5 and 7 mm) were chosen to evaluate transportation and centering ability.

These levels represent the apical, middle, and coronal thirds of the roots with a high risk and incidence of iatrogenic errors.[16] A cross-section at levels 3 mm, 5 mm and 7 mm was evaluated using the following equations:[17]

Canal transportation = (M1-M2) – (D1-D2)
Canal-centering ratio= (M1-M2)/(D1-D2) or (D1-D2)/(M1-M2).

Where:
M1: Shortest distance from the mesial margin of tooth measured to the mesial margin of uninstrumented canal.
M2: Shortest distance from mesial margin of tooth measured to the mesial margin of the instrumented canal.
D1: Shortest distance from the distal margin of tooth measured to the distal margin of the uninstrumented canal.
D2: Shortest distance from the distal margin of tooth measured to the distal margin of the instrumented canal.

A value/ratio closest to 1 indicated perfect centering ability, whereas transportation was measured in millimetres. A transportation value closest to 0 indicated no transportation. The higher the value the greater the transportation.[17]

Statistical analysis

Mean and standard deviations for centering ability, canal transportation, and canal preparation times were determined for each group and one-way analysis of variance (ANOVA) was used to statistically compare groups. Centering ratio and transportation values showed parametric distributions. Statistical procedures were performed on SAS Release 9.3 (SAS Institute Inc., Cary, NC) running under Microsoft Windows (Microsoft Corp., Redmond, WA) and statistical significance was set at $p < .05$.

RESULTS

Canal Transportation and Centering Ratio

Tables 1 and 2 show the mean and standard deviation values of the centering ability ratios and canal transportation at the three different levels for the different groups, respectively. PG/PTN X2 demonstrated a statistically sig

Table 1. Statistical Analysis of Mean Centering Ratio Values for the Tested Group.

System	Apical		Midroot		Coronal		Combined	
	Mean ± SD	Min–Max	*Mean ± SD*	Min–Max	*Mean ± SD*	Min–Max	*Mean ± SD*	Min–Max
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
WOGG/PWOG	$0.36^{a} \pm 0.30$	0.035 – 1.100	$0.45^{a} \pm 0.29$	0.031 – 0.952	$0.35^{a} \pm 0.26$	0.063 – 0.921	$0.40^{a} \pm 0.27$	0.029 – 1.100
PG/PTN X2	$0.62^{b} \pm 0.33$	0.072 – 0.993	$0.48^{a} \pm 0.22$	0.106 – 0.898	$0.31^{a} \pm 0.21$	0.021 – 0.750	$0.48^{a} \pm 0.28$	0.021 – 0.993
P value	.0189		.470		.459		.120	

Mean values with the same superscript letters were not statistically different at $p < .05$ using the ANOVA test.

Table 2. Statistical Analysis of Mean Transportation (mm) for the Tested Groups.

System	Apical		Midroot		Coronal		Combined	
	Mean ± SD	Min–Max	*Mean ± SD*	Min–Max	*Mean ± SD*	Min–Max	*Mean ± SD*	Min–Max
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
WOGG/PWOG	$0.132^{a} \pm 0.061$	0.032 – 0.211	$0.098^{a} \pm 0.056$	0.015 – 0.287	$0.201^{a} \pm 0.168$	0.006 – 0.956	$0.14^{a} \pm 0.13$	0.006 – 0.956
PG/PTN X2	$0.067^{b} \pm 0.068$	0.001 – 0.229	$0.225^{a} \pm 0.364$	0.0 15 – 1.080	$0.264^{a} \pm 0.276$	0.035 – 1.356	$0.19^{a} \pm 0.28$	0.001 – 1.356
P value	.0129		.1176		.3294		.210	

Mean values with the same superscript letters were not statistically different at $p < .05$ using the ANOVA test.

nificantly better centering ratio value than WOGG/PWOG ($p < .05$) at the apical level. At the midroot and coronal levels, there was no statistically significant difference between the centering ratio values of the two groups ($p > .05$). After shaping, PG/PTN X2 demonstrated a statistically significantly lower apical canal transportation value ($p < .05$). At the midroot and coronal levels, there was no statistically significant difference between the transportation values of the two groups ($p > .05$). No statistically significant difference was found in the mean combined centering ratios and transportation values of the two groups ($p > .05$).

The representative sample images (Fig. 2) depict the typical axial canal changes after canal preparation with WOGG/PWOG, and PG/PTN X2 in forward reciprocation. In every representative figure, the black outline represents the original canal shape and red indicates the effect of root canal preparation. No instrument fracture was observed in any of the test group.

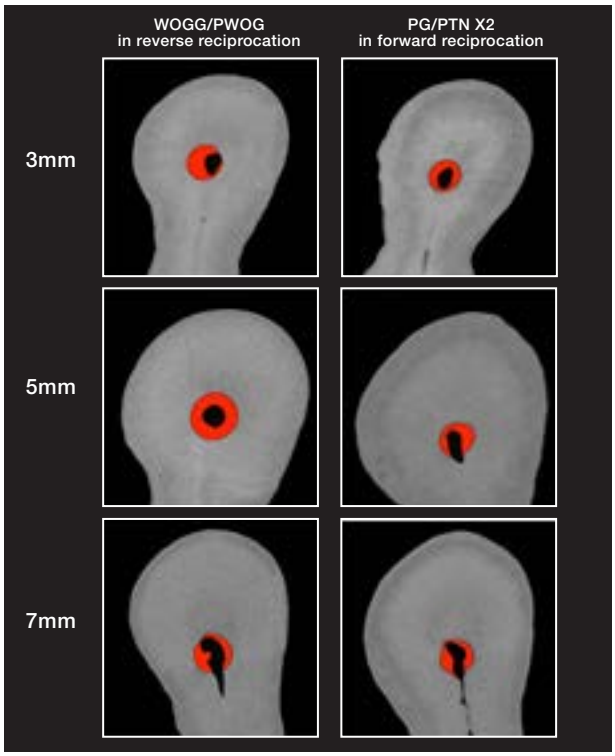

Figure 2. Pre-instrumentation and post-root canal preparation Micro-CT images with red markings showing the effect of root canal preparation and points of measurement used to determine canal transportation and centering ratio.

Canal preparation times

Table 3 depicts the mean and standard deviation values of the mean canal preparation times for the different groups. There was no statistically significant difference between the canal preparation times for the two groups ($p < .06$).

Table 3. Statistical Analysis of Mean Canal Preparation Times for the Tested Groups

System	*Mean ± SD*	Min–Max
	Mean	SD
WOGG/PWOG	48.69a ± 7.97	36.65 – 61.65
PG/PTN X2	42.98a ± 10.15	27.21 – 64.66
P value	.06	

Mean values with the same superscript letters were not statistically different at $p < .05$ using the ANOVA test.

DISCUSSION

The two single-glide path/shaping groups used in this study displayed significant centering and transportation differences only at the apical level. At this level PG/PTN X2 displayed statistically significantly lower mean canal transportation and better centering ability values than WOGG/PWOG. The endodontic files included in this study have different cross-sections, diameters, tapers, alloy types, and tip designs and were used in either a reverse or forward reciprocating motion.

Several studies have shown that instruments with greater flexibility produce more centered preparations.[18,19] The flexibility of an endodontic instrument is influenced by the composition and thermo-mechanical treatment of the metallic alloy, the size of the instrument, and its cross-sectional design.[20,21]

Instruments like WOGG/PWOG, which are manufactured from Gold-Wire super-metal, are said to possess improved metallurgic properties and therefore increased flexibility when compared to instruments made from conventional NiTi and M-Wire, like PG and PTN.[22] The study by Uygun et al.[22] found that ProTaper Gold files (Dentsply Sirona) had higher cyclic fatigue resistance owing to their flexibility compared to the NiTi ProTaper Universal (PTU)(Dentsply Sirona) and M-Wire PTN files at all levels examined.

In the present study however, significantly more favourable transportation and centering values were observed in the apical region following use of the M-Wire glide path/shaping group. Other design features like the final shaping size might also explain these results. Tip sizes of the shaping files used in this study were 25/07 for PWOG and 25/06 for PTN X2.[22]

The cross-sectional design of WaveOne Gold, modified from the design of its predecessor, WaveOne (Dentsply Sirona), is also said to increase its flexibility.[23] Results obtained here might be due to the file design of PG and PTN X2, which manufacturers claim reduces contact between these files and the dentine walls. The parallelogram-shaped cross-sectional design of PWOG is said to limit engagement of the file and dentine to only one or two points of contact at any given stage of canal preparation, which improves the safety of the file with less taper-lock and screw-in effect.

The design features and the swaggering movement of PTN used in CR reportedly present the following advantages: reduction in taper-lock, screw-in effect and stress on the file, and minimal risk of instrument fracture because of the reduced amount of contact between the instrument blades and the dentine walls; increased cutting efficiency and range; and activation of the irrigation solution in the canal, moving the solution into canal irregularities thereby cleaning areas that are not touched by the instrument.[24,25]

The motion in which the PG and PTN X2 files were used in this study might also have contributed to the results displayed in the apical region. The file taper, design, cross-section, and/or metallurgy of these two files might

lend itself to forward RM. Reciprocation of NiTi systems with fewer instruments was introduced to simplify and shorten the root-canal shaping procedure and to reduce instrument fatigue.[3]

RM is typically described as a non-continuous rotation, originally with a movement towards the cutting direction of the instrument (CCW), followed by a minor rotation in the release direction (CW).[26] RM has been extensively evaluated for its effect on instrument longevity, shaping ability, and accumulation or extrusion of debris.[27]

The incidence of instrument separation and deformations of reciprocating files has been reported as considerably low, even less than that reported for rotary instruments.[28] Various studies have examined the potential application of RM of rotary systems. Rotary instruments are produced to cut in CR but the use of these instruments in a forward RM have been evaluated using CW rotation greater than the CCW rotation.[3,9]

A study by Paque, Zehnder and De Deus[29] showed that in terms of root canal curvature, a single F2 PTU file used in RM is as efficient as the conventional PTU full-sequence technique in CR in root canals of extracted human mandibular molars. These results contrast with those of Franco et al.,[30] who showed that Flex Master (VDW) NiTi instruments, designed for use in CR, shaped simulated canals more uniformly resulting in improved centering- when used in RM, compared with the same instruments used in a CR movement.

Similarly, Giuliani et al.[10] compared the shaping effects of WaveOne and PTU files used in RM and CR in s-shaped simulated canals. The authors found that at every level examined the full sequence of PTU files used in CR removed a significantly greater amount of resin than in the other groups of their study. It was concluded that the full-sequence PTU used in a RM exhibited better shaping effects than full-sequence PTU used in a CR motion and WaveOne used in RM.

The authors claimed that this technique offers the advantage of reaching the working length with a more gradual and centered enlargement, progressing from small to large tapers without forcing the file apically. Giuliani et al.[10] attribute the superior performance of the files used in RM to the increased contact area between the instruments and the canal walls, which permits equal canal enlargement on the inner and outer aspects of the curvature.

In this study, the canal shaping abilities of WOGG/PWOG, a reverse reciprocating Gold-Wire file system, and PG/PTN X2, a conventional rotary NiTi M-Wire file used in a forward RM, were analyzed using Micro-CT imaging. The time taken to prepare the canals was similar for the two groups, but the combination of PG and PTN X2 in forward RM yielded significantly better results for both transportation and centering ability at the apical level.

The results of this study suggest that PG/PTN X2 may be used in a forward reciprocating motion. However, further research and clinical studies will be necessary to validate this concept.

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Sterilisation and single-use of endodontic files - a short report

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ABSTRACT

Introduction

In many countries, endodontic files continue to be sterilised and reused in multiple clinical cases as the alternative of single-use of these instruments is avoided due to financial reasons.

Methods

A survey was performed including South African general dental practitioners and specialist prosthodontists to determine the current endodontic file sterilisation methods in place and the adoption rate of single-use protocols of both hand and engine-driven instruments.

Results

The majority of respondents (76.6%, n=141/184) indicated autoclaving endodontic files prior to reuse. Almost a quarter of the respondents (23.4%, (n=43/184) used only cold sterilisation.

Some respondents (2,8%, n=5/181) indicated not sterilising their files at all. A low number of respondents had adopted the single-use of endodontic hand files (10.9%, n=20/184). Engine-driven files were used only once and discarded by 18.5% (n=34/184) of respondents.

Conclusion

It appears that, at times, acceptable infection prevention and control practices regarding the sterilisation these instruments are not necessarily being adhered to. The adoption of single-use protocols of endodontic files in a South African dental setting is higher than previously reported.

Keywords

Endodontic files, single-use, sterilisation, survey.

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All authors have contributed significantly and are in agreement with the manuscript.

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2. **Mohamed Y Gamieldien:** Conceived the study and wrote, reviewed and edited the manuscript - 30%
3. **Sheree Tredoux:** Conceived the study and wrote, reviewed and edited the manuscript - 20%
4. **Nichola Warren:** Conceived the study and wrote, reviewed and edited the manuscript - 10%

INTRODUCTION

In modern dental practice, both hand and engine-driven endodontic files are used for cleaning and shaping procedures of root canal treatment. During this process, these instruments become contaminated with microorganisms and appropriate cross-contamination and sterilisation procedures are necessary if endodontic files are to be reused on multiple cases.[1]

Whilst it is common practice to reprocess many dental instruments, the intricate designs of some make effective cleaning and sterilising a challenge. For this reason several instruments are considered disposable or single-use items.[2]

Previous authors have supported the recommendation for the single-use of both hand and rotary endodontic files due to the inability to adequately reprocess these instruments,[2-4] however this view has been debated.[5] Despite these findings, dentists in many countries continue to reprocess and reuse rotary and hand files in multiple cases following sterilisation procedures.

It has been previously reported that infection prevention and control practices in a South African dental setting may at times be inadequate.[6,7] The sterilisation methods used by South African dental practitioners specifically for the reprocessing of endodontic files is currently unclear.

Furthermore, the proportion of South African practitioners who have adopted single-use protocols, pertaining only to endodontic hand files, has only been previously reported on in one major city.[8]

This study aimed to determine the sterilisation methods used by South African dental practitioners in the reprocessing of both engine-driven as well as endodontic hand files, and to quantify the proportion of practitioners who practice single-use of these instruments.

MATERIALS AND METHODS

A cross-sectional, observational study was conducted. A multiple-choice survey was designed using an online program (Qualtrics, Provo, Utah) and electronically mailed

to 61 members of the Academy of Prosthodontics, South Africa (APSA) and 3191 South African General Dental Practitioners (GDPs) registered in the South African Dental Association (SADA) database.

The survey was circulated on social media platforms to increase visibility to the target groups. A quantitative design consisting of questions with multiple-choice answers was completed by participants. The questions included:

- Demographic information.
- Sterilisation methods used for endodontic instruments.
- Sterilisation conducted prior to first use of new files.
- Sterilisation conducted prior to re-use.
- Single-use of endodontic hand files.
- Single-use of engine-driven files.

Data was collected and exported as comma-separated values (CSV file format) for evaluation in Microsoft Excel 2016, analysed and expressed as simple percentages of the total number of respondents.

Only private practice GDPs and SPs routinely performing endodontic treatment were included in this investigation. GDPs and SPs not engaged in the clinical practice of endodontics and those employed outside of a private practice setting, such as community-service (a compulsory internship year in South Africa), public-sector dentists and full-time academics were excluded.

The research proposal for this study was approved by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria (Protocol number 331/2018).

RESULTS

An electronic mail containing a link to the survey was sent to both APSA members (n=61) and SADA members (n=3191). In total, 215 responses were returned by the cut-off date. The overall response rate was 6.6% of the total number surveyed (n=215/3252).

Almost ten percent of the total respondents (9.7%, n=21/215) indicated not performing private practice endodontic treatment and were excluded. Another respondent provided irrational answers to several questions and was therefore ruled out for inclusion. Analysis was subsequently performed on the valid responses provided by the remaining 193 participants (89.8% of total respondents).

Demographics

Of the 193 participants, 46.1% (n=89) were male and 53.9% (n=104) were female. Eleven participants (5.7%, n=11/193) were SPs and the remainder were GDPs (94.3%, n=182). A wide distribution was found in relation to age and number of years of experience. All South African provinces were represented.

Sterilisation methods used for endodontic files

Only two sterilisation methods were reportedly used for the reprocessing of endodontic files. More than three-quarters of the respondents (76.6%, n=141/184) indicated sterilising files using a steam autoclave.

Cold sterilant solutions were used by almost one-quarter of the respondents (23.4%, n=43/184). Nine respondents practiced single-use of endodontic files and were excluded from analysis as they did not sterilise and reprocess files.

Sterilisation before first use

With regards to initial sterilisation procedures (i.e. when removing endodontic files from the manufacturer's packaging), the majority of respondents (71.5%, n=139/193) indicated that they did not sterilise endodontic files prior to first patient use. The remaining 28.5% (n=55/193) indicated completing a pre-use sterilisation cycle.

Sterilisation before re-use

Almost all the respondents who reused their endodontic files (97,2%, n=176/181) indicated routinely sterilising the files prior to re-use on subsequent cases. A small number (2,8%, n=5/181) indicated the opposite.

Twelve respondents (n=12/193) did not answer this question as they practiced either single-use of their files or did not sterilise endodontic files (or a combination of these reasons).

Single-use of endodontic hand files

Only 10.9% (n=20/184) of respondents reported practising single-use of endodontic hand files. The remaining 89.1% (n=164/184) reused hand files on multiple cases following reprocessing procedures. Nine respondents did not answer this question as they indicated not using hand files routinely.

Single-use of engine-driven files

Rotary and reciprocating files were reprocessed and reused on multiple cases by the majority of respondents (81.5%, n=150/184).

The remaining respondents (18.5%, n=34/184) indicated practicing single-use of these instruments. Nine respondents did not answer this question as they did not use engine-driven files routinely.

DISCUSSION

Although the overall response rate of this survey was low, the response rate was in line with previous South African survey findings conducted on similar cohorts.[9] Furthermore, the survey was completed by respondents from all nine South African provinces and valuable information was therefore collected from a wide geographical distribution. The responses of prosthodontists were included in the present study as South Africa does not train specialist endodontists.[10]

A previous study reported that the single-use of endodontic files had not been adopted by any general dental practitioners surveyed in one major South African city.[8] The results of the present study, which included both a greater number and wider distribution of South African dentists, are in disagreement with the previous findings. This finding highlights the importance of obtaining representative sample sizes, and cautions against the extrapolation of the results of smaller scientific investigations to a broader population.

The philosophy regarding single-use of endodontic instruments originated in the United Kingdom in response to concerns surrounding the potential spread of prion disease[11] as a result of the inability to adequately clean and sterilise endodontic files and reamers.[2] This view was however not universally shared.[5] Whilst several benefits of a single-use approach exist, such as a reduced risk of file separation[12] and no risk of cross contamination[2], the reprocessing and reuse of endodontic files will likely continue in many countries due to the increased cost associated with single-use protocols of endodontic instruments.[8]

When any dental instruments are to be reused, they must be both thoroughly cleaned of bioburden and sterilised to prevent cross-contamination between patients. Although sterilisation may be achieved by several different methods, semi-critical and critical instruments - such as endodontic files - should be sterilised by autoclave.[13] When considering multiple or single-use of any dental instrument, manufacturer recommendations in conjunction with ISO 17664:2017 and local regulatory guidelines should be followed at all times.[2]

Previous investigations have demonstrated that endodontic files and burs are not sterile at the time of purchase and that sterilisation should be performed prior to first use.[4] Less than one-third of the respondents to the present survey complied with this recommendation.

In recent times, however, manufacturers have created pre-sterilised, single-use endodontic instruments which do not need to be sterilised prior to initial use.[14] It is unknown how widespread the use of such pre-sterilised endodontic files are, but this possibility may have contributed to the high number of respondents who indicated not sterilising their files prior to initial use. Future studies may investigate to provide clarity on this issue.

The finding that nearly one quarter of respondents continue to use cold sterilisation as the sole means of reprocessing endodontic files was disappointing. Placement of endodontic files in cold sterilant solutions, such as glutaraldehyde, has been demonstrated to be inferior to steam methods and is no longer recommended as a primary means for the sterilisation of endodontic files.[13]

Additionally, it has been demonstrated that cold sterilising solutions, such as glutaraldehyde, may take up to ten hours to sterilise an instrument.[15] The finding that some respondents of the present study did not sterilise endodontic files at all before reuse was alarming. It is however possible that these respondents misunderstood the question.

CONCLUSION

Within the limitations of this study, the majority of South African GDPs and SPs were demonstrated to reuse endodontic files on multiple clinical cases following reprocessing procedures. A large number of respondents used acceptable methods of sterilisation for reprocessing endodontic files. A significant proportion however continue to use unacceptable methods such as cold sterilisation with glutaraldehyde solution.

Whilst only a limited number of South African dental practitioners have adopted the routine practice of single-use of both engine-driven and hand endodontic files, this number is higher than previously reported.

Declaration

The Author(s) declare that there is no conflict of interest.

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The microbiology of head and neck space infections at the Maxillofacial Clinic at Livingstone Hospital

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ABSTRACT

Introduction

Head and neck space infections remain one of the most commonly encountered conditions at Maxillofacial clinics countrywide. Patients admitted with these infections tend to have prolonged hospital stays and often require intensive care support. This places financial and logistic constraints on our health care system. There are also growing concerns, worldwide, regarding antibiotic resistance.

Aims and objectives

To determine the microbial spectrum of head and neck space infections in patients admitted to the Maxillo-Facial clinic at Livingstone Hospital in the Eastern Cape over a period of 5 years.

Methods

Demographic, clinical and laboratory data was retrieved from the medical records of 140 patients presenting with head and neck space infections.

Results

Most patients were males aged 21-40 years. The most common cause of head and neck infections was non-odontogenic. The submandibular space was the most commonly implicated. Gram positive facultative anaerobes were most commonly identified. *Bacteroides* species and *Staphylococcus aureus* displayed sensitivity to clindamycin and amoxicillin with clavulanic acid. Viridans streptococci were sensitive to both penicillin and clindamycin.

Conclusion

Bacteroides species were the most commonly isolated bacteria, followed by Viridans streptococci and *Staphylococcus aureus*.

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INTRODUCTION

Patients admitted with deep space head and neck infections tend to have prolonged hospital stays and often require intensive care support, which places financial and logistic constraints on our health care system. There are also growing concerns, worldwide, regarding antibiotic resistance.

Several studies reported that odontogenic infections were identified as the most common source of head and neck infections.[1-3] Infiltration through fascial spaces is an important factor to consider in the evaluation of head and neck space infections. The submandibular space was the most frequently involved fascial space in both single[4-8] and multiple space infections.[2,3]

Head and neck space infections are caused by both aerobic and anaerobic microorganisms. The most frequently isolated aerobic bacterium was *Streptococcus viridans*[6] while *Bacteroides* was the most common anaerobic bacterium.[3,8] Molomo et al.[5] and Cabral et al.[9] reported *Staphylococcus aureus* to be the most commonly isolated organism.

Effective management consists of surgical drainage and the administration of the appropriate antibiotic. *Staphylococcus aureus*, *Streptococcus mitis/oralis* and *Morganella morganii* displayed high resistance levels against amoxicillin.[7,10]

Amoxicillin with clavulanic acid was reported as the most effective antibiotic for the most commonly isolated organisms,[7] therefore it was recommended as the empirical drug of choice in head and neck space infections.[7,8]

This study focussed on the microbial spectrum and antibiotic sensitivity patterns in patients with head and neck space infections over a 5 year period, in order to

improve guidelines for appropriate antibiotic prescription, thus decreasing the length of hospital stays and contributing to the fight against antimicrobial resistance.

MATERIALS AND METHODS

Study design

This was a retrospective study which comprised the analysis of patient variables (age, gender and source of infection), microbial spectrum and antibiotic sensitivity patterns in patients presenting with head and neck space infections at the Maxillo-Facial Clinic, Livingstone Hospital, Eastern Cape, South Africa.

Sampling method

Cases were selected using the convenience sampling method. The admissions book at the Maxillofacial clinic was analysed to identify all patients with head and neck space infections admitted to the clinic at Livingstone Hospital from the 1st of January 2012 to the 31st of December 2016.

The medical records of all identified patients were reviewed. All patients who had microbial culture and sensitivity tests performed were included in the study. This study was approved by the Wits Human Research Ethics Committee (Ethical Clearance number: M170719), the Eastern Cape Department of Health and the National Health Laboratory Services.

Data collection

Demographic, clinical and laboratory data was retrieved from the medical records of 140 patients presenting with head and neck space infection. The variables analysed included age, gender, source of infection, fascial spaces involved, microorganisms identified and antibiotic sensitivity.

Microorganisms are considered to be sensitive when they cannot grow in the presence of a drug, resistant when they can grow and intermediate when a higher dose of the antibiotic is required to prevent growth.

Data analysis

Descriptive and inferential statistics were computed for all variables. Bivariate analysis was used for identifying associations. P-value based on the Chi-square test was utilised. A p-value of <0.05 was considered to be statistically significant.

RESULTS

Patient demographic and clinical data

The majority of patients presenting with head and neck space infections were male (n=97; 67%), while only 48 (33%) were female. Eighty five patients (59%) were 21 to 40 years of age. The youngest patient was 13 months and the oldest, 92 years old. Thirty six patients (25%) fell into the 41-60 year age category, while 21 patients (14%) were between 0-20 years old. Head and neck infections appeared to be least common in patients older than 60 years, with only 3 patients (2%) falling into this category.

Sixty four patients presented with an odontogenic cause of infection, while 81 presented with a non-odontogenic cause. Periapical lesions presented in the majority of patients with an odontogenic cause of infection (n=32; 50%), followed by alveolar osteitis (n=22; 34%), pericoronitis (n=4; 10%) and periodontitis (n=4; 6%). Where the aetiology was non-odontogenic, 60 patients (74%) presented with infection of an unknown aetiology, followed by trauma (n=18; 22%).

Distribution of fascial space involvement

The majority (n=81) of patients had only a single space involved, while 54 had multiple fascial space involvement. In 10 cases the fascial space remained unidentified. The submandibular space was the most commonly involved with a total of 50 (62%) patients presenting with infection in this space.

Ten cases involved the buccal space (1%), eight, the submental (10%), six, the peri-orbital (8%) and three, the zygomatic space (4%). The submasseteric, parapharyngeal, superior labial and temporal spaces were less commonly affected and presented with one case each. These results are presented in Figure 1.

Of the 54 patients that presented with multiple space involvement, 31 (57%) had two spaces affected, 22 (41%) had three spaces affected and only one (2%) had 4 fascial spaces being affected.

The most commonly implicated spaces in cases with multiple space involvement was the submandibular (35 cases, 64.9%), followed by the sublingual (15 cases, 27.7%) and submental (14 cases, 26%) spaces (Figure 2).

The spectrum of microorganisms isolated

Thirty eight different types of microorganisms were isolated (Table 1). The most commonly isolated bacteria were *Bacteroides* species (16.7%) followed by Viridans streptococci (11%) and *Staphylococcus aureus* (8.6%).

Less commonly isolated were coagulase negative *Streptococcus* (3.8%), *Streptococcus constellatus* (4.8%); alpha, beta and non-haemolytic *Streptococcus* (3.3%); *Morganella morganii* species (3.8%); *Streptococcus anginosus* (3.8%) and *Streptococcus mitis/oralis* (3.8%).

Antibiotic sensitivities

Bacteroides species, found in 35 specimens, was 100% sensitive to metronidazole, carbapenems, piperacillin, clindamycin, cefoxitin, chloramphenicol and amoxicillin with clavulanic acid.

Six of the 25 isolates of Viridans streptococci showed resistance to erythromycin/azithromycin (24%), while 15 displayed sensitivity (60%). Four (16%) of the isolates displayed resistance to clindamycin while 16 (64%) showed sensitivity.

Seven isolates showed sensitivity to penicillin and ampicillin (28%) while only one showed resistance (4%). Four isolates were sensitive to cefotaxime and ceftriaxone (16%) while one (4%) was resistant. Four isolates were sensitive to vancomycin (16%) and one to linezolid (4%).

Staphylococcus aureus was isolated in 18 specimens, and showed 100% resistance to penicillin and 44.4% (eight isolates) resistance to trimethoprim-sulphamethaxazole. Seven isolates (38.9%), however, showed sensitivity to trimethoprim-sulphamethaxazole. There was 83.3% (15 isolates) with sensitivity to cloxacillin, while 11.1% (two isolates) showed resistance.

Clindamycin was effective in 77.8% (14 isolates) but resistance was noted in 16.7% (3 isolates). Erythromycin/azithromycin was also effective against staphylococci, showing sensitivity rates of 72.2% (13 isolates) and a

Table 1. List of isolated micro-organisms.

Micro-organism	No of isolates	Percentages
Acinetobacter baumannii complex	2	1
Burkholderia cepacia	3	1.4
Escherichia coli	1	0.5
Klebsiella oxytoca	1	0.5
Klebsiella pneumoniae	3	1.4
Proteus species	1	0.5
Pseudomonas aeruginosa	3	1.4
Pseudomonas putida	1	0.5
Coagulase negative staphylococcus	9	4.3
Bacteriodes	35	16.7
Enterobacter cloacae complex	4	1.9
Gram negative bacillus	6	2.9
Haemophilus parainfluenzae	1	0.5
Morganella morganii	8	3.8
Cornybacterium species	4	1.9
Gemella morbillorum	1	0.5
Micrococcus species	1	0.5
Staphylococcus species	4	1.9
Staphylococcus aureus	18	8.6
Candida albicans	3	1.4
Yeast - not *Candida albicans*	3	1.4
Normal oral flora	1	0.5
Staphylococcus epidermidis	7	3.3
Staphylococcus haemolyticus	3	1.4
Streptococcus anginosus	8	3.8
Streptococcus alpha haemolytic	7	3.3
Streptococcus beta haemolytic	6	2.9
Streptococcus bovis	4	1.9
Streptococcus constellatus	10	4.8
Streptococcus cristatus	1	0.5
Streptococcus group A	3	1.4
Streptococcus group C	1	0.5
Streptococcus group F	4	1.9
Streptococcus mitis/oralis	8	3.8
Streptococcus non-haemolytic	6	2.9
Streptococcus pyogenes	1	0.5
Streptococcus sanguinis	1	0.5
Streptococcus warneri	1	0.5
Viridans streptococcus	25	11.9

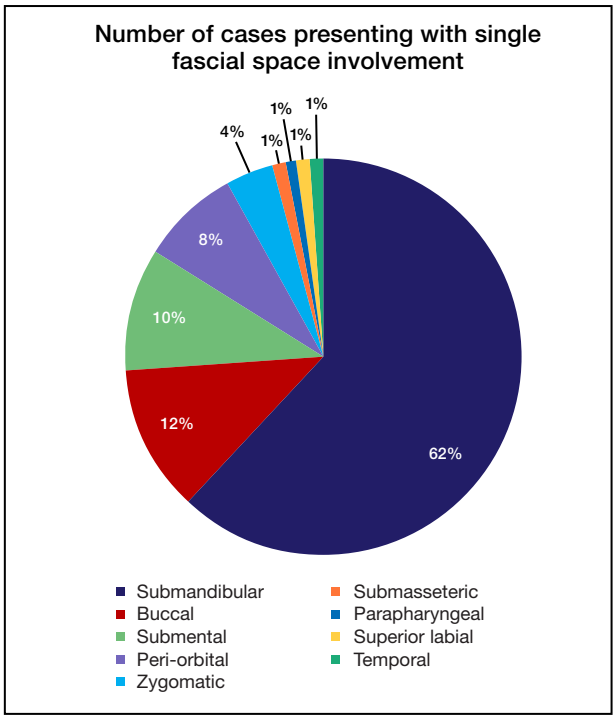

Figure 1. Number of cases presenting with single fascial space involvement.

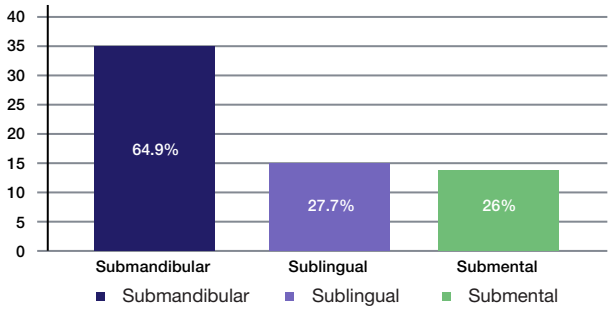

Figure 2. The most common fascial spaces implicated in multiple space involvement.

Table 2. Antimicrobial sensitivity of *Bacteroides* species.

Antimicrobial	Tested	Sensitive	Resistant
Amoxicillin-clavulanic acid	35	35	0
Clindamycin	35	35	0
Metronidazole	35	35	0
Cefoxitin	35	35	0
Chloramphenicol	35	35	0

Table 3. Antimicrobial sensitivity of *Staphylococcus aureus*.

Antimicrobial	Tested	Sensitive	Resistant	Intermediate sensititve
Penicillin	18	0	18	0
Erythromycin	18	13	3	2
Clindamycin	18	14	3	1
Cloxacillin	18	15	2	1
Vancomycin	18	1	0	17

Table 4. Antimicrobial sensitivity of Viridans streptococci.

	Antimicrobial	Tested	Sensitive	Resistant	Intermediate sensititve
1st Line	Penicillin	21	7	1	13
	Erythromycin	21	15	6	0
	Clindamycin	21	16	4	1
2nd Line	Cefotaxime	21	4	1	16
	Vancomycin	21	4	0	17
	Linezolid	21	1	0	20

low resistance of 5.5% (two isolates). With regard to tetracycline, 3 isolates (16.7%) were resistant and 38.9% (seven isolates) were found to be sensitive Only one case (5.5%) was sensitive to vancomycin.

Other commonly isolated microbes and their sensitivities patterns are displayed in Tables 2, 3 and 4 respectively.

Sensitivity of isolates to commonly prescribed antibiotics

Twenty two of the isolates were sensitive to amoxicillin with clavulanic acid (15.2%), 28 were sensitive to penicillin (19.3%) and 61 to erythromycin/azithromycin (42.1%). The majority of the isolates (95) were sensitive to clindamycin (65.5%). Results are shown in Figure 3.

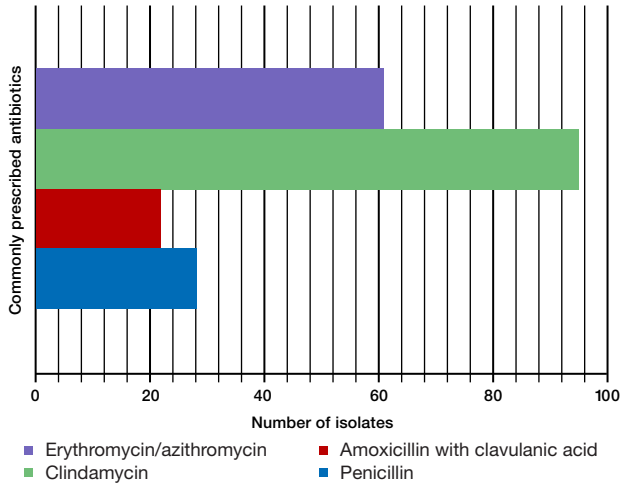

Figure 3. Sensitivity of commonly prescribed antibiotics.

Statistical analysis

Statistically significant association was observed between age and aetiology (p=0.000); age and fascial space (p= 0.005), gender and presence of microorganism (p=0.007).

The presence of microorganisms was statistically significantly associated with antibiotic sensitivity (p=0.000) and resistance (p=0.000) profiles. Similarly the gender was significantly associated with the antibiotic sensitivity profiles.

DISCUSSION

Head and neck infections may result in serious morbidity and mortality. Early recognition of these infections, a thorough understanding of microorganisms involved and their sensitivity patterns are critical in their efficient management. In addition to surgical incision and drainage, antibiotic therapy is vital for successful treatment.

In order to administer antibiotics effectively, microbiological data on the infection is required. However, information on the microbiology and antibiotic susceptibility requires time, and subsequently antibiotics are administered prior to obtaining the aspirate results.[11]

Thus, the selection of the appropriate antibiotics is essential for successful treatment of these infections. The purpose of this study was to identify the microbial flora and antibiotic sensitivity patterns in patients with head and neck space infections and in so doing, provide a better understanding on the management of these infections.

In the current study, 145 patients who had pus aspirates and swabs taken were selected as the sample population. The age of the patients that commonly presented with head and neck space infections ranged from 21 to 40 years. This outcome is similar to the age distribution described in other published works.[3,4,5] Similar to the findings of previous studies,[2,5,7,8] head and neck space infections were more common in males than females in our study.

Our study showed single fascial spaces to be more commonly involved in the head and neck space infections than multiple spaces. This result corroborates the findings of Ye et al.[11] Conversely, Ibeyemi et al.[12] reported multiple space involvement as being more common. In the current study, the most common single space involved was the submandibular space, followed by the buccal and submental space, a finding that is in agreement with that of Singh et al.[8]

A South African study by Molomo et al.[5] showed the submandibular space to be the most commonly involved followed by the submental space. While Molomo et al.[5] did not report on multiple fascial space involvement, our study showed that the submandibular, sublingual and submental spaces were most often implicated in multiple fascial space involvement. However the submandibular space was reported as the most common followed by the submental and lateral pharyngeal spaces by other researchers.[4,6]

Most infections in our study were non-odontogenic in origin (56%). This is contrary to the findings by Boscolo-Rizzo et al.[1] who reported odontogenic infection as the most common cause. Odontogenic causes of infection in the current study comprised 50% periapical lesions, 34% alveolar osteitis, 10% pericoronitis and 6% periodontitis. In contrast, a previous study reported 71%, 17%, 6%, and 1% of odontogenic causes of infection to be due to pulpitis, periodontitis, alveolar osteitis and needle tracts respectively.[2]

Bacteroides species was the most commonly isolated anaerobic bacterium in this study and was found in 15% of cases. Although not the most commonly isolated microorganism in other studies, *Bacteroides fragilis* and *Bacteroides corrodens* did appear in smaller concentrations of 5% and 2.5% of cases respectively, in the study by Walia et al.[10] In contrast, the most commonly isolated microorganisms in a study by Molomo et al.[5] were aerobic.

In the current study, Viridans streptococci were the second most isolated microorganisms, which contradicts other studies where *Streptococcus viridans* species were the most isolated microorganisms.[5-7]

Staphylococcus aureus was the third most isolated microorganism in our study in 8.6% cases. This finding is contrary to previous studies where *Staphylococcus*

aureus was found in higher numbers. A study by Molomo et al.[5] reported 14% cases while Shah et al.[7] reported 16%. *Staphylococcus aureus* observed in our study could have occurred secondary to contamination from the skin and introduced during treatment. The isolation of *Staphylococcus aureus* has clinical significance, as strains resistant to routinely used antibiotics have been reported.[13]

Similarly to Molomo et al.[5] the gram negative aerobes isolated in our study included *Klebsiella, Enterobacter* and *Pseudomonas* species. The presence of gram negative bacilli was also reported by Walia et al.[10] In addition, Prevotella was the most commonly isolated gram negative bacillus in a study by Singh et al.[8] occurring in 25.81% of the specimens.

One unanticipated finding was the identification of *Morganella morganii* complex which were isolated in 3% of cases. Although *Morganella morganii* has a wide distribution, it is considered an uncommon cause of community-acquired infection and it is most often encountered in postoperative and other nosocomial infections such as urinary tract infections. This microorganism was isolated in an aspirate from an HIV positive patient.

The source of infection was a mandibular reconstruction plate that had caused chronic sepsis. A previous study by Ho et al.[14] also reported a rare case of Ludwig's angina caused by *Morganella Morgani*. *Enterobacter cloacae* is a member of the normal gut flora in many humans and is not usually a primary pathogen.

Some strains have been associated with urinary and respiratory tract infections in immunocompromised individuals.[15] *Candida albicans* was found in 1.4% of cases in our study, which is contrary to 5% and 2.5% occurrence in previous studies.[5,10]

In the current study, *Bacteroides* species was 100% sensitive to metronidazole, carbapenems, piperacillin, clindamycin, cefoxitin, chloramphenicol and amoxicillin with clavulanic acid. The South American study by Fernandez-Canigia et al.[16] showed similar high sensitivity rates of 100% to metronidazole and tigecycline, 99% to imipenem and piperacillin-tazobactam, 96% to ampicillin-sulbactam and 91% to moxifloxacin. However, lower sensitivity rates against cefoxitin (72%) and clindamycin (52%) were also observed.

Viridans streptococci displayed highest sensitivities to erythromycin/azithromycin (60%) and clindamycin (64%). In contrast, Shah et al.[7] reported high sensitivity levels of 100% to carbenicillin, amikacin and imipenem and 89.4% to ceftriaxone. Our results also differed from the findings of Rega et al.[6] and Molomo et al.[5] where the highest sensitivity rates to penicillin was reported as 87.1% and 97% respectively.

In the current study, *Staphylococcus aureus* showed sensitivities of 83.3% to cloxacillin, 77.8% to clindamycin and 72.2% to erythromycin/azithromycin while Molomo et al.[5] reported sensitivities of 70%, 90% and 83% respectively. Although Molomo et al.[5] reported 31% resistance, this microbe showed 100% resistance to penicillin. Shah et al.[7] reported a higher sensitivity rate of 100% to amoxicillin with clavulanic acid and a lower resistance of 31.3% to amoxicillin.

Clindamycin was found to be highly effective against the three most commonly isolated bacteria in the current study. This efficacy was reiterated in studies by Bahl et al.[3], Fating et al.[4], Molomo et al.[5] and Singh et al.[8] in which aerobic organisms isolated were sensitive to clindamycin. However, severe side effects like pseudomembranous colitis and the emergence of antibiotic resistance, make this antibiotic unsuitable as the first line drug for the treatment of head and neck space infections. Clindamycin should therefore be reserved for severe penicillin resistant infections to curtail the increasing resistance.

Viridans streptococci and *Staphylococcus aureus* showed high sensitivity rates to erythromycin/azithromycin in agreement with the findings reported by Molomo et al.[5] However the opposite result was obtained in the study by Singh et al.[8] where all isolates displayed low sensitivity rates to erythromycin (38.89%).

There was a statistically significant association between age and aetiology ($p = 0.000$). Older patients in the 51-60 and greater than 60 years age groups presented more commonly with unknown causes of infection. The younger patients in the 0-20 and 21-30 years age groups were more commonly affected by odontogenic infections including alveolar osteitis, periodontal and periapical abscesses.

This finding could be ascribed to the low socio-economic groups comprising the majority of patients presenting at public hospitals. These patients are inadequately exposed to oral health education and are at greater risk for the development of tooth decay and the associated odontogenic infections. This finding was reiterated in the study by Bahl et al.[3], who reported the highest incidence of odontogenic infections in patients in the third decade of life.

There was likewise a statistically significant association between the age and fascial space ($p = 0.005$), with the majority of patients presenting with single space involvement. This correlates with the findings of Walia et al.[10], where single space involvement was significantly more common. Patients younger than 40 years presented more commonly with single space involvement, while the older patients in the 5th decade of life presented more commonly with multiple space involvement.

The association between gender and the presence of microorganisms was also statistically significant ($p = 0.007$). The majority of specimens were acquired from males. This was consistent with studies by Bahl et al. [3], Fating et al.[4] and Walia et al.[10] where the majority of isolates were obtained from male patients. However, more microorganisms were identified in females (45 of 48 patients or 94%) than in males (72 of 97 patients or 74%).

Moreover there was statistically significant association between the presence of microorganisms and antibiotic sensitivity ($p = 0.000$) and resistance ($p = 0.000$) profiles.

This is understandable, as the microorganisms isolated would have displayed either sensitivity or resistance to a specific antibiotic.

It was similarly noted that gender of the patient was significantly associated with antibiotic sensitivity profiles. Thirty nine of 48 female patients (81.2%) that presented with head and neck space infections displayed microorganisms that were sensitive to particular antibiotics.

CONCLUSION

The predominant microorganisms responsible for head and neck infections were gram positive facultative anaerobes. *Bacteroides* species were the most commonly isolated bacteria, followed by Viridans streptococci and *Staphylococcus aureus*.

Most infections occurred in the third and fourth decades of life. Patients older than 50 years presented more commonly with non-odontogenic causes of infection, while younger patients more frequently presented with odontogenic causes of infection. Patients younger than 40 years presented more commonly with single space involvement, while the older patients in the 5th decade of life presented more commonly with multiple space involvement. Microorganisms were more frequently isolated in females than males and in patients in the age range of 21-40 years.

The most commonly isolated microorganisms (*Bacteroides species, Staphylococcus aureus,* Viridans streptococci) in the current study were sensitive to clindamycin. *Bacteroides* species was found to be 100% sensitive to amoxicillin with clavulanic acid.

Limitations

This was a retrospective study which limited the variables that could be studied. The method of collection of the aspirates may have influenced the microbiology results, especially if the anatomical site of collection was not adequately cleaned with an alcohol swab prior to the procedure.

Since the Maxillofacial clinic at Livingstone Hospital is a tertiary care centre, it is likely that most patients included in this study would have received antibiotics prior to admission. Therefore the emergence of resistant strains due to administration of these antimicrobial agents may not have been accurately assessed.

Recommendations

A longer study period with a larger sample size evaluating the microbial spectrum and resistance patterns may be necessary to monitor developing trends.

Since odontogenic infection was found to be a common cause of head and neck space infections, particularly in the third and fourth decades of life, oral health education should further emphasise the importance of caries prevention, good oral hygiene practices, early presentation and intervention to minimise the complications of pulpitis.

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Student perceptions of clinical experiences in endodontic access cavity preparations

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P Gwengu[1], C Jonker[2]

ABSTRACT

Objectives

The aim of this study was to gain understanding into the perceptions of undergraduate dental students regarding their levels of competence and confidence when preparing endodontic access cavities.

Materials and method

Anonymous survey forms were given to 100 undergraduate dental students at Sefako Makgatho Health Sciences University, School of Oral Health Sciences. Students were asked to indicate their self-confidence level by using a 5-point Likert scale as 'not confident', 'manageable', 'comfortable and confident',' extremely confident' and 'never done it'.

Results

The response rate was 75 % out of 100 students. The majority of the participants (88%) indicated that they would perform endodontic access cavity preparation with ease on anterior teeth and the lowest (43%) confidence levels was indicated on multi-rooted posterior teeth.

Keywords

Perceptions, clinical experiences, endodontic access cavity preparation, teaching and learning.

INTRODUCTION

Endodontic treatment and management of patients is a multi-fold approach. It involves the complete debridement of infected tissues inside the root canal system and ultimately a root canal preparation which will meet biological and mechanical needs.[1] The first step in treating an endodontically affected tooth is the preparation of a proper access cavity.[1] The use of rotary burs to create endodontic access cavities or locating root canal orifices can cause serious iatrogenic damage to the tooth and greatly influence the prognosis and restorability.[1]

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1. **Pumela Gwengu:** Principal researcher - 70%, writing of the article - 60% and conceptual stage contribution - 10%
2. **Casper Jonker:** Researcher - 30%, writing of the article - 20%, and conceptual stage contribution - 10%

The use of rotary burs in an incorrect manner and misaligned angle of penetration is often a critical factor in iatrogenic tooth damage.[2] To prevent adverse outcomes like these, appropriately designed pre-clinical teaching and learning strategies will be required.

Access cavity preparation is a crucial step to ensure successful root canal treatment. Incorrect techniques applied during the preparation of access cavities may lead to a variety of procedural accidents. These include perforations, destruction of large amounts of healthy tooth structure and instrument fractures. In order to prevent these complications, dental students need to become competent in preparing access cavities.

Patient safety has always been a concern during clinical teaching and learning of dental students. Thus the importance of ensuring that undergraduate students reach an acceptably high level of competence in their preclinical learning and skills development prior to them being allowed to manage and treat patients.[3,4]

At Sefako Makgatho University (SMU) Oral Health Centre, students have a very limited time to learn and practice preparation of access cavities in their preclinical sessions; nonetheless they are allowed to continue with their preclinical work for few additional sessions until they are ready to treat patients.

A need therefore will always exist to improve endodontic access cavity preparation skills of under-graduate dental students as they continue to manage complex clinical cases. Patient's safety, prevention of complications and procedural accidents are constantly emphasized during preclinical and clinical training.

Students at SMU are exposed to exponential clinical training as well as community outreach programmes. Dental students begin both their pre-clinical and didactic endodontic teaching in the fourth year of their 5-year Bachelor of Dental Surgery (BDS) degree. Dental students would prepare and fill six root canals from extracted single-rooted teeth and four extracted bi-rooted teeth during their preclinical training. Students need to complete access cavities in all ten extracted teeth (six anterior and four premolars). Instructions are given on both conventional stainless-steel files (k-files) as well as rotary files and radiographic images are taken for preoperative diagnosis.

Teaching and training in endodontic discipline for BDS 4 students consists of two-hour theoretical lectures for

a period of fifteen weeks, fourteen two-hour preclinical sessions for a period of four weeks and upon satisfactory completion of the preclinical work, students are allowed to treat patients for one three-hour clinical session weekly for a period of thirty weeks.

The main focus for BDS 4 students is clinical preparation of single-rooted anterior teeth (four incisors or canines) as well as bi-rooted posterior teeth (two premolars). Additional pre-clinical training in endodontics is done for BDS 5 students with one four-hour session weekly for a month. Fifth-year dental students would prepare and fill root canals of four extracted multi-rooted teeth (molars). The focus is on completion of the access cavity preparation on four extracted posterior teeth (molars) plus instructions are given by highly skilled clinicians on how to use the electronic apex locator and rotary files.

Management of more complex cases are carried out by fifth year dental students as part of comprehensive patient care under the supervision of experienced endodontic clinicians. An array of different clinical training platforms allows students to develop academically and professionally. The build-up of knowledge as well as clinical exposure to various oral diseases and conditions does assist in improving their clinical expertise.

Students in their fifth year of endodontic training receive further clinical exposure in access cavity preparation at the emergency clinic (Careline) where patients are seen for the first time. Difficult and extremely complex endodontic cases that necessitate management under Dental Operating Microscope (DOM) are referred and managed by experienced endodontic clinicians.

Student's opinions are important and are a critical aspect of academic course evaluation which can indicate where potential improvements in their Endodontic education and course outcomes can be addressed. However, in recent years more academics have begun to acknowledge the role played by students in providing course evaluation and inputs in a classroom environment. Evaluation processes must be timetabled and in-cooperated into the academic programme and completed independently and by other faculty members other than the course co-ordinators. Students in the higher learning environment must be encouraged to partake in these evaluation processes.

Student competence can be understood as a complex arrangement of a human being's skills that are called into play in a variety of situations.[5] In fact, competence "carries the dual meaning that says there is a track record of such achievement (competent performance) and also that the individual has the capability to perform well in the future. It refers to good adaptation and not necessarily to superb achievement".[5] Systematic competence constitutes an individual's skill in effectively planning his or her work as well as the mastery of relevant techniques.[5]

There are numerous innovative approaches to address the problem of teaching psychomotor skills to under graduate dental students, but none of these were specifically focused on endodontic access cavity preparation.[6] It is, however, well known that undergraduate dental students struggle with the transition of preclinical training to the clinical environment where they have to deal with complex challenges such access cavities on porcelain fused to metal crowns and other patient-related factors.[7,8] Learners are said to struggle with the skills obtained at the "School" and what they have learned, and transferring these skills and knowledge to the clinical or work environment.[9]

The validation for undertaking this study at Sefako Makgatho University (SMU) Oral Health Centre is based on the following aspects; BDS4 students have limited time to learn and practice preparation of access cavities in their preclinical sessions; secondly, BDS4 students are booked patients who already received emergency root canal treatments and access cavity has already been completed, hence this may impact students clinical skills in treating and managing complex and challenging endodontic clinical cases. The study aimed to investigate student's perceptions on their competency and confidence levels in access cavity preparation in endodontics at SMU oral health centre.

METHODOLOGY

Ethical clearance was obtained (SMUREC /D/181/2017) prior to commencement of the study.

A quantitative cross-sectional, observational survey was conducted. One hundred dental students were invited to partake on a voluntary basis. Each participant was requested to complete a self-administered questionnaire at that particular point of clinical training which was closer to the end of the second semester in the 4th year and 5th year of dental training. All dental students who were trained in endodontics consented to participate in the study and those students were in year 4 and 5 of their study. Dental students who were not trained in endodontics were excluded from the study.

QUESTIONNAIRE

A 26-question survey was developed based on past questionnaires that had been previously used successfully by Davey and others in 2014.[10] It was designed specifically for the study in English, together with the information sheet and consent forms. The questionnaires were used to evaluate the responses from 4th and 5th year dental students using Likert scale format.

The first section of the questionnaire was on levels of competence and students rated their perceived competency levels using "unsure", "yes" and "no".[10-14] The remainder of the questionnaire assessed students perceived levels of confidence and they classified this using a 5-point Likert scale with answers as 'not confident', 'manageable', 'comfortable and confident', 'extremely confident' and 'never done it'.[10-14]

The questionnaire assessed students' experiences on: perceived competent levels on access cavity preparation and perceived competent levels on various endodontic tasks of creating access cavity. The closed-ended

questions were used to obtain information on dental student's perceptions when performing endodontic access cavity preparations. Dental student's perception of their competence level was self-rated and scored in the assessment tool. Students were not coerced to answer in a particular way and this was ensured by making use of an independent research assistant.

A pilot test of randomly selected small group of five students from the fifth-year group was performed by the research assistant to determine feasibility, content clarity, the validity of the questionnaire and its acceptability so that potential problems could be identified and resolved before commencing the study itself.

The students who participated in the pilot study were voluntarily excluded from the main study. Some few questions were reviewed as per input from the participants of the pilot study. Sufficient time was allowed to create a relaxed environment without rushing or coercing students with an aim of obtaining a true reflection of their perceptions.

The background information regarding this research topic was introduced by the investigators to the participating students before consent was obtained. Response bias was addressed by reassuring participants of their anonymity and that their participation in the study was not going to influence students' academic outcome. Response bias from participants was also minimized by adding an "unsure" option in the questionnaire as part of response. Distribution and collection of the questionnaires was managed by the independent research assistant to minimize students fear.

STATISTICAL ANALYSIS

Data was first captured in Microsoft Excel 2016 before exporting to SPSS (Statistical Package for the Social Sciences version 20, (SPSS Inc., Chicago, Il, USA) for analysis. Preliminary analysis of data was done where missing values and errors were checked and corrected. Reliability of the instrument was measured using Cronbach's Alpha. Two constructs (competency and confidence) were defined in the study. Competency and confidence scales recorded Cronbach's alpha values of 70.3% and 79.3% respectively. An overall Cronbach's alpha value of 77.2 % was achieved. This is a good overall level of internal consistency which is above the 70.0% threshold.

Normality tests were performed using Kolmogorov-Smirnova and indicated that the data of the study was not normally distributed. Therefore, nonparametric statistics and tests (such as frequencies, percentages, Chi squared tests and Kruskal Wallis tests) were appropriate to use in the study as opposed to parametric tests.

RESULTS

The results of the pilot study were evaluated and the content was adjusted before the questionnaires were distributed the students. A total of 100 questionnaires were distributed to a target audience of 100 dental students in the Bachelor of Dental Science, BDS 4 = 50 and BDS 5 = 50 (notable excluding the five piloted students). Out of this total, 75 questionnaires were completed in full and returned. Each questionnaire took approximately fifteen minutes to complete. Research questionnaire was distributed and collected by a research assistant upon completion. This gives a response rate of 75 % which was 72 % for BDS 5: 36 (48%) and 78 % for BDS 4: 39 (52%) (Table 1).

Table 1. Students response rate.

Year	No. contacted	No. participated	Response (%)
A	50	36	72.0
B	50	39	78.0
Total	100	75	75.0

Perceptions of competence levels when performing endodontic access cavities on anterior and posterior teeth

Out of 75 who completed the questionnaire, 70 (93.3%) confirmed that they were competent in endodontic access cavity preparation on anterior teeth and 47 (62.7%) confirmed to be competent on the posterior teeth.

Of the 70 who confirmed that they were more competent in endodontic access cavity preparation on anterior teeth 36 (48.0 %) were fourth-year dental students and 34 (45.3%) were fifth-year dental students. Of the 47 who confirmed that they were competent in endodontic access cavity preparation on posterior teeth 19 (25.3 %) were fourth-year dental students and 28 (37.3%) were fifth-year dental students (Table 2).

Table 2. Students perceptions of their competence when performing endodontic access cavities.

Do you feel competent when performing endodontic access cavities on	Years of Study		Total
	4th	5th	
An anterior tooth			
Yes	36 (48.0%)	34 (45.3%)	70 (93.3%)
No	0 (0.0%)	0 (0.0%)	0 (0.0%)
Unsure	3 (4.0%)	2 (2.7%)	5 (6.7%)
A posterior tooth			
Yes	19 (25.3%)	28 (37.3%)	47 (62.7%)
No	13 (17.3%)	4 (5.3%)	17 (22.7%)
Unsure	7 (9.3%)	4 (5.3%)	11 (14.7%)
A single-rooted posterior tooth			
Yes	33 (44.0%)	32 (42.7%)	65 (86.7%)
No	3 (4.0%)	0 (0.0%)	3 (4.0%)
Unsure	3 (4.0%)	4 (5.3%)	7 (9.3%)
A multi-rooted posterior tooth			
Yes	18 (24.0%)	24 (32.0%)	42 (56.0%)
No	14 (18.7%)	5 (6.7%)	19 (25.3%)
Unsure	7 (9.3%)	7 (9.3%)	14 (18.7%)

Furthermore, a noticeable difference was observed between the perceived competence levels of the single rooted posterior teeth (BDS 4: 33 (44%) & BDS 5: 32 (42.7 %) and multi-rooted posterior teeth (BDS 4: 18 (24.0 %) & BDS 5: 24 (32.0 %). However, none of the fifth-year dental students that reported that they were incompetent in performing endodontic access cavity on anterior teeth and a few of them 4 (5.3%) confirmed that they were incompetent in endodontic access cavity on posterior teeth.

A small number of fifth year dental students 2 (2.7%) confirmed that they were not sure of their competency level for anterior teeth and 4 (5.3%) for the posterior teeth (Figure 1).

Perceptions of confidence levels when performing endodontic access cavities on teeth with variable dental status

A certain number of fourth year dental students 10 (13.3%) reported to be extremely confident when performing endodontic access cavity on anterior teeth whilst there was about 3 (4.0%) students who were extremely confident in endodontic access cavity on posterior teeth (Table 3).

Additionally, there was only one (1.3%) 5th year dental students who reported that she/he was not confident in performing endodontic access cavity on posterior teeth.

There were some fourth-year dental students who stated that they never prepared endodontic access cavity on anterior teeth with massive carious lesion (BDS 4: 13 (17.3%) and on posterior teeth with massive carious lesions (BDS 4: 12 (16.0%).

Most students 33 (45.8%) confirmed that that they never prepared endodontic access cavity on anterior teeth with gold inlays (BDS4: 22(30.6%) and BDS 5: 11 (15.3%).

Of the 43 (57.3%) who confirmed that they never prepared endodontic access cavity on anterior teeth with metal, porcelain or in ceramic crowns, there were (BDS 4: 29 (38.7%) & BDS 5: 14 (18.7%).

Of the 17 (22.7%) who confirmed that they were extremely confident in endodontic access cavity on anterior teeth with fractured clinical crown, they were (BDS 4: 4 (5.3 %) & BDS 5: 13 (17.3%).

Perceptions of confidence levels when performing endodontic clinical stages during access cavity preparations

Data revealed that there were 60 (80.0%) dental students who reported that they were extremely confident in delivering local anaesthesia for anterior and 49 (65.3%) were extremely confident for posterior teeth (Table 4).

Most dental students 45 (60.0%) confirmed that they were extremely confident in rubber dam placement on anterior teeth; BDS 4: 20 (26.7%) and BDS 5: 25 (33.3%). There were about 20(26.7%) students who perceived themselves to be extremely confident in taking intra-oral x-rays for the purpose of diagnosing clinical crown length; BDS 4: 11 (14.7%) and BDS 5: 9 (12.0%) and there were about 12 (16%) who were extremely confident and able to identify the depth of the access cavity on pre-operative, intra-operative and post-operative x-rays; BDS 4: 6 (8.0%) and BDS 5: 6 (8.0%).

Of the 30 (40.0%) dental students out of 75 who confirmed that they were comfortable and confident in bur selection, these were BDS 4: 15 (20.0%) and BDS 5: 15 (20.0%). Fourteen (18.7%) dental students reported that they were extremely confident in the creation of a coronal flare on anterior teeth; BDS 4: 6 (8.0%) and BDS 5: 8 (10.7%) and on posterior teeth BDS 4: 5 (6.7%) and BDS 5: 1 (1.3%). There were some students 10 (13.3%) who confirmed that they have never done any coronal flare on posterior teeth; BDS 4: 9 (12.0%) and BDS 5: 1 (1.3%).

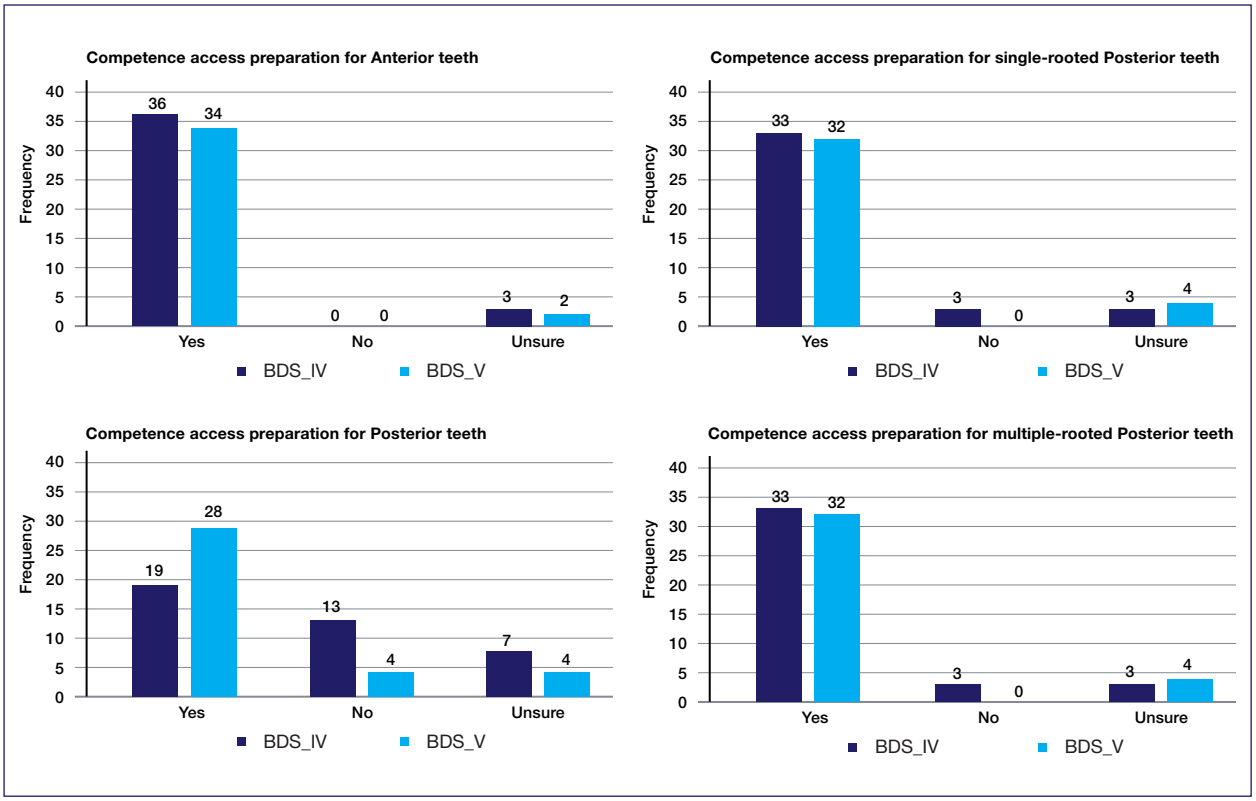

Figure 1. Students perceptions of their competence when performing endodontic access cavities.

Thirty nine (52%) dental students out of 75 reported that they were extremely confident in the placement of inter-appointment temporal restorations using Kalzinol and IRM; BDS 4: 17 (22.7%) and BDS 5: 22 (29.3%) with an exception of one (1.3%) BDS 4 student who reported that she/he was not confident in placing a temporal restoration.

Statistical analysis

Kruskal-Wallis test was used to determine significant differences between the two groups (BDS 4 and BDS 5) on competency levels and confidence levels on access cavity preparations (Table 5). It was observed that there were significant ($p<0.05$) differences between BDS 4 and BDS 5 on competency levels on access cavity preparations for posterior teeth. There was no statistical evidence to suggest any differences between the two groups on competency levels for anterior teeth, single rooted posterior and multi-rooted posterior teeth. There were highly statistically significant ($p<0.01$) differences between BDS 4 and BDS 5 on confidence levels on access cavity preparations for anterior teeth with crowns (metal, porcelain and in Ceramic) and anterior teeth with massive carious lesions. Statistically significant ($p<0.05$) differences were also observed on confidence levels on access cavity preparations for posterior teeth with crowns (metal, porcelain and in Ceramic).

DISCUSSION

Dental student's evaluation input is important to improve the curriculum and to correct existing errors and to identify the missing elements of the curriculum.[11] Student self-assessments of their own proficiency serve as helpful means to make a realistic evaluation of dental curricula and the assessment of the effectiveness of specific courses. Students questionnaire are one of the important tools that can be used in collecting data for the purpose of getting student's input.[12] At Sefako Makgatho Health Science University where the study was conducted, curriculum reviews are done for both theoretical and clinical practise and these reviews includes dental students evaluation input.

Dental students are given enough opportunities to fine-tune their clinical skills in access cavity preparation during their professional training. Management of endodontic patients are carried out by fifth-year dental students as part of comprehensive patient care and they are supervised by experienced endodontic clinicians. These stu-

Table 3. Students perceptions of their confidence when performing endodontic access cavities.

How confident do you feel when performing endodontic access cavities on	Years of Study		Total
	4th	5th	
An anterior tooth			
Not confident at all	0 (0.0%)	0 (0.0%)	0 (0.0%)
Manageable	5 (6.7%)	4 (5.3%)	9 (12.0%)
Comfortable & confident	24 (32.0%)	16 (21.3%)	40 (53.3%)
Extremely confident	10 (13.3%)	16 (21.3%)	26 (34.7%)
Never done it	0 (0.0%)	0 (0.0%)	0 (0.0%)
A posterior tooth			
Not confident at all	5 (6.7%)	1 (1.3%)	6 (8.0%)
Manageable	14 (18.7%)	13 (17.3%)	27 (36.0%)
Comfortable & confident	11 (14.7%)	20 (26.7%)	31 (41.3%)
Extremely confident	3 (4.0%)	2 (2.7%)	5 (6.7%)
Never done it	6 (8.0%)	0 (0.0%)	6 (8.0%)
A single-rooted posterior tooth			
Not confident at all	2 (2.7%)	0 (0.0%)	2 (2.7%)
Manageable	6 (8.0%)	4 (5.3%)	10 (13.3%)
Comfortable & confident	22 (29.3%)	16 (21.3%)	38 (50.7%)
Extremely confident	6 (8.0%)	16 (21.3%)	22 (29.3%)
Never done it	3 (4.0%)	0 (0.0%)	3 (4.0%)
A multi-rooted posterior tooth			
Not confident at all	5 (6.7%)	2 (2.7%)	7 (9.3%)
Manageable	14 (18.7%)	15 (20.0%)	29 (38.7%)
Comfortable & confident	10 (13.3%)	16 (21.3%)	26 (34.7%)
Extremely confident	3 (4.0%)	3 (4.0%)	6 (8.0%)
Never done it	7 (9.3%)	0 (0.0%)	7 (9.3%)
An anterior tooth with massive carious lesion			
Not confident at all	0 (0.0%)	1 (1.3%)	1 (1.3%)
Manageable	7 (9.3%)	10 (13.3%)	17 (22.7%)
Comfortable & confident	14 (18.7%)	17 (22.7%)	31 (41.3%)
Extremely confident	5 (6.7%)	8 (10.7%)	13 (17.3%)
Never done it	13 (17.3%)	0 (0.0%)	13 (17.3%)
A posterior tooth with massive carious lesion			
Not confident at all	3 (4.0%)	5 (6.7%)	8 (10.7%)
Manageable	11 (14.7%)	11 (14.7%)	22 (29.3%)
Comfortable & confident	9 (12.0%)	12 (16.0%)	21 (28.0%)
Extremely confident	4 (5.3%)	7 (9.3%)	11 (14.7%)
Never done it	12 (16.0%)	1 (1.3%)	13 (17.3%)
A heavily restored anterior tooth with composite			
Not confident at all	0 (0.0%)	1 (1.3%)	1 (1.3%)
Manageable	14 (18.7%)	10 (13.3%)	24 (32.0%)
Comfortable & confident	19 (25.3%)	13 (17.3%)	32 (42.7%)
Extremely confident	1 (1.3%)	11 (14.7%)	12 (16.0%)
Never done it	5 (6.7%)	1 (1.3%)	6 (8.0%)
An anterior tooth restored with gold inlay			
Not confident at all	0 (0.0%)	1 (1.4%)	1 (1.4%)
Manageable	8 (11.1%)	10 (13.9%)	18 (25.0%)
Comfortable & confident	7 (9.7%)	9 (12.5%)	16 (22.2%)
Extremely confident	2 (2.8%)	2 (2.8%)	4 (5.6%)
Never done it	22 (30.6%)	11 (15.3%)	33 (45.8%)
A crowned anterior tooth with any of these (porcelain or in ceramic or metal)			
Not confident at all	0 (0.0%)	2 (2.7%)	2 (2.7%)
Manageable	2 (2.7%)	9 (12.0%)	16 (21.3%)
Comfortable & confident	7 (9.3%)	9 (12.0%)	16 (21.3%)
Extremely confident	1 (1.3%)	2 (2.7%)	3 (4.0%)
Never done it	29 (38.7%)	14 (18.7%)	43 (57.3%)
A crowned posterior tooth with any of these (porcelain or in ceramic or metal)			
Not confident at all	2 (2.7%)	1(1.3%)	3(4.0%)
Manageable	2 (2.7%)	7(9.3%)	9(12.0%)
Comfortable & confident	72(2.0%)	6(8.0%)	8(10.0%)
Extremely confident	1(1.3%)	1(1.3%)	2(2.7%)
Never done it	32(42.7%)	21(28.0%)	53(70.7%)

dents are also exposed to integrated clinical dentistry and students are responsible for all dental treatments of the patients that are assigned to them.

The study aimed at understanding student's perceptions in terms of their confidence and competence levels in their clinical experiences whilst performing endodontic access cavities. These findings on competency on access cavity preparation on anterior teeth, single-rooted and multi-rooted posterior teeth are in line with theoretical expectations as it is stated in other studies.[13]

In this study, all dental students were competent in access cavity preparation on anterior teeth as opposed to posterior teeth. This is not unexpected because many studies have shown that molar endodontics is a complex procedure in which students had the least confidence.[12-14] Davey and other researchers in 2015 were also in agreement to the fact that molar endodontics is the most difficult clinical procedure.[10]

Endodontic treatment can be quite challenging and may pose difficulties both in terms of clinical conditions of that particular tooth such as massive carious lesion, restored with clinical crowns and morphological characteristics of that particular tooth.[12]

When different types of teeth were scored by dental students in terms of self-confidence levels, it was observed that molar endodontic access cavity preparation yielded relatively lower values and these results are consistent with the results of previous studies.[13,15,16]

Notable from the results of this study, is that most of the fourth-year dental students have never attempted complex access cavity preparation. This assertion has been demonstrated by the highly statistically significant levels between BDS 4 and BDS 5 on access cavity preparations of anterior teeth with crowns (metal, porcelain and in Ceramic).

Table 4. Students perceptions of their confidence when performing endodontic clinical stages during access cavity preparation.

How confident do you feel when performing these endodontic clinical stages	Years of Study		Total
	4th	5th	
Delivery of local anesthesia for an anterior tooth			
Not confident at all	0 (0.0%)	0 (0.0%)	0 (0.0%)
Manageable	1 (1.3%)	1 (1.3%)	2 (2.3.0%)
Comfortable & confident	5 (6.7%)	7 (9.3%)	12 (16.0%)
Extremely confident	30 (40.0%)	30 (40.0%)	60 (80.0%)
Never done it	1 (1.3%)	0 (0.0%)	1 (1.3%)
Delivery of local anesthesia for a posterior tooth			
Not confident at all	0 (0.0%)	0 (0.0%)	0 (0.0%)
Manageable	3 (4.0%)	3 (4.0%)	6 (8.0%)
Comfortable & confident	9 (12.0%)	8 (10.7%)	17 (22.7%)
Extremely confident	24 (32.0%)	25 (33.3%)	49 (65.3%)
Never done it	3 (4.0%)	0 (0.0%)	3 (4.0%)
Rubber dam placement on an anterior tooth			
Not confident at all	0 (0.0%)	1 (1.3%)	1 (1.3%)
Manageable	4 (5.3%)	3 (4.0%)	7 (9.3%)
Comfortable & confident	15 (20.0%)	7 (9.3%)	22 (29.3%)
Extremely confident	20 (26.7%)	25 (33.3%)	45 (60.0%)
Never done it	0 (0.0%)	0 (0.0%)	0 (0.0%)
Rubber dam placement on a posterior tooth			
Not confident at all	0 (0.0%)	4 (5.3%)	4 (5.3%)
Manageable	6 (8.0%)	8 (10.7%)	14 (18.7%)
Comfortable & confident	13 (17.3%)	8 (10.7%)	21 28.0%)
Extremely confident	19 (25.3%)	16 (21.3%)	35 (46.7%)
Never done it	1 (1.3%)	0 (0.0%)	1 (1.3%)
Pre-operative, intra-operative and post-operative radiographic interpretation of size, shape and content of pulpal chamber			
Not confident at all	1 (1.4%)	1 (1.4%)	2 (2.7%)
Manageable	9 (12.2%)	4 (5.4%)	13 (17.6%)
Comfortable & confident	23 (31.1%)	26 (35.1%)	49 (66.2%)
Extremely confident	6 (8.1%)	4 (5.4%)	10 (13.5%)
Never done it	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pre-operative, intra-operative and post-operative radiographic interpretation for measuring clinical crown length			
Not confident at all	0 (0.0%)	1 (1.3%)	1 (1.3%)
Manageable	9 (12.0%)	6 (8.0%)	15 (20.0%)
Comfortable & confident	19 (25.3%)	20 (26.7%)	39 (52.0%)
Extremely confident	11 (14.7%)	9 (12.0%)	20 (26.7%)
Never done it	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pre-operative, intra-operative and post-operative radiographic interpretation of depth and size of access cavity			
Not confident at all	1 (1.3%)	1 (1.3%)	2 (2.0%)
Manageable	12 (16.0%)	5 (6.7%)	17 (22.7%)
Comfortable & confident	19 (25.3%)	24 (32.0%)	43 (57.3%)
Extremely confident	6 (8.0%)	6 (8.0%)	12 (16.0%)
Never done it	1 (1.3%)	0 (0.0%)	1 (1.3%)
At selecting the type of a bur that you would use			
Not confident at all	1 (1.3%)	1 (1.3%)	2 (2.7%)
Manageable	8 (10.7%)	6 (8.0%)	14 (18.7%)
Comfortable & confident	15 (20.0%)	15 (20.0%)	30 (40.0%)
Extremely confident	15 (20.0%)	14 (18.7%)	29 (38.7%)
Never done it	0 (0.0%)	0 (0.0%)	0 (0.0%)
At coronal flare creation for an anterior tooth			
Not confident at all	3 (4.0%)	0 (0.0%)	3 (4.0%)
Manageable	11 (14.7%)	13 (17.3%)	24 (32.0%)
Comfortable & confident	17 (22.7%)	14 (18.7%)	31 (41.3%)
Extremely confident	6 (8.0%)	8 (10.7%)	14 (18.7%)
Never done it	2 (2.7%)	1 (1.3%)	3 (4.0%)
At coronal flare creation for a posterior tooth			
Not confident at all	3 (4.0%)	2 (2.7%)	5 (6.7%)
Manageable	12 (16.0%)	20 (26.7%)	32 (42.7%)
Comfortable & confident	10 (13.3%)	12 (16.0%)	22 (29.3%)
Extremely confident	5 (6.7%)	1 (1.3%)	6 (8.0%)
Never done it	9 (12.0%)	1 (1.3%)	10 (13.3%)
At placing an inter-appointment temporal restoration			
Not confident at all	1 (1.3%)	0 (0.0%)	1 (1.3%)
Manageable	6 (8.0%)	5 (6.7%)	11 (14.7%)
Comfortable & confident	15 (20.0%)	8 (10.7%)	23 (30.7%)
Extremely confident	17 (22.7%)	22 (29.3%)	39 (52.0%)
Never done it	0 (0.0%)	1 (1.3%)	1 (1.3%)

Furthermore, highly statistically significant level were observed between the two groups on access cavity preparations for anterior teeth with massive carious lesions. This also confirms the validation of the study because fourth-year dental students do not rotate at an emergency unit (Careline), where most of the emergency root canal treatments, access cavity preparations on teeth with various clinical status, complex and challenging clinical cases are being managed. Therefore, this absence of rotation by fourth-year dental students at Careline must be seen as a shortcoming of our institutional planning and curriculum design.

Students also reported lower confidence levels in delivery of local anaesthetics on posterior teeth, these findings are in line with previous studies whereby it was stated by students that the most difficult areas in terms of obtaining anaesthesia was on posterior teeth.[17,18] In addition, students confirmed lower confidence levels in rubber dam placement for posterior teeth.

A previous study by Tanalp and other authors in 2013 stated that rubber dam application was one of the endodontic clinical steps where students reported the lowest confidences.[12] However, rubber dam application is a prerequisite and students are not allowed to complete their treatments without the use of this significant apparatus at Sefako Makgatho Health Science University. Rubber dam is also an indispensable element of endodontic clinical practice and is not only a valuable tool but an ethical and medico-legal prerequisite for dental practitioners.[12]

In our study, it was also observed that confidence levels varied in some instances according to both the year of study as well as the practical steps of endodontic access cavity. When summarizing the results of the study, it was observed that molars were the most difficult teeth group for all steps of endodontic treatment.

Table 5. Comparison of fourth- and fifth-year dental student's competencies and confidences using Kruskal Wallis test.

Significant attribute	Chi-Square	df	Asymp. Sig.	Significance
Anterior teeth competences	0.136	1	0.71	NS
Posterior teeth competences	3.935	1	0.05	**
Single rooted posterior teeth competences	0.186	1	0.67	NS
Multi-rooted posterior teeth competences	0.940	1	0.33	NS
Anterior teeth confidences	2.148	1	0.14	NS
Posterior teeth confidences	0.012	1	0.91	NS
Single rooted posterior teeth competences	3.004	1	0.08	*
Multi-rooted posterior teeth competences	0.216	1	0.64	NS
Anterior teeth with massive carious lesion confidences	7.198	1	0.01	***
Posterior teeth with massive carious lesion confidences	3.486	1	0.06	*
Anterior teeth with a huge composite restoration confidences	0.783	1	0.38	NS
Anterior teeth with gold inlay confidences	3.728	1	0.05	*
A crowned anterior teeth with porcelain or in Ceram or metal	11.157	1	0.00	***
A crowned posterior teeth with porcelain or in Ceram or metal	4.497	1	0.03	**

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; NS not significant

The significant variations that are shown between BDS 4 and BDS 5 students in this study is a clear indication of non-clinical exposure to complex and challenging endodontic cases at an emergency unit. The findings may prompt Sefako Makgatho Health Science University to reconsider the endodontic theoretical and clinical course by in cooperating the necessary curriculum changes. Changing of the endodontic programme may also assist students to be able to progress in clinical knowledge and expertise. Endodontic education at this institution should be improved by adding the clinical rotations for BDS 4 students at an emergency unit and gradually introduce them to complex access cavity preparations.

CONCLUSION

The results showed students' lower confidence levels in the more challenging aspects of endodontic access cavity preparation and these findings varied in some instances according to the year of study, complexity of the case as well as the practical steps of endodontic access cavity.

The significance of this research study is to provide the dental institution with valuable information that can improve student's skills on endodontic access cavity preparation regarding the readiness of students to manage complex and challenging endodontic access cavities.

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Do the CPD questionnaire on page 223

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

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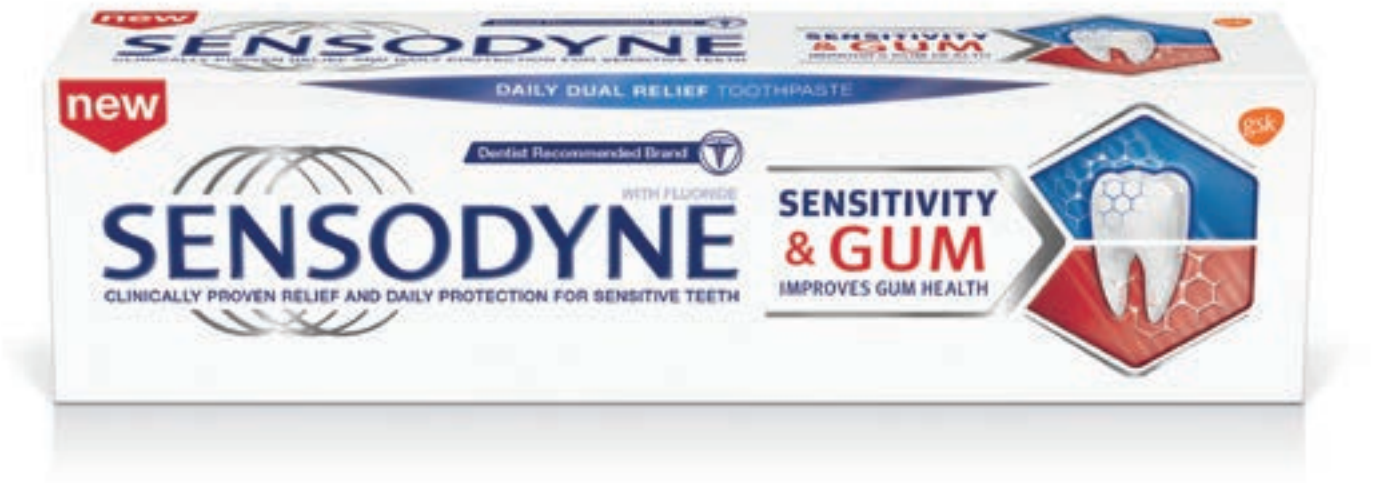

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Focal dermal hypoplasia
- a radiographic case report

SADJ May 2020, Vol. 75 No. 4 p208 - p210

Z Yakoob[1], C Nel[2]

ABSTRACT

Focal dermal hypoplasia (FDH) is an unusual X-linked dominant disorder that affects ectoderm and mesoderm derived tissues with females affected in 90% of cases. A case report of a 12 year old female diagnosed with FDH is presented. The dental significance of these patients are multifactorial and dental management should be focused on prevention and regular monitory visits.

Restoration of functionality should be addressed by a combination of orthodontic, basic restorative and prosthodontic disciplines. Due to the multisystem involvement and the dental complexities of patients suffering from FDH a multidisciplinary approach is required for optimal patient care.

Keywords

Focal dermal hypoplasia, Goltz-Gorlin syndrome, Ectodermal Dysplasia.

INTRODUCTION

Focal dermal hypoplasia (FDH), also known as Goltz-Gorlin syndrome was first reported in 1962 by Goltz, Peterson, Gorlin and Ravitz.[1] FDH is an unusual X-linked dominant disorder that affects ectoderm and mesoderm derived tissues.[2]

The PORCN (porcupine O-acyltransferase) gene mutation can be inherited or occur sporadically, with females affected in 90% of cases.[3,4] FDH is characterized by a wide range of multisystem abnormalities and all patients present with dermatological conditions. The eyes, teeth, skeletal, urinary, gastrointestinal, cardiovascular and central nervous systems may all present with manifestations (Figure 1).[3,5]

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Author contributions:

1. **Zarah Yakoob:** First draft, revision, final write-up and final approval - 50%
2. **Chané Nel:** Conceptualization, first draft, revision, final write-up and approval - 50%

Over 280 cases have been reported in the literature, with a small number of these reporting oral and dental features.[3] The reported dental abnormalities associated with this condition include; hypodontia, enamel hypoplasia and structural alterations such as taurodontism and abnormal root morphology.

Disturbances in eruption and ectopic teeth are also a common finding.[3] One study reports the presence of enamel defects in the form of vertical grooves that run along the Blaschko lines, as a strong indicative factor for FDH.[6]

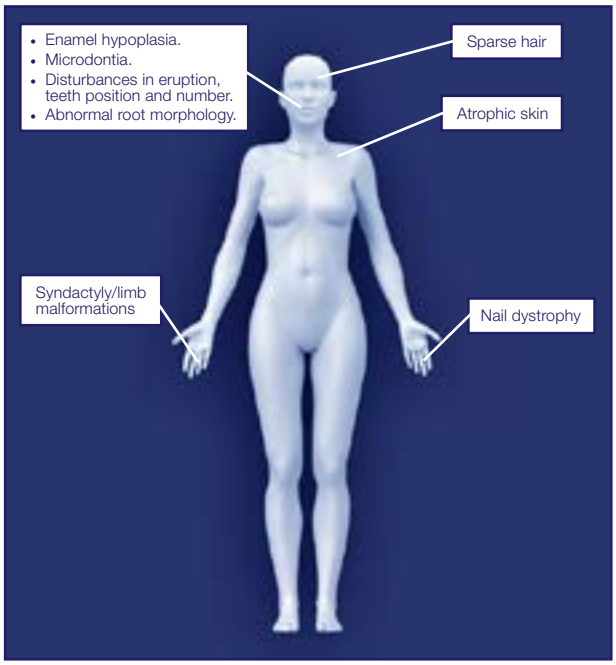

Figure 1. Most common conditions associated with FDH.[4]

CASE DESCRIPTION

A 12 year old female diagnosed with FDH reported to our institution seeking dental care. The diagnosis was made by a geneticist at infancy. She has been managed for numerous multisystem conditions since birth and was referred to our institution for further dental and orthodontic management.

The patient has a history of surgical treatment for the correction of syndactyly of the hands (Figure 2). The patient's toes have not been surgically corrected (Figure 3). The patient has been reportedly struggling with chronic conjunctivitis, middle ear infections and dermatitis.

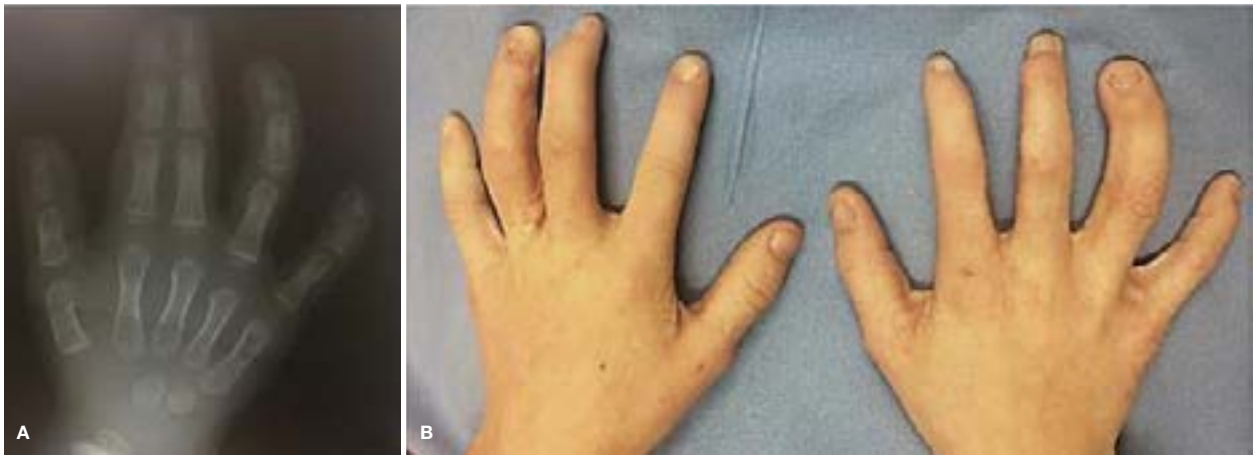

Figure 2. Preoperative radiograph (A) of right hand exhibiting syndactyly. Soft tissue union of the right index and middle finger. Clinical picture (B) of hands after surgical correction.

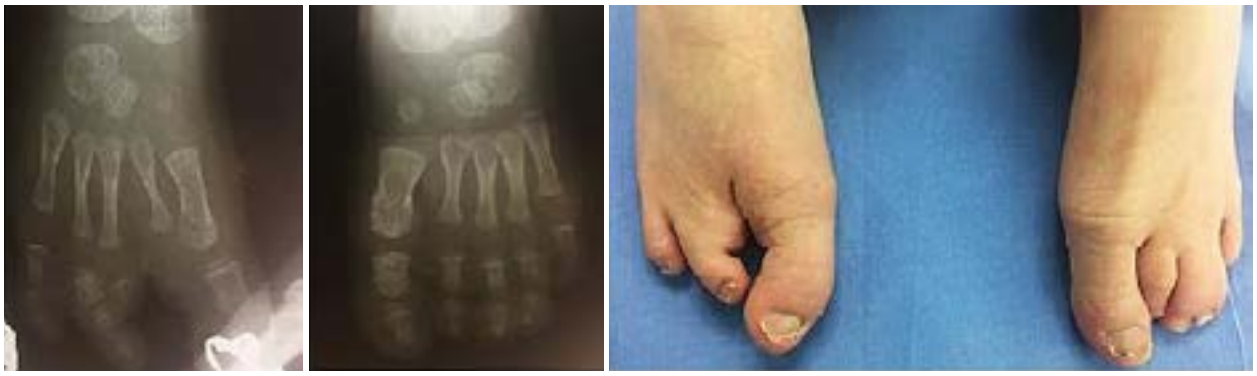

Figure 3. Current clinical presentation and previous radiographs of feet. On the right foot the proximal, middle and distal phalanges of the index toe are missing. The middle and distal phalanges of the middle toe on the right foot is also missing. On the left foot soft tissue union is visualised between the middle and fourth toe.

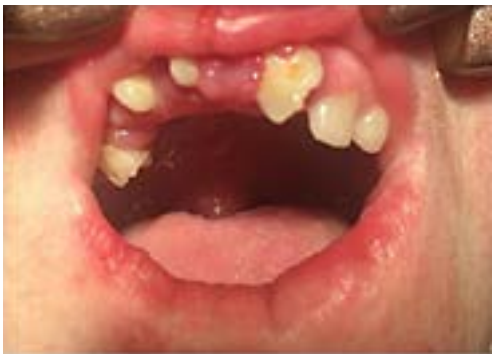

Figure 4. Clinical photograph demonstrating patchy skin, gingival enlargement and enamel hypoplasia.

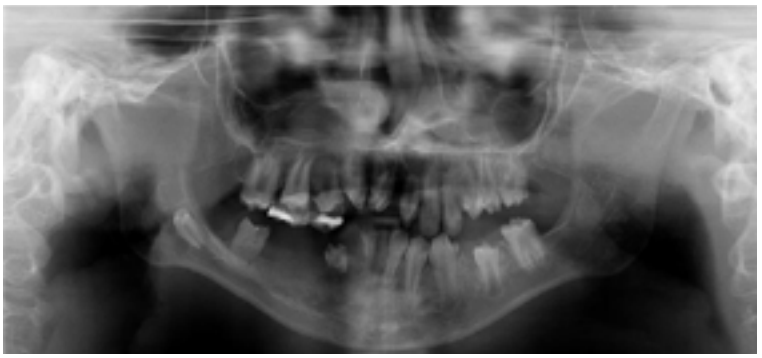

Figure 5. Panoramic radiograph of the patient exhibiting enamel hypoplasia and hypodontia.

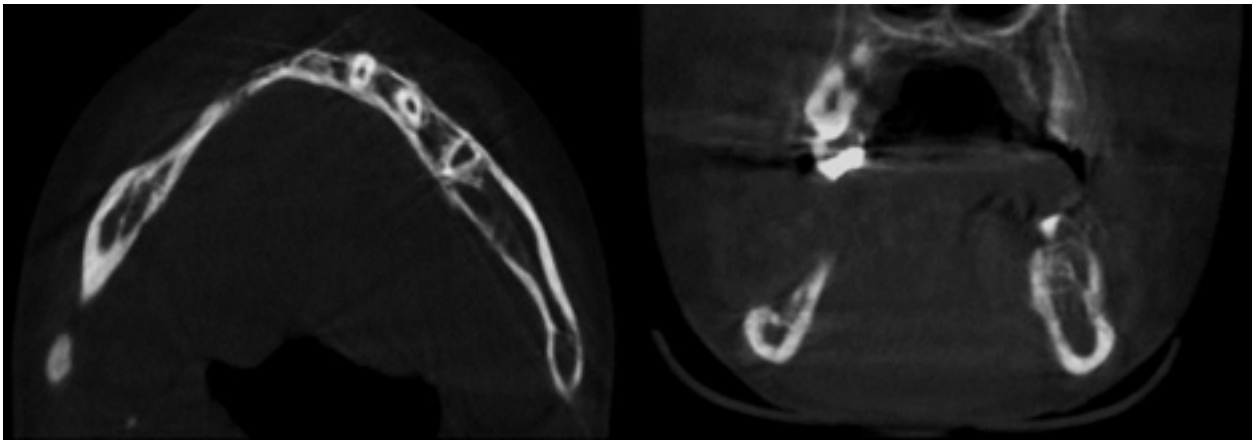

Figure 6. Axial and coronal CBCT slice exhibiting mandibular bone.

The extra-oral examination revealed sparse hair, dystrophic nails and red patchy skin. The intra-oral examination revealed microstomia, generalized inflammatory gingival enlargement and numerous missing and mal-aligned teeth (Figure 4).

The visualization of vertical grooving of the anterior teeth was not feasible due to the altered eruption and alignment. The patient was subsequently referred for radiographic assessment. The panoramic radiograph (Figure 5) revealed an elongated left condylar neck and interrupted calcification of the right stylohyoid ligament. Generalized enamel hypoplasia and hypodontia was the most striking radiographic finding.

Radicular hypoplasia was also visible on 43 and 22. Overlap and crowding of maxillary anterior teeth and a disto-angular impaction in the right mandibular corpus was noted. The bone in the 4th quadrant had an irregular presentation and the decision was then made to take a CBCT scan of the area (Figure 6).

The CBCT scan revealed thin crestal bone in the area of the 4th quadrant with intact cortication. This explains the irregular appearance of the bone seen on the panoramic radiograph as the thin bony crest was outside of the panoramic focal trough. The excess mobile soft tissue in the 4th quadrant was excised under general anaesthesia and submitted for histology.

The histological features were that of inflammatory fibrous hyperplasia. The 55, 54 and 43 were also extracted during this procedure. A carious 46 was also detected on the radiograph and was subsequently restored. The patient was assessed by maxillofacial surgeons, orthodontists and a geneticist during her visit at our institution and was further managed by the pedodontics department for restorative and preventive care. Initial verbal consent and later written informed consent was obtained from the mother of the child to continue with the study. Ethical approval was obtained from the University of Pretoria Ethics committee (Reference number: 143/2019).

DISCUSSION

A three year follow up study found that enamel hypoplasia is a significant risk factor for caries development.[7] Therefore patients with FDH have increased susceptibility to caries formation due to the hypoplastic enamel. Additionally, hypoplastic enamel is significant as it is associated with altered aesthetics and increased dentinal sensitivity.

Masticatory functionality is impaired due to the hypodontia and ectopic teeth with few teeth in full occlusion. The microstomia influences oral hygiene practices which often leads to gingivitis and a higher prevalence of caries of the susceptible enamel. Dental treatments and interventions should be focused on prevention with regular dental check-ups, fissure sealants and topical fluoride application. Restoration of functionality should be addressed by a combination of orthodontic, basic restorative and prosthodontic disciplines. Due to the multisystem involvement and the dental complexities of patients suffering from FDH a multidisciplinary approach is required for optimal patient care.

Declaration

The authors declare no conflict of interest.

Ethical considerations

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

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

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

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Lichenoid Granulomatous Stomatitis - an oral medicine case book

SADJ May 2020, Vol. 75 No. 4 p211 - p213

L Robinson[1], AW van Zyl[2], WFP van Heerden[3]

CASE REPORT

A 72-year-old male patient presented with a painful area on the labial mucosa of the upper lip adjacent to tooth 12. He complained of a non-healing "bruise" on the inside of his lip that had been present for about 4-weeks. The patient was a non-smoker and reported taking anti-hypertensive medication (Lisinopril, hydrochlorothiazide) for 10-years. A prior colonoscopy 4 years ago revealed adenomas.

On examination, a swelling was noted with the overlying mucosa appearing erosive and erythematous with peripheral white striae, clinically similar to lichen planus. The lesion also involved the facial gingiva associated with teeth 12 & 22 (**Figure 1**). This red-white lesion was excised as well as minor salivary glands that extruded during the biopsy procedure. No additional pharmacotherapeutic agents were administered.

The specimen submitted from the lip lesion consisted of a mucosa-covered tissue fragment measuring 12x5x4mm. Histological evaluation confirmed the presence of a tissue fragment surfaced by stratified squamous epithelium with areas of hyperparakeratosis, as well as vacuolar degeneration of the basal cell layer with associated apoptotic bodies. A band-like lymphohistiocytic infiltrate was seen in the underlying superficial lamina propria. Secondarily, varying degrees of granulomatous inflammation within the superficial lichenoid inflammatory infiltrate was noted. These poorly formed granulomas were composed of epithelioid macrophages, however no giant cells or central necrosis could be appreciated. Additionally, lymphoid follicles were seen, with a striking perineural and perivascular distribution (**Figures 2 & 3**). No foreign material was noted under polarised light. Periodic acid–Schiff (PAS) and Ziehl-Neelsen histochemical stains failed to highlight any fungal elements or acid-fast bacilli respectively.

In conclusion, a final diagnosis of lichenoid granulomatous stomatitis was made.

The patient was followed-up one month after total excision of the lesion to reassess for further treatment. He reported that healing was uneventful, and all symptoms had disappeared after the excision biopsy. Intra-oral examination showed an absence of any clinical signs in the original area (**Figure 4**).

The patient will be followed-up for routine examination every few months and was instructed to immediately report back should symptoms reappear.

DISCUSSION

The presence of lichenoid inflammation with concomitant granulomatous inflammation is an uncommon observation within the oral cavity. Many diseases are typified by either lichenoid or granulomatous inflammation.[1] However when both patterns occur simultaneously, problems arise in determining which pattern represents the primary disease process, or whether the coexistence of both patterns represents a distinctive disease entity.

The term lichenoid granulomatous stomatitis (LGS) was first described in literature by Robinson et al. in 2006.[1] Lichenoid inflammation may render the oral mucosa susceptible to the ingress of foreign material, resulting in granuloma formation. LGS has been reported in cases of foreign body gingivitis. In a series of 61 foreign body gingivitis cases, investigators reported the presence of both patterns of inflammation in 26% of biopsies studied.[2] In the present case, no foreign material could be identified under polarised light.

To date the largest review by Hakeem et al.[3] in 2019 identified 47 patients with LGS. In this study, patient demographics showed a female predilection of 1.9:1 with a mean age of 59 years. Seventy-nine percent of patients were older than 55 years. Patients commonly presented with a solitary lesion, with most cases occurring on the attached gingiva followed by the buccal mucosa and vestibule. With regards to clinical description, 38% were described as erythroleukoplakia, 36% as leukoplakia, and 26% as purely erythematous lesions.

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2. **André W van Zyl:** Clinical case, treatment and follow-up - 25%
3. **Willie FP van Heerden:** Diagnosis, histological images and advisor - 25%

There was an equal incidence of presentation amongst patients regarding painful or non-painful lesions. The clinical impressions for all cases in this study (for which multiple were listed in some instances) included lichen planus (17 cases), dysplasia/carcinoma *in situ*/squamous cell carcinoma (11 cases), vesiculobullous lesions (9 cases), trauma-associated (5 cases), leukoplakia (5 cases), allergy (2 cases) and other differentials (4 cases). No clinical diagnosis was reported in 7 cases.[3]

Histologically, LGS consists of three distinctive components. First, is the presence of lichenoid inflammation, characterised by hyperkeratosis, basal cell degeneration with associated apoptotic bodies and a band-like lymphohistiocytic inflammatory cell infiltrate. Secondly, variable degrees of granulomatous inflammation can be seen throughout the corium. Importantly, all granulomas consist of epithelioid macrophages without giant cells or areas of necrosis. Thirdly, lymphoid follicles are present in the corium showing a prominent perineural distribution.[1]

Additional studies ruling out infective agents and foreign material should be performed in suspected cases. A study of six cases of LGS by Robinson et al.[1] found that presence of fungal hyphae was not associated with a lichenoid inflammatory reaction.[1] Secondly, granulomatous inflammation is typical of deep mycoses and not superficial candidosis.

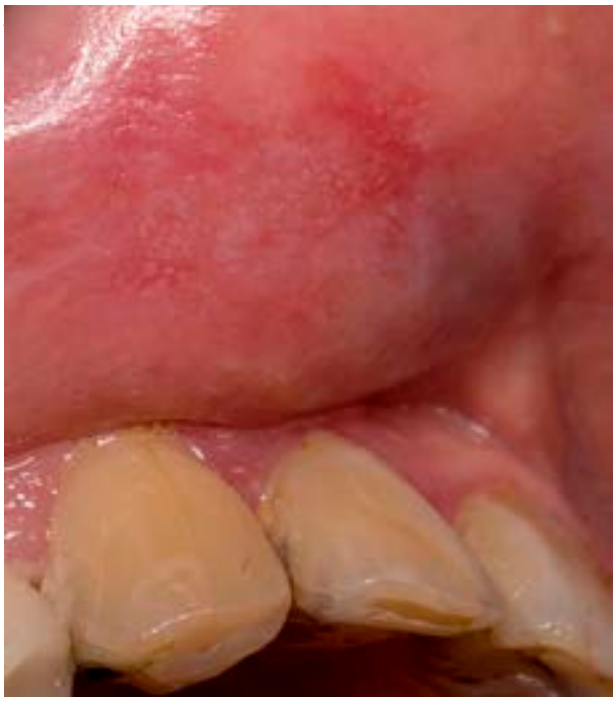

Figure 1. Initial clinical presentation.

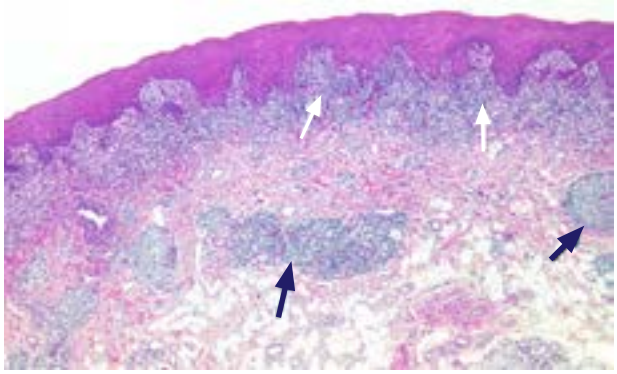

Figure 2. H&E-stained section showing the band-like inflammatory cell infiltrate (white arrows) and lymphoid aggregates in a perineural and perivascular distribution (black arrows) (original magnification x 40).

Patients taking certain medications may develop LGS, which may ultimately resolve with discontinuation of the medication.[3] Additionally, the case review by Robinson et al., reported two patients known to be on medications that have an association with lichenoid eruptions, namely Naproxen (Non-steroidal anti-inflammatory drug), Atenolol (β-adrenoceptor blocker), and Ramipril (Angiotensin-converting enzyme inhibitor).[4] Furthermore, these groups of drugs have also been implicated in both lichenoid and granulomatous dermatitis.

Equally rare is the presence of both patterns of inflammation in dermatological conditions. Lichenoid granulomatous dermatitis (LGD) was first described by Gonzalez in 1986.[5] A study by Magro and Crowson[6] reported a series of 40 patients with skin lesions showing lichenoid dermatitis with a granulomatous component. The majority of these cases had confounding medical problems associated with the disease, however one-fifth of the cases were considered idiopathic. Furthermore, in 12 cases an infective cause was implicated. The agent was either a

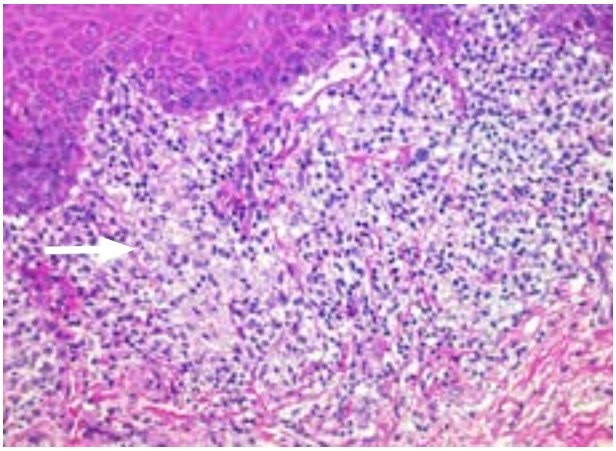

Figure 3. H&E-stained section showing a poorly formed granuloma (white arrow) within the superficial inflammatory cell infiltrate (original magnification x 200).

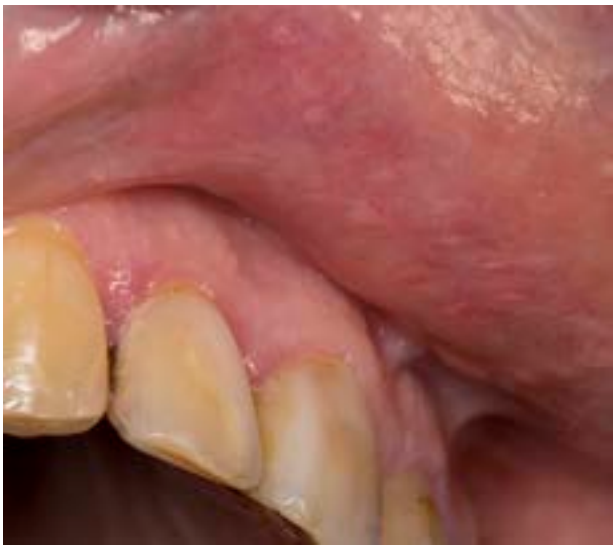

Figure 4. Clinical presentation one month post initial biopsy.

or bacterial infection and not fungal in origin.[6] Both inflammatory patterns have also been reported to coexist in a rare skin condition, lupus erythematosus profundus.[7]

In total approximately 57 cases have been previously reported as LGD. The gender ratio reported in the prior cases showed a slight female predilection of 1.3:1 with mean age of 48 years. The trunk, arms, and legs were the most common location. Dermatologic lesions mostly presented as erythematous or as maculopapular entities.[6,8-9]

Although many similarities were found when comparing histological features of LGS and LGD, some important differences were noted. Cases from the oral mucosa did not show an interstitial array between collagen fibers surrounded by palisaded histiocytes, granuloma annulare-like appearance, focal Langhans giant cells or granulomatous vasculitis. Additionally, a prominent perivascular inflammatory infiltrate, as seen in LGS cases, was not emphasised in descriptions of lesions involving the skin.[3]

Literature is sparse regarding the treatment of LGS, however, it appears to respond well to similar regimens used in treating conventional lichen planus.[3]

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

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Compiled and edited by V Yengopal

1. Alvogel versus absorbable gelatin sponge as palatal wound dressings following epithelialized free gingival graft harvest

K Ehab, O Abouldahab, A Hassan, KM El-Sayed. Alvogel and absorbable gelatin sponge as palatal wound dressings following epithelialized free gingival graft harvest: a randomized clinical trial. Clinical Oral Investigations. 2020; Mar 6:1-9.

The gingiva covering the hard palate is composed of three histologic layers: the orthokeratinized epithelium, the coarse subepithelial connective tissue (the lamina propria), with its high proportion of inter-cellular substance, and the submucosa, attaching the lamina propria to the periosteum of the underlying bone.[1]

Clinically, the hard palate gingiva is harvested (donor tissue) for tissue grafting in a variety of sites in the body, e.g., the hip and ocular regions. Postoperative pain and bleeding at these donor sites on the hard palate are most common complication following free gingival palatal graft harvesting until complete re-epithelization.

Although various agents have been suggested to protect the denuded donor areas of the palate, including stents, collagen-gel tin scaffolds, resorbable gelatin sponge, oxidized cellulose and sterile gauze combined with external pressure, platelet-rich fibrin (PRF), medicinal plant extract dry socket (MPE), platelet concentrates and equine-derived collagen, currently, no gold standard exists.[1]

Ehab and colleagues from Egypt (2020)[1] reported on a trial that sought to clinically compare for the first time the effects of Alvogel (used commonly for the management of dry socket [alveolar osteitis]) versus absorbable gelatin sponge as a palatal wound dressing on the incidence and severity of postoperative pain, amount of analgesic consumption, post-surgical bleeding, and palatal wound re-epithelization, following epithelialized free gingival graft harvesting in a randomized controlled clinical trial.

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MATERIALS AND METHODS

This was a prospective, randomized clinical trial with a parallel design that sought to investigate the effects of Alvogel (intervention group) versus absorbable gelatin sponge (control group) as palatal wound dressing agents, on the incidence and severity of postoperative pain, amount of analgesic consumption, post-surgical bleeding, and palatal wound re-epithelization, following epithelialized free gingival graft harvesting.

Thirty six healthy patients scheduled for different periodontal and peri-implant plastic surgeries, requiring palatal mucosal graft harvesting, either epithelialized or de-epithelialized, were recruited for this trial. Patients with severe gagging reflex, smoking patients, pregnant or lactating females, patients with psychiatric disorder, patients with coagulation disorders, patients with known allergies to any of the used agents, and diabetic patients were excluded.

Before the procedure, all patients received full mouth supra- and subgingival scaling and detailed oral hygiene instructions. Patients were then randomized into intervention (receiving Alvogel as a dressing for their palatal wounds) and control (receiving the absorbable gelatin sponge as a dressing for their palatal wounds) groups, with an allocation ratio 1:1.

Blinding of the participants and outcome assessor was possible but the operators placing the test materials could not be blinded. The primary surgical site requiring soft tissue grafting was prepared using a standardized protocol on both groups. The graft was used as it is or de-epithelialized extraorally, according to the purpose it was harvested for.

The graft dimensions (width and length) and the thickness of the residual palatal mucosa in a midpoint of the wound area were recorded, using William's graduated

periodontal probe. In the intervention group, the denuded palatal area was superficially covered with a continuous thin layer of Alvogel (Septodont), while in the control group, absorbable gelatin sponge (Cutanplast Standard) was cut to the palatal wound size and applied. Following manual compression of the wound area, both agents were secured in place using compressive palatal sling sutures.

After the procedure and placement of Alvogel or gelatin sponge, every patient was given 1 g amoxicillin plus clavulanic acid twice per day for 6 days and 150 mg biprofenid for 7 days when needed. Patients were advised to rinse twice a day with 0.12% chlorhexidine HCL solution for 3 weeks following the surgery. Sutures were removed 14 days following the surgery. The Alvogel and the gelatin sponge were not removed postoperatively and disintegrated, and were incorporated into the healing tissues over the healing period.

Patient-reported daily VAS pain scores (scores vary between 0 and 10. 0, no pain; 1, minimal pain; 5, moderate pain; 10, severe pain) for 2 weeks post-surgically were defined as the study's primary outcome.

Post-surgical bleeding and complete re-epithelialization of the palatal wound over the follow-up period of 5 weeks until complete healing were achieved in addition to the number of analgesic tablets consumed over 7 days (1st week) were defined as secondary outcomes.

Re-epithelization of the palatal wound was evaluated using the H2O2 test. Briefly, the healing area to be evaluated was dried, and 3% H2O2 was sprinkled on the wound. If the epithelium was still discontinuous, H2O2 diffuses into the palatal connective tissue, where the enzyme catalase acts on H2O2, releasing water and oxygen and clinically producing bubbles on the wound surface. Complete healing scores were recorded as a dichotomous variable (yes/no). Re-epithelization of the palatal wounds was evaluated weekly for 5 weeks postoperatively.

RESULTS

Thirty-six patients were recruited for the present randomized controlled clinical trial: 18 patients in the intervention (13 females and 5 males, mean age 31.3 years) and 18 patients in the control group (11 females and 7 males, mean age 34.1 years). The intervention and control groups were balanced for age and gender ($p > 0.05$).

There were no dropouts and all patients in both groups completed the follow-up period until complete healing postoperatively. No adverse effects were reported in any of the groups.

Although the harvested grafts varied in their width (5 to 15 mm) and length (8 to 22 mm), according to the mucogingival procedure they were harvested for, no significant differences were noted in the harvested graft dimensions between the intervention and the control groups. The remaining palatal tissue thickness varied between 0 and 2 mm, with significantly lower palatal tissue thickness noted in the control group.

At 1, 2, 3, 4, and 5 days, significantly higher patient-reported VAS pain scores were noted in the control as compared with the intervention group. At days 6 and 7, no significant differences were notable between the groups. The control group continued to demonstrate significantly higher pain scores from days 8 to 12.

Again, on the 13th and 14th days, no significant differences were notable in the pain scores between the two groups. Over time, a significant decrease in pain scores was notable independently in the intervention group and the control group (within group comparison).

A significantly higher number of analgesic tablets were consumed by patients in the control group in contrast to the intervention group over the first 7 days of the healing period (Table 5, Mann-Whitney U test).

Up to 3 weeks following the palatal graft harvesting, no complete re-epithelization was noted in any of the cases of the intervention or control groups. At 4 weeks, no significant differences were notable between groups, with 22.2% of subjects in the intervention and 11.1% subjects in the control group demonstrating complete re-epithelization of their palatal engraftment sites. At 5 weeks postoperatively, all subjects in both groups demonstrated complete re-epithelization of their palatal. No postoperative bleeding was reported in any of the groups.

CONCLUSION

The trial results suggest that Alvogel is a viable option as a practical palatal dressing agent, comparable with absorbable gelatin sponge, in haemostasis, pain reduction, and palatal wound re-epithelization supporting properties.

Implications for practice

Alvogel, could be considered as another viable option to protect the denuded donor areas of the palate when undertaking grafting procedures in the palate.

Reference

1. Ehab K, Abouldahab O, Hassan A, El-Sayed KM. Alvogel and absorbable gelatin sponge as palatal wound dressings following epithelialized free gingival graft harvest: a randomized clinical trial. Clinical Oral Investigations. 2020; Mar 6:1-9.

2. Comparison of four different suture materials as regards oral wound healing, microbial colonization, tissue reaction and clinical features

Dragovic M, Pejovic M, Stepic J, Colic S, Dozic B, Dragovic S, Lazarevic M, Nikolic N, Milasin J, Milicic B. Comparison of four different suture materials in respect to oral wound healing, microbial colonization, tissue reaction and clinical features-randomized clinical study. Clinical oral investigations. 2019; Jul 24: 1-5.

Sutures support the damaged or injured tissues until continuity of surface and enough tensile strength is re-gained during the process of wound healing.[1] Oral wound healing follows the well-known general principles of wound healing but with certain peculiarities.

First of all, oral mucosa is colonized by bacteria which, in conjunction with food detritus, form biofilm and facilitate wound infection. Secondly, oral wounds cannot be immobilized due to the function of oral tissues. Lastly, these wounds are often in contact with avascular structures (enamel, ceramic, metal) and thus devoid of active metabolic exchange during the healing process.[1]

Clinically, there are two types of wound healing: healing by primary intention, resulting in regeneration of specific tissues with the same characteristics as the tissue prior to trauma and healing by secondary intention where the tissue is not regenerated but only repaired and replaced with nonspecific scar tissue.[1]

In contemporary oral surgery, primary healing enabled by the use of sutures along with an adequate intraoperative handling of soft tissues is an absolute imperative in order to obtain optimal functional and aesthetic long-term results.

Sutures can increase the risk of postoperative as oral microbes can attach themselves to the surfaces of the suture material. Sutures also can induce inflammatory reactions due to them being foreign bodies introduced into the oral cavity during wound repair/treatment.

Dragovic and colleagues (2019)[1] reported on a trial that sought to compare four different suture materials used in oral surgery in terms of their biocompatibility, degree of bacterial colonization and inflammatory reaction, influence on wound healing, and basic clinical parameters.

MATERIALS AND METHODS

A total of 32 patients (21 females and 11 males) aged 18-25 indicated for surgical extraction of four totally impacted wisdom teeth were included in the study. Only healthy patients, non-smokers without systemic and/or oral diseases, were included. Using standard surgical protocols, unilateral upper and lower wisdom teeth have been extracted at the same time.

In the mandible, an envelope design for the mucoperiosteal flap was used with sulcular incision going from the first molar, engaging second molar and extending buccally along the external oblique ridge. In the maxilla, standard triangular flap was performed with the vertical releasing incision made at the distal part of interdental papilla between first and second molar. Several interrupted sutures were placed in order to obtain primary wound healing. After a period of 4-5 weeks, impacted molars from the other side were extracted following the described procedure. Each wound was closed with a different suture material taking care of equal distribution between jaws. Suture positions for the first patient were determined by toss of a coin and after that, clockwise rotation was done until each suture material was placed in every quadrant equal number of times. Stitches were removed 7 days postoperatively.

Patients were given uniform postoperative instructions which included antibiotics regime (amoxicillin 500 mg or clindamycin 300 mg) and rinsing with chlorhexidine solution 0.2%, three times a day for 7 days. Patients were also told to apply cold packs immediately after surgical procedure until bedtime with breaks on every 15 min. Before the operation and the day after, 4 mg of dexamethasone was administered in order to reduce postoperative swelling and patient discomfort. For pain control, ibuprofen 400 mg was prescribed four times a day for the first 2 days postoperatively.

The suture materials used in this study were Sofsilk® (non-absorbable natural multifilament wax coated silk); *Surgipro*® (non-absorbable synthetic monofilament polypropylene); *Polysorb*® (absorbable multifilament co-polymer of glicolide and lactase 9:1-*Lactose*® coated with Ca-stearate and E-caprolactone); and *Caprosyn*® (absorbable monofilament co-polymer of E-caprolactone, glicolide, trimethylen carbonate, lactase 6:2:2:1-*Polyglytone 6221*®). All sutures were applied with a 4–0 gauge with 19 mm, 3/8 circle “reverse cutting” needle.

In order to visualize the surface and the structure of sutures, samples of all materials used in this trial were chosen randomly and analyzed using scanning electron microscopy (SEM).

In order to assess suture material biocompatibility, an MTT (3-(4,5-dimethylthiazolyl-2)-2,5 diphenyltetrazolium bromide) assay was done using gingival fibroblasts obtained from a healthy male patient, 18 years old. The cells were cultured at 37 °C in humidified atmosphere containing 5% CO^2. Ten thousand cells were seeded onto a 96-well plate. After 24 h, four different suture materials were suspended in 100 µl of growth medium with cells. The growth medium was replaced every second day. After 7 days, MTT was added to each well, incubated for 4 h, and the supernatant with suture ma-

terials was discarded. Precipitates were dissolved in 100 µl dimethyl sulfoxide (Sigma-Aldrich) by shaking at 37 °C. Optical density (OD) was measured at 540 nm using an ELISA reader. The percentage of viable cells was calculated using the following formula: % of viable cells = OD (sample)/OD (control) × 100. All experiments were done in triplicate. For micro-organism quantification, PCR testing was done.

For histological analysis, one knot of every suture material from each patient was obtained on the day of the removal and immersed in 10% neutrally buffered formalin solution. Only the part of the suture that was implanted in the tissue was sectioned. Individual sections were stained with hematoxylin and eosin (H&E) and examined under optical microscope. Inflammatory cells were counted on three different sections of each suture sample and according to average number, indirect assessment of inflammatory reaction was scored as follows:

(1). **No** inflammatory reaction (0 inflammatory cells).
(2). **Mild** inflammatory reaction (< 30 inflammatory cells).
(3). **Moderate** inflammatory reaction (30 - 60 inflammatory cells).
(4). **Strong** inflammatory reaction (> 60 inflammatory cells).

Clinical assessments were done on the first, third, and seventh days postoperatively. Soft tissue healing was judged by the oral surgeon with the help of a healing index (HI). Using a visual analogue scale (VAS), the operator rated threads with respect to ease of intraoperative handling immediately after the intervention and ease of removal 7 days later.

Patients, using the same scale, evaluated the discomfort and suture removal pain for each type of suture. Postoperative amount of slack was assessed for every suture material with the help of graduated probe UNC 15. The knot was carefully lifted with cotton pliers, and the distance from the knot to the tissue was measured to the nearest 0.5 mm. In the lower jaw, this procedure was carried out on the suture which was placed at the interdental papilla between first and second molar. In the upper jaw, measuring was done on the suture placed at the mesial corner of the mucoperiosteal flap.

RESULTS

All suture threads were analyzed, and substantially more amount of dental plaque was found on multifilament sutures compared to monofilament ones as seen on representative micrographs. Microscopic analysis showed more pronounced inflammatory reaction around multifilament sutures, as a significantly higher number of inflammatory cells were found around these sutures compared to monofilaments. The highest number of inflammatory cells was found around NA-Multi (*Sofsilk*®) and the smallest number around NA-Mono (*Surgipro*®). A statistical difference in the number of inflammatory cells was also found between all sutures compared between them, except between NA-Multi (*Sofsilk*®) and A-Multi (*Polysorb*®). Moreover, incidence and degree of inflammatory reaction differed significantly among all sutures NA-Multi (*Sofsilk*®) was the suture that attracted gingival fibroblast the most. Moreover, a statistically significant difference in percentage of viable fibroblast around this suture compared to NA-Mono (*Surgipro*®) and A-Mono (Caprosyn®) ($p = 0.023$*, $p = 0.004$* respectively) was observed.

A total of 128 suture samples were examined for microbial adherence, and significantly lower amount of microbial load was found on monofilament compared to multifilament sutures. Statistically significant differences were found between suture types compared between them ($p = 0.000$*) except for the comparison of NA-Multi (*Sofsilk*®) and A-Multi (*Polysorb*®) ($p = 0.243$). Clinically, there was significantly better healing around all synthetic materials NA-Mono (*Surgipro*®), A-Mono (*Caprosyn*®), and A-Multi (*Polysorb*®) compared to natural multifilament NA-Multi (*Sofsilk*®) both on the third and seventh day postoperatively.

Significant statistical differences were found between all sutures regarding the ease of handling and ease of removal. For suture removal pain, statistically significant difference was found between all sutures except between NA-Multi (*Sofsilk*®) and A-Multi (*Polysorb*®) ($p = 0.849$). Although NA-Mono (*Surgipro*®) caused the greatest discomfort to patients among all suture types, the statistical significance was found only for the seventh day postoperatively between this suture and NA-Multi (*Sofsilk*®) and A-Mono (*Caprosyn*®) ($p = 0.037$*, $p = 0.003$* respectively). NA-Mono (Surgipro®) was the suture that exhibited the least postoperative amount of slack compared to all other sutures throughout the entire postoperative period.

In the linear regression model in which microbial adherence was used as dependent variable, the following explanatory variables were found to be independent predictors of variabilities among patients: suture type, suture slack (seventh day), ease of suture removal, postoperative infection.

CONCLUSIONS

Non-resorbable polypropylene sutures showed superior clinical characteristics among all sutures. Moreover, the best healing of soft tissue and the least inflammatory reaction was found around this thread. The poorest soft tissue healing was found around non-resorbable silk suture. This suture elicited strongest inflammatory reaction and showed the greatest microbial adherence affinity compared to alternative sutures.

Implications for practice

Monofilament synthetic suture should be used in order to obtain the best soft tissue healing, reduce the risk of postoperative infection, and alleviate the suturing after oral surgery procedures.

Reference

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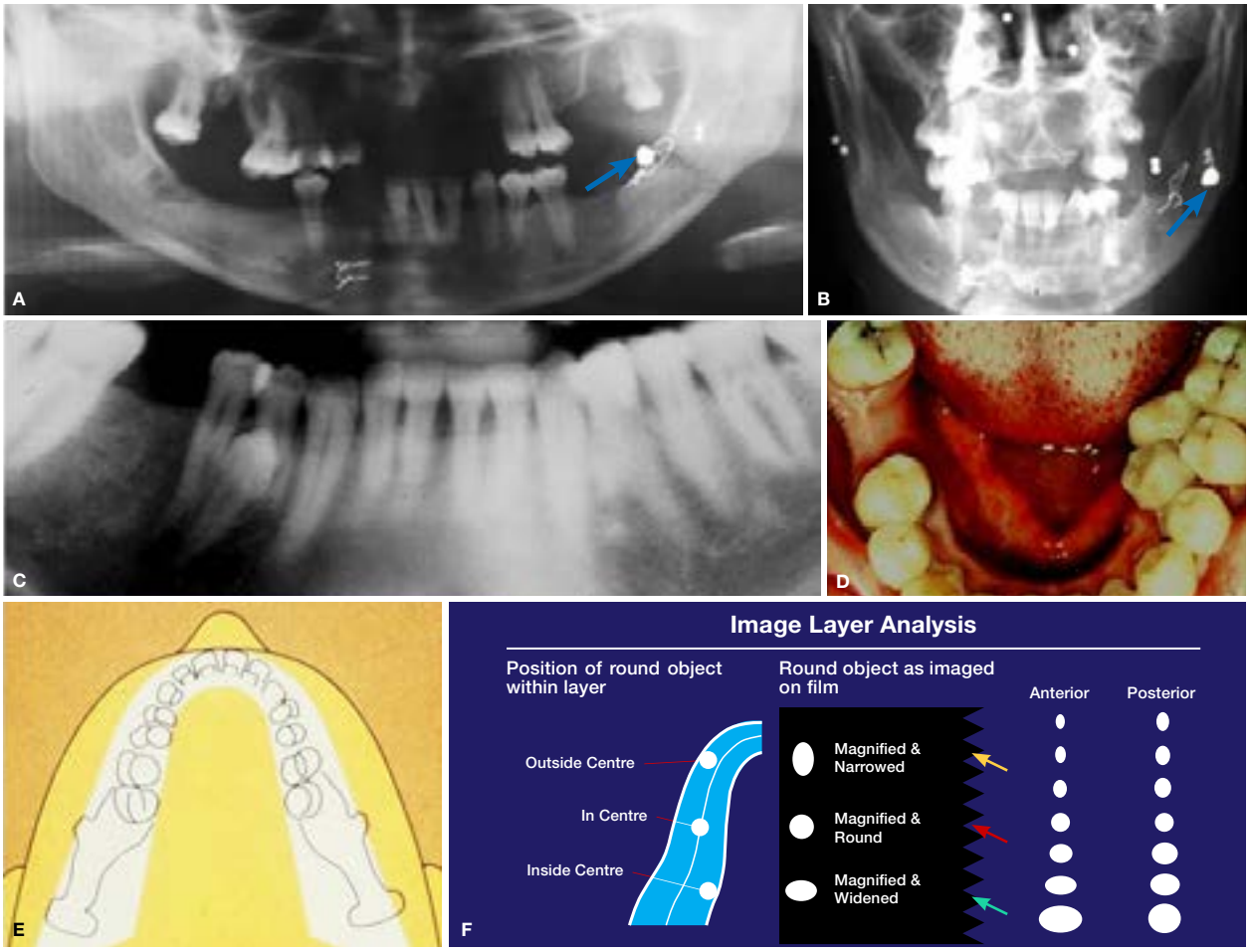
Maxillofacial Radiology 180

SADJ May 2020, Vol. 75 No. 4 p218

CJ Nortjé

Figures, A & B are images of a patient who presented with underlying fractures of the body on the right side and angle of the mandible on the left side. Discuss the most important radiological features discernible on the radiographs and what are your conclusions?



INTERPRETATION

The most important findings are: Figure A shows ligature wiring of the bilateral fractures and the presence of a pellet (blue arrow). However the posterior-anterior mandible radiograph (Fig. B) of the same patient shows multiple pellets which are not discernible on the pantomograph (Fig. A).The blue arrow in Figure A represents the same blue arrow in Figure B. To illustrate to you how easy it is to have a problem I want to illustrate the following case. Looking at the cropped pantomograph (Fig. C) we see a missing tooth in the right lower jaw, as well as a supernumerary tooth. But if you examine the patient clinically, you will notice that there are two supernumerary teeth (Fig. D) in the lower left mandible, which is not depicted on the radiograph because the supernumerary teeth are not present in the layer (focal trough) (Fig. E).

What it means is that a small error in the positioning of the patient may cause diagnostic problems for example if it gets close to the edge of the layer or when the structure is not exactly in the middle of the layer, may result in misdiagnosis. If something is not in the layer, you would not be able to observe it. The many birdshot present in Figure B, are not discernible in the pantomograph because the birdshot was not in the layer. However when something is in the middle of the layer it has its nice configuration and a perfect shape. Looking at Figure F you will notice that the metal ball has a perfectly round shape if it is in the centre of the layer (red arrow). However if the object is close to the edge of the layer towards the film (buccally) you will notice that it is narrow (yellow arrow) and if the object is on lingual side of the layer, the object appears to be widened (green arrow).

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Yes, you **can** say no

SADJ May 2020, Vol. 75 No. 4 p219 - p222

LM Sykes[1], E Crafford[2], A Fortuin[3]

INTRODUCTION

Quality dental care begins with determining the patient's understanding of the dental treatment, their expectations, attaining all the diagnostic information and compiling a treatment plan best suited to each individual.[1] Once a decision has been made to undertake treatment, the clinician may adopt a paternalistic approach or could lean towards respecting patient autonomy.[2]

In the former, the clinician takes on an authoritative role and imposes the treatment plan on the patient, while in the latter there is more emphasis on the doctor:patient relationship and it is the patient who ultimately decides on what treatment will be performed. If there is a lack of agreement between the two, the practitioner may be faced with a legal and/or ethical dilemma.[2]

In legal terms, paternalism has been defined as "Restriction of a subjects self-regarding conduct primarily for the good of that same subject".[3] However many disputes have arisen over its use and justification in the health care setting.

Confusion and disagreement has been compounded by the fact that there are no clear boundaries between what should be considered "soft" (weak) paternalism, and what constitutes "hard" (strong) paternalism. Soft paternalism can be justified on the basis that the individual "lacks the requisite decision-making capacity to engage in the restricted conduct". This includes situations where their decision was: "not factually informed; not adequately understood; coerced; or not substantially voluntary".

Maturity and mental capacity have also been mentioned as factors to consider. Soft paternalism does not call for the constraint of any decision, but rather for the constraint of an "impaired decision" due to a person's "compulsion, misinformation, impetousness, clouded judgement, immaturity, or defective faculties of reasoning", and is meant to protect that subject from dangerous choices that are not truly their own.[1] It is often not regarded as truly paternalistic if the agent's liberty-limiting actions are performed to either protect the subject from harm, or from receiving no benefits, or to confirm that their decisions were truly voluntary. Note that agents' motives matter!

Hard paternalism often includes politically, morally, or ethically controversial issues such as government legislation regarding wearing of seat belts, prohibition of recreational drugs or water fluoridation.[4]

When deciding if it is liberty-limiting one has to consider whether it is justified and to what extent. Pope (2004)[3] proposed that an action may be regarded as justifiable hard paternalism if the agent's liberty-limiting intervention met four criteria: the agent must:

1. intentionally limit the subject's liberty;
2. believe their actions will contribute to the subject's welfare and must intervene with a benevolent motive either to confer a benefit or to prevent the subject from harm;
3. show benevolence independent of the subject's preferences; and
4. disregard the fact that the subject's actions are voluntary, or deliberately limits their voluntary conduct.

To further distinguish between hard paternalism and tyrannical dictatorship, the liberty-limiting action of the clinician must be "subject focused", altruistic, benevolent and aim to confer benefit or avert harm.[3] Note, that he states it must be "benevolent" not necessarily "beneficent". Once again it is a matter of intent. The former refers to the agent's will (*volens*) to do good (*bene*), while the latter refers to the actual action of doing (*facere*) good (*bene*).

In medical terms, paternalism refers to "acting without consent or overriding a persons wishes, wants or actions, in order to benefit the patient or prevent harm to them".[3] Strong paternalism is when the clinician overrides competent patient's wishes and is rejected as it violates their autonomy and falsely presumes knowing what is best for them.[3] Weak paternalism refers to acting for the benefit of an incompetent patient and may be justified in order to restore their competence, or to prevent them from harm, and as such may be justified.[5]

At the same, it is a social, political, and moral obligation to respect an individual's autonomy and self-determination. Proponents of this right argue that the beneficence of paternalism may be at the expense of autonomy, how-

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3. **Alwyn Fortuin:** Third author - 20%

ever they often fail to consider the benevolence of the action. It is also situation specific, and open to change. A clinician's opinions and subsequent actions could vary depending on the circumstances at that time. The important issue to consider is the intention that guided their judgment and decision. This was clearly illustrated by results of one survey question described below.

SURVEY DESIGN

In the same survey as was reported on in the ethics paper of April 2020[6], dental practitioners were asked to complete a questionnaire in which a number of practice-related ethical scenarios and questions were posed. One question related to patient autonomy, beneficence, non-maleficence, paternalism, and informed consent.

A case scenario was presented in four parts with additional information given progressively in order to see if and how the respondents' opinions changed depending on the circumstances. Over 40 dentists completed the questionnaire, and the results are presented below.

RESULTS

The case read as follows: "A young attractive lady comes to your rooms and asks you to place veneers on all her anterior teeth in order to give her a bright, A1 smile.

All of her teeth are sound, and in your opinion she already has an attractive and natural looking smile. You educate her as to all the risks involved in the procedure but she is still adamant that she wants to go ahead with the treatment."

a). In terms of respect for patient autonomy, would you concede to treat?

Only 35% of the respondents said they would treat, (Figure 1) some having added provisos such as: "I would only treat if full consent had been given and if I know I can do the work well". Sixty five percent said they would not treat with many stating that they would advise her to seek a second opinion.

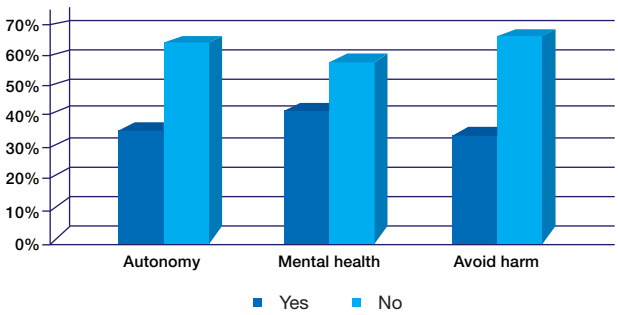

Figure 1. Clinicians' responses to the three questions posed in parts a), b) and c) of the case scenario.

b). The WHO defines health as "a state of complete physical, mental, and social well-being, and not merely an absence of disease or infirmity". With this in mind, if the patient pleaded that she was experiencing emotional and psychological distress as a result of being self-conscious, that she understood all the risks, and was willing to take full responsibility, would you then agree to treat her?

Only 6% more dentists (41%) now agreed to treat despite the added psychological perspective (Figure 1). There was concern that the patient needed psychological rather than dental intervention, which made some even more reluctant to treat her.

I am not a trained psychologist but would be alert to issues of body dysmorphia and suggest pre-counselling.

I would have to consider the risks of acquiescing to treatment demands being made in that context.

She must seek other help, this is not an emergency.

No, this is intrinsically wrong.

In that case I would whiten them for her only.

c). Ethical behaviour refers not only to the act of doing good (beneficence), but also to the duty of preventing harm. If she now said that she knew of a technician who was willing to carry out the work for her. You were concerned that this person was not a trained clinician, and may provide a poor service. Would you then concede to treat in order to prevent possible harm?

Opinions did not change despite the added information to consider the risks of harm. Thirty three percent agreed to treat and 67% refused (Figure 1).

Further comments were received when asked to elaborate on any of the above questions. Many advised to get a second opinion from another dentist. Other comments included:

As a health care practitioner I have a duty and responsibility not to do harm. If "it is not broken, why fix it" – we are also educators if there is no need for treatment do not force it.

I'll strongly advise a second opinion and get her to sign that this was not life threatening or an emergency and so didn't need me to treat her at that time.

Regardless of her arguments, if I think it's a clinically incorrect decision I still will not treat. Healthy enamel cannot be bought - for everything else there is MasterCard (sic).

I believe in a healthy mouth preservation and my duty to inform patients

The patient is informed of what her rights are and what the role of the dentist/and other professionals is

As long as you have informed her and made a document of all discussions, you can let her make her own decision

I would rather discuss all the aspects of tooth bleaching.

Those whose opinion was altered by her final argument gave reasons such as:

Yes, in this case if it's the patient's choice and her wish, I'd rather she gets professional treatment by me than someone else.

The patient would be educated by me and the scope of practice of a technician and advised to get another dental opinion or psychological counselling, however, if she chose to persist in spite of being provided all pertinent information this would be a case of her exercising her autonomy and she can do it.

Help her to prevent her suffering from future harm.

A few had strong opinions that were not swayed by the final argument:

I said no as this case is a disaster waiting to happen.

There is also a time to say NO.

Definitely not.

There are many dentists around and the patient will move on.

This type of patient is a danger to the practice.

Unfortunately I don't like being forced into doing something so NO!

The last question related to the issue of paternalism, and whether this is ever justified in a health care setting.

d). **Would you as an educated health care provider, feel justified to take a paternalistic approach and refuse treatment based on your opinion that the procedure was both unnecessary and destructive?**

The majority (83%) felt justified that they could refuse treatment based on their training and judgement (Figure 2), and justified their decision with comments such as:

Sound clinical rationale is not paternalistic and does not conflict with patient autonomy.

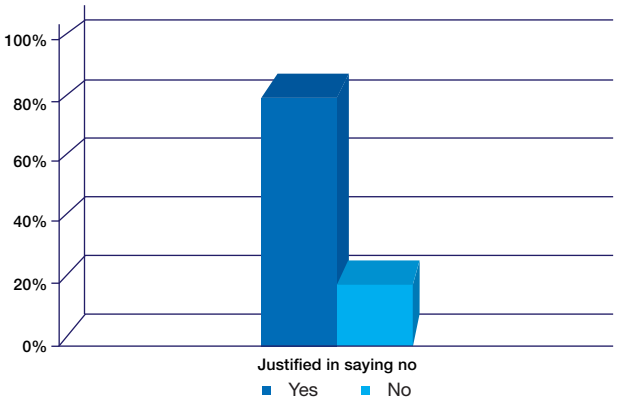

Figure 2. Responses on whether clinicians feel justification in refusing treatment.

DISCUSSION

Traditionally in medicine and dentistry, the clinician, being the trained professional, was presumed to know what was the best for their patients, and thus justified in making treatment decision for them.

Proponents of outside agent intervention argued that the choices individuals make do not always reflect their true desires and preferences, and are often not in their own best interest. Carl Elliot went so far as to state that "People do not always mean what they say; they do not always say what they want; and they do not always want what they say they want".[7] This radical opinion may have led others to question the ethics of hard paternalism, and the subsequent development of a more patient-centred approach.

Beauchamp and Childress were leaders in the field of biomedical ethics when they published their "Principles of Biomedical Ethics".[8] Since then there has been growing emphasis on the principles surrounding respect for patients' autonomy.[3] This holds that individuals have the right to make their own choices, and develop their own life plan. In the health care setting it translates into informed consent, and requires a clinician to provide all necessary information for patients to make a free, intelligent decision; ensure they understand the information; and to recommend an ideal treatment option without persuasion, pressure or coercion.[5]

They strongly supported the notion that "The core of any clinical encounter in a health care setting is respect for patients' autonomy, and their right to chose or decline a recommendation without intimidation or pressure, and should be able to make decisions for themselves free from controlling interference or influence".[8]

Others have added that "respecting patients' autonomy yields satisfaction for that person directly, while interfering with their autonomy may be experienced as a form of pain and suffering. Furthermore, when people who are capable of making autonomous choices are allowed to do so, their maximal well-being will almost always be more efficiently produced than if someone else chooses instead".[9]

Many other authors have added to the literature on "patient-centeredness", and the need to ensure that the treatment plan is tailored to incorporate options for a patient with respect to their individuality, values, ethnicity and social endowments.[10] It has been postulated that this type of communication would lead to better acceptance of treatment plans and improved interactions between patients and clinicians.[10]

The patient-centred model further evolved to the shared decision-making approach which entails the compilation of several viable treatment options for a specific problem, presentation of the disadvantages and advantages of each, and allowing the patient to choose which suited them the most.[11]

This stratagem aims to bridge the gap between paternalism and patient autonomy due to the nurturing of a

mutual trust between the opinion of the clinician and the decision-making process of the patient.[11] It also leads to complete informed consent by enhancing the patient's understanding and knowledge of each of the options and how each could address their specific problems.[12]

However, care should be taken to not indulge and over-express information pertaining to a specific treatment option that the clinician prefers. This practice has been termed "nudging" and will inevitably lead to a libertarian paternalism wherein the patient tends to make "the popular decision".[12]

While these authors do concede that patient education is a prerequisite to decision making[9], the overarching sentiment is that autonomy is sacrosanct and dentists should not assume an "unwarranted degree of authority over their patients".[13] This has led to the concept of paternalism becoming frowned upon and even regarded as taboo by some medical professionals.

Dworkin (1988) considered paternalism as "interference with a person's liberty of action justified by reason referring exclusively to the welfare of the person being coerced".[14] He further argued that it prevented people from doing what they had decided, interfered with how they arrived at their decisions, or attempted to substitute one's own judgement for theirs, in order to promote their welfare.

His concern was that this presumption of being right and thus justified in trying to override the other person's judgement denied them the opportunity to choose their own actions and treated them as "less than moral equals".[13,14]

Where then does this leave the trained dental clinicians who do not agree with their patient's demands or desires? Even soft paternalism does not allow them to impose their views, as the patients in question are generally not considered to be incompetent. Thus, regardless of whether their judgment is based on moral principles or educated discretion, do they have the right (and courage) to disregard the patient's autonomy, and refuse to treat?

In the above survey it was evident that most dentists held onto their original treatment decisions regardless of the added issues presented in the subsequent questions. In fact slightly more refused to treat when they sensed they were being pressurised or manipulated by the patient (67% vs. 65%). The overwhelming majority (83%) felt justified to take a paternalistic approach and not treat based on their moral principles or diagnostic reasoning.

How then do they justify a paternalistic decision centred on their personal ethical views, experience, training, clinical judgement, and desire to promote beneficence/non-maleficence, especially if this goes against the principles of respect for patient autonomy? There is no clear and simple answer. However, a practitioner needs to recognise that there are "limits on what each person can do and that many treatment options are mixed, containing both chance of benefit and risk of harm".[5] So **yes**, sometimes this does mean they can take a paternalistic approach and be justified in saying **no**!

CONCLUSION

Paternalism has been both "defended and attacked in clinical medicine, public health, health policy and the law".[15] It is no longer clear when, if and which types are justified in clinical practice. Perhaps the best advice is to "always consider the patient's best interest, do those acts that do more good than harm, not do those that could cause harm, and constantly maintain the highest standards of care".[5]

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CPD questionnaire

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

GENERAL

COVID-19: Focus on masks and respirators – Implications for oral-health care workers

1. Identify the CORRECT statement. The direct equivalent respirator to an N95 respirator is:
   A. FFP3 respirator
   B. Surgical mask
   C. FFP2
   D. N100 respirator

2. Identify the INCORRECT statement. Possible interventions to reduce the chance of COVID-19 transmission to an OHCW are:
   A. The appropriate respirator
   B. Oxidative pre-procedural mouthrinse
   C. Rubber dam
   D. Chlorhexidene pre-procedural mouthrinse

3. Identify the CORRECT statement.
   The size of SARS-CoV-2 is:
   A. 1-3 µm
   B. 0.06 and 0.14 µm
   C. 0.05–0.5 µm
   D. 0.63 µm

4. Identify the INCORRECT statement regarding small particles < 5-10 µm:
   A. More likely to cause a upper respiratory tract infection
   B. High risk for airborne transmission
   C. Has an aerodynamic diameter that follow airflow streamlines
   D. Mainly short range transmission when no strong air currents are present

Comparison of forward and reverse single-file reciprocation for root canal instrumentation in curved mandibular molar canals - a Micro-CT analysis

5. Identify the CORRECT statement. In this study, the authors used Protaper Next in which motion?
   A. Reverse reciprocation and rotation
   B. Full rotation
   C. Forward reciprocation
   D. Forward reciprocation and rotation

6. Identify the CORRECT statement. Yared et al. (2008) observed the following when using ProTaper Next F2 in forward reciprocating motion?
   A. Less instruments were needed for canal instrumentation
   B. Cost of treatment increased
   C. There was an increase in instrument fatigue
   D. Instrumentation cross-contamination was observed

Sterilisation and single-use of endodontic files - a short report

7. Identify the CORRECT statement. Which of the following sterilisation methods is INAPPROPRIATE for reprocessing endodontic files?
   A. Autoclave
   B. Statim
   C. Glutaraldehyde solution
   D. Dry heat sterilisation
   E. All of the above

8. Identify the CORRECT statement. When should endodontic files be sterilised?
   A. Before first use on a patient
   B. After removal from the manufacturers packaging
   C. After every patient
   D. All of the above
   E. None of the above

9. Identify the CORRECT statement. Which of the following is NOT a benefit to a single-use approach?
   A. Decreased incidence of file separation
   B. No risk of cross-contamination
   C. Lower overall cost to practitioners
   D. All of the above
   E. None of the above

The microbiology of head and neck space infections at the Maxillofacial Clinic at Livingstone Hospital

10. Identify the CORRECT statement. Name the 3 most common fascial spaces involved in head and neck infections.
    A. Submandibular, submental and peri-orbital spaces
    B. Submandibular, buccal and submental spaces
    C. Submental, buccal and periorbital spaces
    D. Submental, peri-orbital and zygomatic spaces

11. Identify the CORRECT statement. Viridans streptococci showed the highest resistance to:
    A. Erythromycin/azithromycin
    B. Clindamycin
    C. Cefotaxime/ceftriaxone
    D. Vancomycin

12. Identify the CORRECT statement. Statistically significant association was observed between:
    A. Age and fascial space
    B. Age and etiology
    C. Gender and the presence of microorganisms
    D. All of the above

Student perceptions of clinical experiences in endodontic access cavity preparations

13. Identify the CORRECT statement. Improper access cavity designs and incorrect techniques may lead to:
    A. Perforations
    B. Destruction of healthy tooth structure
    C. Instrument fractures
    D. All of the above

14. Identify the CORRECT statement. When summarizing the results of the study, which tooth was the most challenging to treat in all phases of endodontics:
    A. Maxillary canines
    B. Mandibular incisors
    C. Premolars
    D. Molars
    E. None of the above

Focal dermal hypoplasia - a radiographic case report

15. Identify the CORRECT statement. Focal dermal hypoplasia (FDH) an unusual X-linked disorder affecting:
    A. Mesoderm tissues
    B. Ectoderm tissues
    C. Both mesoderm and ectoderm tissues
    D. None of the above

16. Identify the CORRECT statement. FDH is characterized by a wide range of multisystem abnormalities, with the most common involving:
    A. Dermatological, eyes, teeth, skeletal, urinary, gastrointestinal, cardiovascular and central nervous systems
    B. Dermatological, eyes and teeth only
    C. Eyes, teeth and skeletal systems
    D. None of the above

Lichenoid Granulomatous Stomatitis – an oral medicine case book

17. Identify the CORRECT statement. Lichenoid granulomatous stomatitis is characterised by the following histological features:
    A. Lichenoid inflammation with basal cell degeneration and apoptotic bodies
    B. Varying degrees of granulomatous inflammation
    C. Lymphoid follicles with a perineural distribution
    D. All of the above

18. Identify the CORRECT statement. Lichenoid granulomatous stomatitis may be associated with:
    A. Fungal infection
    B. Certain medications
    C. Dysplasia
    D. All of the above

Clinical Windows - What's new for the clinician?

19. Identify the CORRECT statement. In the Ehab et al. trial, blinding was possible for (choose the most correct option):
    A. The patient
    B. The operator or surgeon doing the procedure
    C. The assessor examining the outcome
    D. A & C
    E. A & B
    F. A, B and C

Maxillofacial Radiology 180

20. Identify the CORRECT statement. When a patient is placed too far forward in a pantomographic machine the following can be seen on the radiograph:
    A. The anterior teeth will appear very broad
    B. The anterior teeth will appear very narrow
    C. The posterior teeth will overlap resulting in loss of clarity on the image
    D. The premolars will be blurred because they will be out of the focal trough

ETHICS

Yes you can say no

21. Identify the CORRECT statement. Which of the following is NOT one of the four principles Medical Ethics as proposed by Beuchampos and Childress?
    A. Beneficence
    B. Justice
    C. Informed consent
    D. Autonomy

22. Identify the CORRECT statement. Dentists are permitted to:
    A. send patients for psychological counselling
    B. nudge patients towards making the best decision
    C. refer patients to a technician for minor restorative procedures
    D. All of the above

23. Identify the CORRECT statement. The WHO definition of health includes:
    A. absence of disease or infirmity
    B. mental well-being
    C. economic well-being
    D. Only A and B above
    E. All three: A, B, and C

24. Identify the CORRECT statement. Body dysmorphia may include:
    A. an altered perception of self
    B. an obsessive focus on others
    C. a desire to change one's image
    D. Only A and B above
    E. Only A and C above

25. Identify the CORRECT statement.
    Benevolence refers to:
    A. the act of doing good
    B. the act of avoiding harm
    C. the desire to do good
    D. the desire to avoid harm

THE SOUTH AFRICAN DENTAL JOURNAL
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