THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

APRIL 2020
Volume 75 Number 3

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

SADA
THE SOUTH AFRICAN
DENTAL ASSOCIATION

Prof JC Middleton Shaw
Doyen of Dental Education
in South Africa

Prof JC Middleton Shaw: Doyen of Dental Education in South Africa
Professor John C Middleton Shaw established and developed Dental Education in South Africa. He was the dominant figure in the field from 1925 to 1956.

SADA

DENTAL & ORAL HEALTH CONGRESS AND EXHIBITION

28 - 30 AUGUST 2020 | Emperors Palace Convention Centre, Johannesburg

STRONGER. TOGETHER.

The Power of A Team

#sadacongress20

Register at
www.sada.co.za

28 - 30 AUGUST 2020

SAVE THE DATE!

- A world-class **exhibition area**
- Trailblazing **workshops**
- Phenomenal **guest speakers**
- Exciting **social functions**

THE SOUTH AFRICAN DENTAL JOURNAL
SADJ

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

CONTENTS

Our Front Cover for this Issue…

The theme for the Front Cover of the South African Dental Journal this year provides for some historical figures, some characters illuminating dental history and some important achievements in South African Dental history. The April issue draws focus to the doyen of Dental Education in South Africa.
Read more on page 115.

Prof JC Middleton Shaw:
Doyen of Dental Education in South Africa
Professor John C Middleton Shaw established and developed Dental Education in South Africa. He was the dominant figure in the field from 1925 to 1956.

THE SOUTH AFRICAN DENTAL JOURNAL

SADJ

CONTENTS

Published by:

On behalf of:

Accredited by the Department of Education

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

Prof JC Middleton Shaw
...doyen of Dental Education in South Africa

Christmas day 1925 brought an unusual present to South Africa, for it was on the 25th of December that year that a young dentist, John C Middleton Shaw, arrived as the newly appointed Senior Lecturer in the Department of Anatomy, University of the Witwatersrand, Johannesburg.

Intriguingly he also held the post as Head of the Dental Clinic operated by the University! Under his energetic ...some would say, authoritarian, direction, the Dental Clinic would grow into the first Faculty of Dentistry in South Africa.

Dr Middleton Shaw was an Irishman, appointed by the Faculty of Medicine to lead the Department of Dentistry. He found at the Clinic an enthusiastic group of 20 dentists who were volunteer teachers of a small group of students, and who also cheerfully delivered treatment to the numerous patients, most of whom were indigent.

Prof JC Middleton Shaw

The students had enrolled in 1923, most having completed a two year apprenticeship in Dental Mechanics. Two medical students had pre-empted that arrangement, however, for Messrs Shlom and Shein had previously inveigled their way into the Dental Clinic and were already working there when Shaw arrived. He allowed them to continue and the two became the first Wits (and South African) dental graduates.

Middleton Shaw had at first a Dental School which was accommodated in the Tuberculosis Clinic, a facility which had been erected in Bok Street by the Red Cross and the Order of St John. In short order he had imposed a curriculum based on the Irish example and that format continued virtually unchanged from 1926 right through to 1941.

He taught Anatomy, Dental Anatomy, Dental Surgery, Maxillo-Facial Surgery amongst other dental topics. Middleton Shaw was determined to establish an independent School of Dentistry and in due course he gave notice to the Chest Clinic that the building was to become the Dental School.

Arriving at the premises on the day when the Chest Clinic should have vacated the rooms, and finding that no action had been taken, he locked the clinic and declined to allow any of the Chest Clinic personnel in! But he invited them to come around to the Dental Clinic for a cup of tea! Soon the building was in fact the first Dental School in South Africa!

Middleton Shaw holds a reputation of being a terrier in his determination to gain his goal, and a martinet in delivering discipline. His Irish temper was frequently to the fore and his tongue lashings were legendary. He ruled Dental Education in South Africa from his arrival in 1925 to his departure back to Ireland in 1956.

He had faced many hurdles and obstacles in his mission to create a fine reputation for South African Dentistry, overcoming resistance from the University, the Dental Association and the South African Government. He left a legacy in Dentistry which is unsurpassed.

It was from Wits that came the Deans of the new Dental Faculties at Pretoria and Stellenbosch. At the time when his tenure was finally coming to a close, Wits Dental Faculty was widely recognised as amongst the top in the world.

John Middleton Shaw... a towering figure in South African Dentistry. He set by example the highest standards and demanded that those standards be maintained by his School.

Life in the time of COVID-19

SADJ April 2020, Vol. 75 No. 3 p116

NH Wood

We are collectively, and as individuals, faced with a situation in which numerous foci of tension is directed towards us that cover a spectrum of stressors that may include health, financial and/or psychological matters. Many of us are turning to our individual coping mechanisms whilst still considering the looming, perhaps rhetorical question: "What's going to happen?"

Braun-Lewensohn and Sagy explained that an individual's ability to use external and internal resources to cope not only influences the way in which that individual perceives challenges, but has a direct influence on how well that individual will cope with the particular stressors.[1]

Some consider that a strong sense of coherence confers a coping advantage on a person faced by a stressor, in that it prevents this tension to convert into stress. This theory, referred to as the salutogenic model, was first described by Antonovsky[2] as a cross-cultural concept that takes appropriate resources available to different cultures into consideration.

This ability, or a stronger sense of coherence, is believed to lower anxiety or anger during these challenging times. It is therefore beneficial to identify those internal and external resources that one draws on as protective factors. These range from different levels of interpersonal relationships, hobbies and activities, physical activity and routines, to the religious, psychologic and other relevant group interactions to name but a few.

We are all awaiting the outcome of the 21 day lockdown period, and I remain hopeful that the rate of infection of the SARS-CoV-2 virus will decrease. This titanic effort, along with our own personal actions and contributions, all aim at reducing the risk of overwhelming our healthcare system.

Reducing the numbers of new infections, or flattening the curve of new cases, provides our healthcare facilities and staff the space to cope with the COVID-19 burden. In addition to that, we all need to play a further part to "flatten the baseline", that is, to reduce accidents and emergencies as much as possible to reduce pressure on healthcare systems.

Thank you to our contributors for a stimulating April issue of the SADJ. To all our readers: please remain vigilant and be reminded of the Department of Health Corona virus hotline: 0800 029 9999. During this challenging time, in addition to looking towards our various echelons in leadership positions, let us also engage one another in an effort to be a supportive and caring community. Please stay safe during the COVID-19 lockdown, and I hope that we will all have the opportunity to reflect on this time together once it is over.

"We will only fight Coronavirus in South Africa with facts and evidence-based strategies, not fake news".

- Dr Zweli Mkhize,
Minister of Health,
press conference
01 April 2020

References

1. Braun-Lewensohn O, Sagy S. Salutogenesis and culture: Personal and community sense of coherence among adolescents belonging to three different cultural groups, International Review of Psychiatry. 2011; 23(6): 533-41.
2. Antonovsky A. Unraveling the mystery of health. San Francisco, CA. 1987: Jossey-Bass.

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

SADA slams HPCSA for outrageously high annual registration fees and asks whether the council has gone rogue

SADJ April 2020, Vol. 75 No. 3 p117 - p118

SADA Head Office

The association vows to do all in its power to prevent its members from being subjected to untenable increases.

The South African Dental Association (SADA) is outraged at the unjustifiable increases communicated by the Health Professions Council of SA (HPCSA) for the annual registration fees payable by practitioners registered under the Health Professions Act, including dentists, dental specialists and others.

SADA is of the view that the HPCSA has gone rogue, and on behalf of its members and the professional at large it urgently calls on the Council to suspend and review its annual fee increase for 2020, and to demonstrate an appreciation of the economic reality in South Africa with an increase based on the consumer price index (CPI), and then manage its budgets within those parameters.

SADA is vehemently opposed to the announced 2020 fees and if the Association does not get a reasonable accommodation of its concerns, it will do everything in its power to ensure its members are not subjected to untenable increases, which will put even more pressure on an already financially strained profession. "This is a fight we are prepared to take on" says Mr KC Makhubele, SADA CEO.

Responding to the announcement in Board Notice 11, published in the Government Gazette Number 43024 of 17 February 2020, Makhubele said: "Health practitioners have made the mistake of not vehemently challenging these increases in the past and it seems that the HPCSA is emboldened and doubled up on the increasing percentage. The HPCSA has indeed gone rogue and has to be stopped!"

He said SADA has urgently raised its serious concerns in a letter dated March 5, 2020, to the HPCSA, where it outlined its objections over the registration fee increases for 2020, which are ranging from 21.65% to 21.24% for dentists and dental specialists, respectively. These fees are payable by practitioners by April 1, 2020.

"This follows from 12.29% and 12.13% for dentists and dental specialists from 2018 to 2019," said Makhubele. "Both increases are substantially above CPI. These fees are extremely high and they do not reflect the realities on the ground.

"The nation's economy remains soft, practitioners' reimbursements are down, overhead costs are up; regulatory compliance is increasing; private practice is a tough business but so is the public sector.

Most businesses - large or small, product or service, retail or otherwise - are feeling a financial pinch, including business operated by our members. The cost of running a practice is becoming prohibitively expensive as practitioners are forced to perform more and more administrative tasks without reimbursement.

"A poor economic climate, low medical aid tariffs which are below inflation, and has been the case for many years, and other regulatory developments have increased the financial strain on health practitioners."

SADA is particularly disturbed by the fact that the HPCSA did not consult with its constituents who are registrants with the Council and directly affected by such increases. The Council has sought to unilaterally impose exorbitant increases while neglecting to inform its members, the Association of what the reasons were for the double-digit percentage increases.

SADA asks: Why have they implemented such fees? Is this to line their pockets and continue to sustain the dysfunctional HPCSA, as per the Ministerial Task Team (MTT) Report chaired by Professor Bongani M Mayosi in October 2015, which found that the HPCSA is a deeply dysfunctional mega-organisation of 12 professional boards which lacks coherence and cohesion.

Dysfunction and ineffective? "Is this what we must pay for? Did they not anticipate that this will be met with dissatisfaction? Is the HPCSA really so far removed from its constituents? SADA only became aware of the increases following the publication in the government

gazette," said Makhubele, who added that the report of the MTT found the HPCSA is unable deliver effectively and efficiently on its primary objects and functions in terms of the Health Professions Act 56 of 1974.

"The status quo of the ineffectiveness of the HPCSA has not changed since 2015; these fee increases by the HPCSA are but one of the symptoms of the malaise. SADA has tried to engage the various levels of the HPCSA but they don't seem to be willing or capable of changing for the better. We are always met with arrogance, indecision, inordinate delays and half-hearted responses."

The council has failed in many respect which SADA has recorded in the various meetings and correspondence.

This further strengthens SADA's strong support of the MTT in its recommendation: "It is the view of the MTT that the best interests of the health system are not served by the current structure and organisation of the HPCSA. The MTT recommends that consideration be given to the unbundling of the HPCSA into at least two entities: the historic Medical and Dental Council (which constitutes a third of the current membership of the HPCSA) and a Health and Rehabilitation Council (for the rest of the professional membership of the HPCSA). These new Councils would join the South African Pharmacy Council, the South African Nursing Council and other autonomous councils in the Forum of Statutory Health Professions Councils."

SADA affirms that its members view the 2020 registration fees payable to the Council as unreasonable and disproportionately exorbitant in comparison to other registerable categories within the HPCSA. This is a unique feature of the HPCSA, in that the majority of its finances come from the contribution of doctors and dentists through their annual subscriptions.

As such, SADA calls on all organised professions under the HPCSA to reject these increases and implore the HPCSA to urgently suspend its exorbitant and unjustifiable 2020 fee increases and institute reasonable fee increases that are in touch with reality. Failure to do so will be met with a dogged determination by SADA to prevent the HPCSA from crippling its members any further. We hope that the HPCSA will respond positively to our fair and reasonable request.

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

SADA
THE SOUTH AFRICAN
DENTAL ASSOCIATION

Notice is hereby given that the 20th Annual General Meeting (AGM) of the South African Dental Association (SADA) will be held at the SADA Head Office, 31 Princess of Wales Terrace, Parktown, Johannesburg, on Thursday 28 May 2020 at 18h00. The meeting will be followed by snacks and refreshments. The Agenda for the meeting will be posted on the SADA website.

SADA is *your* Association and your voice counts.

KC Makhubele
Chief Executive Officer
25 February 2020

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a1

COVID-19 pandemic and the dental practice

SADJ April 2020, Vol. 75 No. 3 p119 - p125

S Koutras[1], S Govender[2], NH Wood[3], PD Motloba[4]

ABSTRACT

Coronavirus disease 2019 (COVID-19), originating in Wuhan, China in December 2019 has become a pandemic affecting numerous countries worldwide, with over 1353 positive cases and 4 deaths confirmed in South Africa thus far.

Dental practitioners are at the forefront of this outbreak through direct and contact transmission via face-to-face communication and through the generation of significant amounts of droplets and aerosols during routine dental procedures, posing potential risks of infection transmission.

There are no guidelines for South African dental practitioners to follow in the time of the COVID-19 pandemic. This paper provides consolidated evidence and best practice on how to prevent and minimise the spread of infection within the dental setting through the use of a flowchart.

The level of evidence provided is based on global recommendations and experience. We conclude that unless dental professionals stick to stringent infection control practices, they are likely to contribute to the spread of the COVID-19.

Author affiliations:

1. **Sandra Koutras:** *BDS, MSc(Dent)(OMP), MDent(OMP),* Department of Periodontology and Oral Medicine, School of Oral Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa.
2. **Shogan Govender:** *BChD, PDD, MChD(OMP),* Department of Periodontology and Oral Medicine, School of Oral Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa.
   ORCID Number: 0000-0003-4470-1530
3. **Neil H Wood:** *BChD(UP), DipOdont(MFP), MDent(OMP),* Department of Periodontology and Oral Medicine, School of Oral Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa.
   ORCID Number: 0000-0001-8950-7999
4. **Pagollang D Motloba:** *BDS, MPH(Epidemiology), MDent(CommDent), MBL,* Chief Specialist, Head of Department Community Dentistry, South Africa.
   ORCID Number: 0000-0003-1379-7576

Corresponding author: Pagollang D Motloba
Chief Specialist, Head of Department Community Dentistry, South Africa.
Email: pagollang.motloba@smu.ac.za

Author contributions:

1. **Sandra Koutras:** First draft, diagram, revision, final write-up and final approval - 25%
2. **Shogan Govender:** First draft, diagram, revision, final write-up and final approval - 25%
3. **Neil H Wood:** Conceptualization, revision, final write-up and final approval - 25%
4. **Pagollang D Motloba:** Conceptualization, first draft, revision, final write-up and final approval - 25%

We recommend that during this outbreak, dental professionals consider scaling down on their normal routine, and protect themselves and patients. Focus should be on the management of pain, sepsis and trauma. The epidemic will pass, and dental professionals should outlast the scourge.

Keywords

Epidemic, pandemic, dentistry, COVID-19, dental professionals, SARS-CoV-2.

INTRODUCTION

The Coronavirus disease 2019 (COVID-19) pandemic appears to be taking a firmer grip on South Africa with 1353 positive cases and 4 deaths confirmed at the time of writing this article. More oral healthcare practitioners will face the potential transmission of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), yet very little information is condensed into appropriate resources and management of this outbreak. In this paper we review the available evidence to deliver the latest information concerning this pandemic facing the oral health professions.

What is an epidemic?

Our ability to intervene and control the spread of the COVID-19 epidemic is intricately linked with our understanding of the history and course of outbreaks. Epidemics are conditions that prevail extensively among a given population.

These conditions can be contrasted with endemic conditions which are always prevalent among the people in less or subdued rates. Epidemics are characterized by the peaking or fermenting of new or endemic conditions resulting in a significantly greater than normal number of affected individuals in places and periods.

Several epidemics have plagued humankind since time immemorial, displaying great variations in consequences and malevolence. Yet these conditions display similar and definite features, which explains the anatomy of epidemics and in the case of COVID-19, a pandemic.

1. Epidemics are all fevers, characterized by conditions such as Plague, Yellow Fever, Cholera, Small-Pox, Typhus, Scarlet Fever, Influenza, Ebola and presently COVID-19.

2. Epidemics have a widespread course; prevailing and attacking a large number of people at once or in rapid succession. Hence the tendency to peak exponentially.

3. Epidemics display rapidity in their course, beginning slowly, advancing disjointedly and suddenly striking a major blow, resulting in huge morbidity and or mortality.

4. Epidemics provide a distinct and unmistakable warning; at first these conditions spread violently and suddenly, later resulting in a milder form. This explains the tendency of epidemics to eventually burn out or attenuate in severity.

5. Epidemics result from a transformation of an ordinary disease into a new type of disease. Most recent epidemics can be traced back to changes in diseases occurring in lower animals.

6. Epidemics have a similar manner of migration and course, characterized by periods of quiescence, increase to peak, decrease or decline and disappearance. All epidemics go through these phases repeatedly from one location to the next; from one period to the next.

7. The duration of the epidemic is related to the size of the locality.

8. Epidemics have a short brevity of time from the moment of attack to the recovery or death. Most persons exposed to these conditions will recover in good time… or die therefrom.

9. Epidemics are produced by primary and predisposing causes acting together in unison. The primary cause cannot take effect until the system is weakened or rendered susceptible. The effector agents or predisposing factors (internal or external) contribute to a collapse of the resistance of the body.

The Coronavirus (COVID -19) – overview of the pandemic

Coronaviruses are a group of viruses known to infect humans and animals; in humans they cause severe respiratory illnesses ranging from common cold-like symptoms to pneumonia.

The most recent coronavirus epidemic, was the Severe Acute Respiratory Syndrome (SARS-CoV) reported in China in 2002.[1]

The present strain of coronavirus, the SARS-CoV-2, recently encountered in humans, originated in Wuhan[2], and has been named COVID-19. The genetic sequence of COVID-19 shows more than an 80% identity with SARS-CoV and 50% with the Middle East respiratory syndrome-related coronavirus (MERS-CoV),[3,4] both of which originate in bats.[5] Based on the present epidemiological data, SARS-CoV-2 has higher transmissibility than SARS-CoV and MERS-CoV.[6]

COVID-19 displays all the hallmarks of an epidemic such as fever, a global penetration, rapid and exponential spread; similarity in genetic profile to viruses isolated from lower animals; short latency periods from being asymptomatic, to morbidity, to mortality. Typical of a viral epidemic, the mortality due to COVID- 19 is higher in compromised individuals such as those with underlying co-morbidities such as hypertension, diabetes and cardiovascular disease.[7] The increase in infection rates is indicative of the initial phase of the epidemic.

It is notable that current available evidence indicates that smoking hastens COVID-19 progression and has a high association with unfavourable outcomes such as admission into ICU, mechanical ventilation and/or death.[8]

The literature is deficient in determining the effect of COVID-19 on vulnerable populations, specifically children. An investigation of 1391 children (aged 16 and younger) for SARS-CoV-2 infections showed that 12.3% tested positive, with a median age of 6.7 years. Of these, 41.5% had fever.[9] Although coughing and pharyngeal erythema were commonly found, 15.8% of these children had no symptoms or signs of infection. A further 12 showed radiologic signs for pneumonia, but were asymptomatic. In this group, one child (10 months old) passed away.

As things stand, the rising rates of infections are indicative of only the initial phase of the epidemic. The global decrease, decline and disappearance phases of the epidemic may be a long way away.

Management of epidemics

The management of an epidemic entails all activities to be undertaken, before, during and after the onset of the outbreak. These include the processes which should be involved in order to anticipate or predict the occurrence of an outbreak, enabling preventive measures.

Early detection and surveillance can limit the spread and minimize the impact of the outbreak. Failure to follow these processes often results in dire health, economic and social consequences.

Therefore, coordination among and communication by, all sectors and levels of the State are critical for effective management of an outbreak. Ordinarily, the technical groups, including healthcare professionals, are specifically positioned to detect and manage outbreaks.

These groupings are able to fulfil their responsibilities provided they receive the necessary support and resour-

ces from the political and public health authorities. Failure in epidemic control is commonly due to failure of authorities and the public to heed the call of the technical experts, more so because their advice tends to infringe on the individual rights and restrict liberties.

Role of the dental profession in the management of COVID-19

Oral healthcare practitioners carry the greatest risk of COVID-19 acquisition, resulting from face-to-face communication with patients, as well as frequent exposure to body fluids such as saliva and blood together with fomites (such as dental instruments).[10] Following routine dental procedures, through the use of air- turbine handpieces, low-speed handpieces, ultrasonic scalers, bicarbonate polishers, and polishing cups, as well as, drilling and air sprays inside the oral cavity, a bio-aerosol is created.

Aerosolization occurs when biological particles produced during dental procedures are suspended in gaseous media in the immediate environment, posing a risk in terms of transmission and spread of the virus. Bio-aerosols containing infectious microorganisms remain suspended in the air post-treatment in high concentrations, and can spread to inactive dental treatment areas.[11,12] This in turn increases the risk of exposure to clinicians and patients which can result in the spread of micro-organisms including the SARS-CoV-2.[13]

An *in vitro* study on the viability of the SARS-CoV-2 virus in aerosol and on different surfaces showed that the virus remains viable for up to 3 hours.[12] It may be longer as the experiment itself only lasted for 3 hours. When surface viability was assessed, the virus was detected up to 72 hours later. The authors reported that the virus was more stable on plastic and stainless steel surfaces than on copper and cardboard, but present on all nonetheless. This indicates that aerosol and fomite transmission routes are entirely possible.[12]

Therefore, special efforts to protect or reduce transmission should focus on susceptible populations including healthcare providers, and dental professionals in particular. Figure 1 provides clinical guidelines for oral health personnel on measures to prevent the transmission of the virus in their practices. The prevention strategies and precautions are intended to guide clinicians with key clinical activities including the following: patient assessment and treatment procedures, personal hygiene measures, infection control and disinfection, pre-operative rinses, isolation and barrier control techniques, imaging, and waste management.[13-17]

1. Patient assessment

It is critical for dentists to establish a pre-treatment assessment point or triage area in their practice. At this designated area, a thorough questioning of the patient should take place (Figure 1). Further investigation, specifically the measurement of temperature should be undertaken. During this assessment, patients and their entourage must be supplied with masks to restrict transmission of secretion.

The number of persons accompanying patients (in the case of minors or the elderly) should be limited to one.[18,19] The patient waiting area should be well ventilated, with a one metre separation between patients (social distancing).

Based on the level of risk estimated, the patients should be triaged to relevant service centres including hospitals for further management.[20] It is advisable that only "emergencies" should be attended to. This includes the management of pain, sepsis or trauma.

It is important to note that fever can be associated with acute dental infection. The use of aerosol-producing instruments should be avoided. Any elective or non-essential procedures should be postponed to after the outbreak.

For suspected/confirmed cases of COVID-19 who require urgent dental treatment, procedures should be performed within a negative pressure room with a minimum of 12 air changes per hour to facilitate ventilation, as per the World Health Organization's recommendations.[20] Mechanical ventilation should also be initiated between patients. Personal protective equipment of the highest standard should be utilised at all times.

2. Personal hygiene measures

2.1. Hand hygiene

The importance of handwashing for twenty seconds is critical in the prevention of infection transmission. The cleansing of hands can be performed with either soap and water or an alcohol-based hand rub.[21]

Hand hygiene should be performed before touching a patient, before any procedure, after exposure to body fluids, after touching a patient, and after touching a patient's surroundings.[22]

2.2. Personal protective equipment (PPE)

Preventing fine and ultrafine particle exposure can only be achieved through the use of high level personal protective equipment.[22,23]

(i). Goggles / face-shields

The spread of oral microorganisms during oral procedures radiates mostly towards the inner part of the eyes and around the nose.[24] COVID-19 may also be transmitted through the conjunctiva receiving infectious

President Cyril Ramaphosa declared a national state of disaster in light of the novel Coronavirus pandemic which has spread to numerous countries with the number of confirmed cases and deaths steadily rising. One thousand three hundred and fifty three cases and four deaths (23 March 2020) are confirmed in South Africa.

DENTAL TRIAGE

TELEPHONICALLY

QUESTIONNAIRE

WITHIN THE LAST 14 DAYS

- Have you had a fever?
  (Temperature > 37,3°C)
- Have you had a cough or respiratory symptoms?
  (Cough or difficulty breathing)
- Is there any history of travel or residence in the epidemic areas?
  - High risk: China, USA, UK, Germany, Spain, Iran, South Korea and Italy.
  - Medium risk: Portugal, Hong Kong, and Singapore.
- Have you been in contact with anyone who has/had a fever, respiratory symptoms or confirmed COVID-19.

NO

YES

INSTRUCT TO SELF-ISOLATE AND CALL
THE DEPARTMENT OF HEALTH CORONA VIRUS HOTLINE:
0800 029 9999

HIGHER RISK INDIVIDUALS:

- Males.
- Individuals > 60 years old.
- With Comorbidities:
  - Diabetes.
  - Hypertension.
  - Cardio-vascular diseases.
- Immune-compromised individuals.
- Positive response to questionnaire.
- Having travelled from epidemic areas.

PPE (Personal Protective Equipment includes:

- PPE (Personal Protective Equipment) includes:
- Headwear, face shield/goggles, N95 mask, disposable gowns, closed shoes. Hand hygiene is imperative at all times.

ORAL / DENTAL EMERGENCIES*

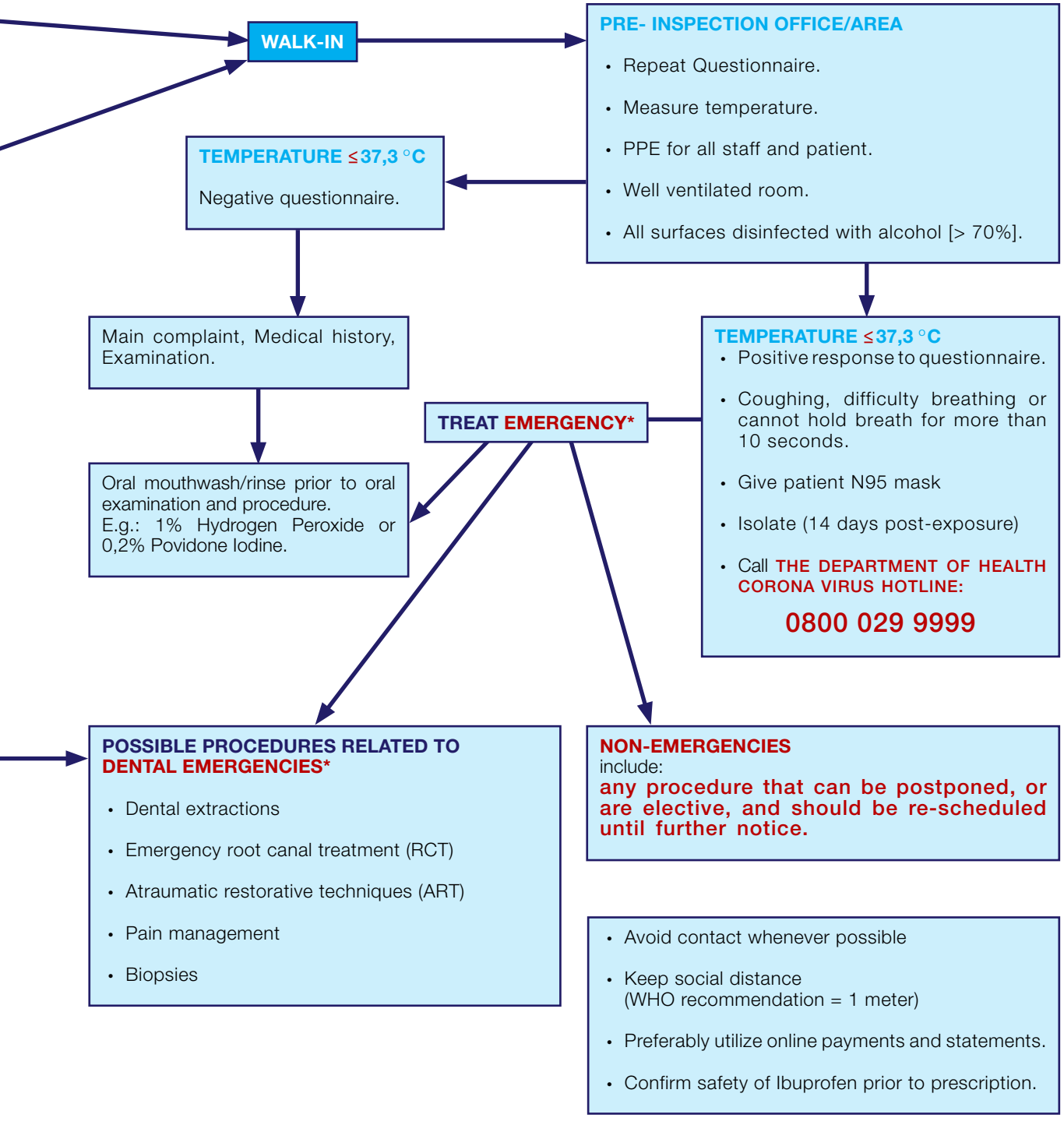
- Pain, Trauma, Sepsis/Infection, or
- Cases where non-treatment would inhibit normal oral function to the extent where this will negatively impact a patient's health in the next three to six months. Dentists will use their professional judgment to treat patients in this category.

ORAL / DENTAL EMERGENCIES*

- Important to ensure:
  - Rubber dam use
  - High volume suction use
  - Extra-oral imaging (preferable)
  - The use of aerosol producing instruments/ equipment to be avoided as far as possible
  - Well-ventilated surgery
  - 4 – handed dentistry
  - Disinfect all equipment and surfaces with alcohol [>70%]
  - Chlorine containing disinfectants on floors and walls
  - Discard PPE after each patient
  - Educate patient regarding COVID-19 and transmission
  - Patients to be unaccompanied unless elderly or minor
  - Schedule longer appointments to facilitate optimal infection control procedures

Figure 1. Triage schematic for Dental professionals

Adequate prevention can be achieved through the implementation of stringent control measures to curb the spread of the virus as the risk of cross infection is high. The following flowchart provides some guidance to the practitioner on how to manage patients, staff, and the workplace during this SARS-CoV-2 outbreak. Also consult the NCID website: **www.ncid.ac.za**.



Access the complete diagram for download and print at the follow link - https://imgur.com/TGZjUdf

droplets.[25] It is for this reason that protective eyewear or face-shields should be worn and should be disinfected between procedures.

(ii). Face masks

A National Institute for Occupational Safety and Health (NIOSH)-certified N95, European Standard Filtering Face Piece 2 (EU FFP2), or equivalent mask should be used.

N95 respirator masks have been shown to filter at least 95% of airborne particles with an aerodynamic diameter of 0.3um or above, but are not resistant to oil particles.

It should be noted that there is no standard test for nanoparticle penetration on respirators. However, the improper use of the mask and the possibility of leakage around the mask seal could negate the intended effect of the mask.

It is also important to note the variability of these masks in relation to the manufacturer as different N95 models may differ in shape, and whether they have an exhalation valve or not.[26]

3. Infection control and disinfection

Droplets containing infective agents produced during aerosol generating procedures deposit on the surrounding surfaces and can persist for days. Biocidal surface disinfectants containing 62%-71% ethanol, 0.5% hydrogen peroxide, and 0.1% (1 g/L) sodium hypochlorite should be used for a period of one minute to disinfect the dental surgery between patients.

27 Items which should be disinfected include and are not limited to the dental chair, cabinet tops, taps, door handles, blood pressure cuffs as well as computer keyboards/mouse, pens and cell phones.

Other steps taken to reduce aerosol contamination include:[24]

- Disinfection of the water line to the dental chair equipment.
- Sterilization of all dental treatment machines and instruments.
- Installation of a valve and strainer in the dental chair to prevent sucking reintegration infected liquid, aerosols and particulate materials.

4. Additional treatment regimen

The universal use of pre-procedural rinses and high-volume evacuations is recommended in addition to standard infection control barriers such as PPE, as a means of reducing infection risk. Pre-operative mouth rinsing, usually through the use of Chlorhexidine 0.12%, has been shown to reduce the microbial count.[28]

Unfortunately, this antiseptic mouthwash may not be effective in killing SARS-CoV-2.[6] Due to the vulnerability of the virus to oxidation, the use of 1% hydrogen peroxide or 0.2% povidone have been recommended as alternatives prior to any dental procedure.[6,29] Rubber dam isolation eliminates up to 98.5% of the microbial content within aerosols,[30,31] and for this reason should be used during every procedure. The use of a high-volume evacuator further diminishes the aerosol produced.[28]

5. Imaging and radiography

Dental imaging, which is generally used as the main diagnostic aid by dental professionals should be limited to extra-oral imaging where possible. This diminishes pooling of saliva and gagging reflex.[6]

6. Medical waste management

All disposable personal protective equipment should be discarded into the infectious waste bin which should be collected and discarded according to established waste management protocols. Reusable items and instruments should be sterilized as per the Asia Specific Society for Infection Control (APSIC) guidelines for disinfection and sterilization of instruments in health care facilities.[6]

CONCLUSION

It is prudent for dentists to keep abreast with the developments around the COVID-19, in order that they may institute appropriate clinical practice which will ensure maximum protection for themselves, staff and patients.

The decision about the nature and level of service to be provided remains the prerogative of each practitioner depending on the level of risk assessment and the readiness of the practice.

Figures are correct as reported on day of sending to print.

References

1. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. Respirology. 2018; 23: 130-7.
2. Hui DS, Madani TA, Ntoumi F, et al. The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health - the latest 2019 novel coronavirus outbreak in Wuhan, China. Int J Infect Dis. 2020: 91: 264-6.
3. Hussin AR, Siddappa NB. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. Journal of Autoimmunity. 2020. https://doi.org/10.1016/j.jaut.2020.102433.
4. Lu R, Zhao X, Li J, et al. Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. Lancet. 2020; 395 (10224): 565-74.

5. Cui J, Li F, Shi LZ. Origin and evolution of pathogenic coronaviruses. Nat Rev Microbiol. 2019; 17: 181-92.
6. Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. International Journal of Oral Science. 2020; 12(1): 1-6.
7. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. JAMA 2020 doi: 10.1001/ jama.2020.1585. [epub ahead of print 7 Feb 2020] in press.
8. Vardavas CI, Nikitara K. COVID-2019 and smoking: A systematic review of the evidence. Tob Induc Dis. 2020; 18 (March) 2020.
9. Lu X, Zhang L, Du H, et al. SARS-CoV-2 infection in children. N Engl J Med. 2020; DOI:10.1056/NEJMc2005073.
10. Chan JF, Yuan S, Kok KH, et al. 2020. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet. 202: 0395(10223): 514-23.
11. Ahmed MS, Girish DB, Devi RE, et al. (2020). Dental considerations in Corona Virus Infections: First review in literature. Journal of Advanced Medical and Dental Sciences Research. 2020 http://doi.org/10.1371/journal.pone. 0225644.21276/jamdsr.
12. Van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. NEJM 2020; http://doi.org/10.1371/journal. pone.0225644.1056/NEJMc2004973.
13. Ling ML, Ching P, Widitaputra A, et al. APSIC guidelines for disinfection and sterilization of instruments in health care facilities. Antimicrobial Resistance & Infection Control. 2018; 7(1): 25.
14. Harrel SK, Molinari J. Aerosols and splatter in dentistry: a brief review of the literature and infection control implications. JADA. 2004; 135: 429-37.
15. Cleveland JL. et al. Transmission of blood-borne pathogens in US dental health care settings: 2016 update. JADA. 2016; 147: 729-38 .
16. Rajput R, Chouhan Z, Suthar P, et al. MERS-CoV (middle east respiratory syndrome corona virus): a dental surgeon perspective. International Journal of Contemporary Medical Research. 2015; 2(5): 1228-30.
17. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID -19): Emerging and future challenges for dental and oral medicine. J Dent Res. 2020. doi:10.1177/00220345209142 46.
18. Liu MH, Chen CT, Chuang L, et al. Removal efficiency of central vacuum system and protective masks to suspended particles from dental treatment. PLoS ONE. 2019; 14(11): e0225644. http://doi.org/10.1371/journal.pone.0225644
19. Kohn WG, Collins AS, Cleveland JL et al. Centers for Disease Control and Prevention. 2003. Guidelines for infection control in dental health-care settings. 2003. https://www. cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm.
20. World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (2019-nCoV) infection is suspected: interim guidance [accessed 2020 Feb 17]. https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when -novel-coronavirus-(ncov)-infection-is-suspected.
21. Ge ZY, Yang LM, Xia JJ, et al. Possible aerosol transmission of COVID-19 and special precautions in dentistry. Journal of Zhejiang University-SCIENCE B. 2020; 1-8.
22. WHO, 2009. WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge - Clean Care is Safer Care. World Health Organization, Geneva, Switzerland.
23. Larson EL, Early E, Cloonan P, et al. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. Behav Med. 2000; 26(1): 14-22.
24. Nejatidanesh F, Khosravi Z, Goroohi H, et al. Risk of contamination of different areas of dentist's face during dental practices. Int J Prev Med. 2013; 4(5): 611-5.
25. Lu CW, Liu XF, Jia ZF. 2019-nCoV transmission through the ocular surface must not be ignored. Lancet 2020; 395(10224): 39. https://doiorg/10.1016 S0140-6736(20)30 313-5.
26. Ntlailane MGL, Wichmann J. Effectiveness of N95 respirators for nanoparticle exposure control (2000-2016): A systematic review and meta-analysis. J Nanopart Res. 2019; 21: 170. http://doi.org/10.1007/s11051-019-4596-0.
27. Kampf G, Todt D, Pfaender S, et al. 2020. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect. 2020; https://doi.org/ 10.1016/j.jhin.2020.01.022.
28. Narayana TV, Mohanty L, Sreenath G, et al. Role of pre-procedural rinse and high volume evacuator in reducing bacterial contamination in bioaerosols. JOMFP. 2016; 20(1): 59.
29. Maki DG, Hassemer CA. Flash sterilization: carefully measured haste. Infect Control. 1987; 8: 307-10.
30. Cochran MA, Miller CH, Sheldrake MA. The efficacy of the rubber dam as a barrier to the spread of micro-organisms during dental treatment. JADA. 1989; 199: 141-4.
31. Evans D, Samaranayake LP, Reid J. The use of rubber dam in reducing atmospheric contamination. J Dent Child. 1989; 56: 442-4.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a2

Mandibular first and second premolars with challenging root canal anatomy - Part 1: Review of the literature

SADJ April 2020, Vol. 75 No. 3 p126 - p129

PJ Van der Vyver[1], M Vorster[2], CH Jonker[3]

INTRODUCTION (Part 1)

Mandibular premolars can be one of the most difficult teeth to treat endodontically because of the variations in root canal anatomy.[1,2]

According to England, Hartwell and Lance,[3] variation in root canal anatomy is one of the main reasons why mandibular premolars have a high frequency of failures and flare-ups. The literature indicates that the incidence of the number of roots and the number of canals varies greatly in human teeth.[4,5]

MANDIBULAR FIRST PREMOLARS

Mandibular first premolars can present with an extremely complex internal root canal morphology.[6,7] A study by the University of Washington showed mandibular first premolars to have the highest failure rate when evaluating non-surgical root canal therapy, with a reported failure rate of 11.4%.[8]

This high incidence of failure could be attributed to the high incidence of variations in these teeth and the difficulty of negotiating, shaping and cleaning these canals if present. Age, sex and ethnicity are some of the factors that contribute to the variations in canal configurations between different studies.[9-11]

According to Cleghorn, Christie and Dong,[12] who reported on eight anatomical studies that include 4 462 teeth, most mandibular first premolars have a single root with a single root canal (97.9%) (Figure 1).

Author affiliations:
1. **Peet J van der Vyver:** *BChD, PG Dip Dent (Endo), PG Dip Dent (Aesthet Dent), MSc, PhD (Pret),* Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa.
   ORCID Number: 0000-0003-1951-6042
2. **Martin Vorster:** *BChD, PG Dip Dent (Endo), MSc (Pret),* Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa.
   ORCID Number: 0000-0003-4470-1530
3. **Casper H Jonker:** *BChD (Pret), Dip Odont (Endo), MSc (Pret),* Division of Endodontics, Department of Operative Dentistry, Sefako Magatho Health Sciences University, Ga-Rankuwa, South Africa.
   ORCID Number: 0000-0002-9110-5208

Corresponding author: Peet J van der Vyver
Postal address: PO Box 2609, Cresta, 2118, South Africa.
Tel. no.: +27 (0)11 781 1020
Fax no.: +27 (0)11 781 1392
Email: peetv@iafrica.com

Author contributions:
1. **Peet J van der Vyver:** Scientific writing and editing - 40%
2. **Martin Vorster:** Scientific writing and editing - 30%
3. **Casper H Jonker:** Scientific writing and editing - 30%

Vertucci[4] shows that a single canal is found in 70% of cases; in 4% of cases there could be two canals joining at a common apical foramen (Figure 2); in 24% of cases one root canal bifurcates at the apical third of the root into two branches (Figure 3); and in 1.5% of cases there could be two independent canals (Figure 4).

In 1990, Hülsmann[13] reported a mandibular first premolar with three root canals and, according to Baisden, Kulild and Weller,[14] this tooth can also present with a C-shaped root canal.

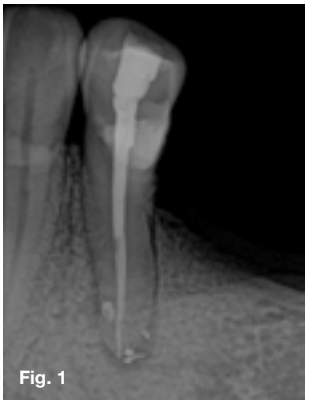
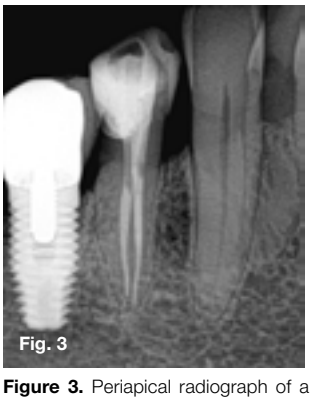


Figure 1. Periapical radiograph of a mandibular left first premolar with a single canal. Note the multiple portals of exit that are visible after irrigation and obturation.

Figure 2. Periapical radiograph of a mandibular left first premolar with two root canal systems joining in the apical third into a single canal. Note the midroot lateral canals that are visible after irrigation and obturation.



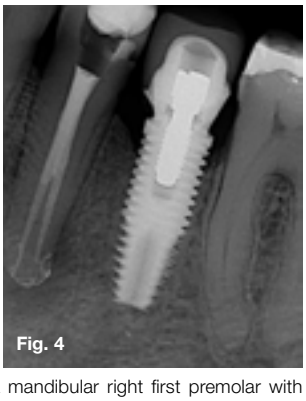


Figure 3. Periapical radiograph of a mandibular right first premolar with two independent root canals in one root.

Figure 4. Periapical radiograph of a mandibular right first premolar with a root canal system that bifurcates into two branches at the junction between the midroot and apical third of the root.

A review by Cleghorn, Christie and Dong[12] reports on the internal morphology of 4 733 mandibular first premolar teeth. One canal was present in 75.8% of the teeth studied, compared to 24.2% of teeth having two or more canals.

A single apical foramen was found in 78.9% of teeth, whereas two or more apical foramina were found in 21.1% of teeth. They also reported that mandibular first premolars with two roots were found in 1.8% of cases and that three-rooted (0.2%) and four-routed (<0.1%) varieties were quite rare.

MANDIBULAR SECOND PREMOLARS

The mandibular second premolar usually has one root with a single root canal system that can occur in 65% to 100% of cases[4,7,12,15,16] (Figure 5). A review of the literature on root configuration of mandibular second premolars when 4 019 teeth were assessed showed a 99.6% incidence of single-rooted teeth.[12]

The single root can also present with two canals in 1–11%[12,17,18] with a single apical foramen in 91.8% (Figure 6), or two or more apical foramina in 8.2% of cases (Figure 7).[12]

Several authors have also reported single roots with three root canals in approximately 0.4% of cases (Figures 8A-E).[18-21]

Rhodes[22] and Macri and Zwemer[23] have reported mandibular second premolars with four and five root canals respectively. According to a literature review by Cleghorn, Christie and Dong,[12] mandibular second premolars can have two separate roots in 0.3% of cases (Figure 10) and three separate roots in 0.1% of cases (Figure 11).

Although normal root canal anatomy and canal configuration are well documented in the literature,[8] there are still large variations in data on anomalies and the incidence thereof.[12]

Similar findings are reported by Park et al.[24] These authors report an incidence of 0.6% of mandibular second premolars presenting with two separate roots. According to Sachdeva et al.[25] an investigation of available literature revealed no cases of four separate roots and four distinct root canals in mandibular second pre-molars.

It is important to note that the root and canal morphology of the second mandibular premolar can be influenced by gender, age and ethnicity.[26-28] Park et al.[24] and co-workers conclude in their study that no significant differences could be found between female and male patients or between left and right sides of the mandibula.

Tzanetakis et al.[29] report a unique case of a mandibular second premolar with four canals diagnosed and treated with the use of the dental operating microscope, emphasising the vital role of proper magnification in diagnosis and treatment of challenging anatomy. The use of conventional radiographs provides limited information; investigation using specialised radiographic techniques in conjunction with traditional two-dimensional images is advocated to confirm challenging anatomy.[25]

In part two of this article the authors will provide the clinician with guidelines and clinical techniques that might aid in root canal treatment on mandibular premolars that present with unusual root canal anatomy.

Figure 5. Periapical radiograph of a mandibular right second premolar with a single root with two separate root canal systems joining in the apical third of the root to form one apical foramen.

Figure 6. Periapical radiograph of a mandibular right second premolar with a single canal. Note the multiple ports of exit that are visible after irrigation and obturation.

Figure 7. Periapical radiograph of a mandibular right second premolar with a single root and two separate root canal systems with two apical foramina. Note the midroot lateral portal of exit that is visible after irrigation and obturation. .

Figure 8.
(A). Periapical radiograph of a mandibular right second premolar with a single root with a large periapical radiolucency.
(B). Three root-canal systems were located, joining in the apical third to end in one apical foramen.
(C). Obturation of the three root-canal systems.
(D). Periapical radiograph after six months showing good healing of the periapical pathology.
(E). Axial slice of a 6-month follow-up CBCT 3mm from the apex showing the three separate root canals.

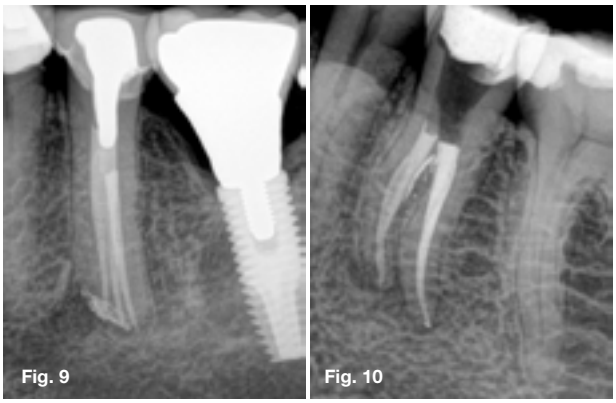


Figure 9. Periapical radiograph of a mandibular left second premolar with a single root and 3 separate root-canal systems ending in three apical foramina.

Figure 10. Periapical radiograph of a mandibular left second premolar with two separate roots and root canals.

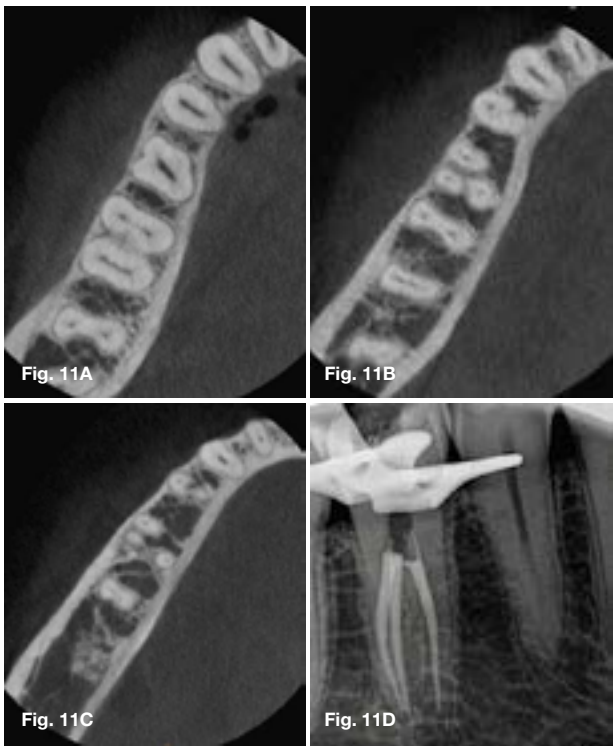


Figure 11.
(A). Axial slice of a CBCT scan through the coronal aspect (DEJ level) of a non-vital mandibular right second premolar showing an irregularly shaped root;
(B). Axial slice of a CBCT scan through the midroot aspect depicting three separate roots and root canals;
(C). Axial slice of a CBCT scan through the apical level showing three separate roots and root canals;
(D). Post-operative periapical radiograph illustrating the final result after root canal preparation and obturation (courtesy of Dr M du Bruyn).

References

1. Slowey R. Root canal anatomy: road map to successful endodontics. Dent Clin North Am. 1979; 23: 555-73.
2. El Deeb ME. Three root canals in mandibular second premolars: literature review and a case report. J Endod. 1982; 8(8): 376-7.
3. England Jr MC, Hartwell GR, Lance JR. Detection and treatment of multiple canals in mandibular premolars. J Endod. 1991; 17(4): 174-8.
4. Vertucci FJ. Root canal morphology of mandibular premolars. J Am Dent Assoc. 1978; 97(1): 47-50.
5. Jordan RE, Abrams L, Kraus BS. Kraus' dental anatomy and occlusion: Mosby Year Book; 1992.
6. Walton RE, Torabinejad M. Principles and practice of endodontics: Saunders; 1996.
7. Ash MM, Nelson SJ. Wheeler's dental anatomy, physiology, and occlusion 8th Edition: Saunders; 2003.

8. Ingle JI, Baumgartner JC. Ingle's endodontics 6: PMPH -USA; 2008.
9. Trope M, Elfenbein L, Tronstad L. Mandibular premolars with more than one root canal in different race groups. J Endod. 1986; 12(8): 343-5.
10. Pineda F. Roentgenographic investigation of the mesiobuccal root of the maxillary first molar. Oral Surg, Oral Med, Oral Pathol. 1973; 36(2): 253-60.
11. Sert S, Bayirli GS. Evaluation of the root canal configurations of the mandibular and maxillary permanent teeth by gender in the Turkish population. J Endod. 2004; 30(6): 391-8.
12. Cleghorn BM, Christie WH, Dong CC. The root and root canal morphology of the human mandibular second premolar: A literature review. J Endod. 2007; 33(9): 1031-7.
13. Hülsmann M. Mandibular first premolar with three root canals. Dent Traumatol. 1990; 6(4): 189-91.
14. Baisden MK, Kulild JC, Weller RN. Root canal configuration of the mandibular first premolar. J Endod. 1992; 18(10): 505-8.
15. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral surg, Oral Med, and Oral Pathol. 1984; 58(5): 589-99.
16. Rodig T, Hulsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three root canals. Int Endod J. 2003; 36(12): 912-9.
17. Pineda F, Kuttler Y. Mesiodistal and buccolingual roentgenographic investigation of 7,275 root canals. Oral Surg, Oral Med, and Oral Pathol. 1972; 33(1): 101-10.
18. Zillich R, Dowson J. Root canal morphology of mandibular first and second premolars. Oral Surg, Oral Med, and Oral Pathol. 1973; 36(5): 738-44.
19. El Deeb ME. Three root canals in mandibular second premolars: literature review and a case report. J Endod. 1982; 8(8): 376-7.
20. Singh RP, Stamps HF, Tatum RC. Endodontic considerations of a tricanaled mandibular second premolar: case report and literature review. J Md State Dent Assoc. 1987; 30(1): 13-6.
21. Fischer GM, Evans CE. A three-rooted mandibular second premolar. Gen Dent. 1992; 40(2): 139-40.
22. Rhodes JS. A case of unusual anatomy: a mandibular second premolar with four canals. Int Endod J. 2001; 34(8): 645-8.
23. Macri E, Zmener O. Five canals in a mandibular second premolar. J Endod. 2000; 26(5): 304-5.
24. Park JB, Kim N, Park S, Kim Y, Ko Y. Evaluation of root anatomy of permanent mandibular premolars and molars in a Korean population with cone-beam computed tomography. Eur J Dent. 2013; 7(1): 94-101.
25. Sachdeva GS, Ballal S, Gopikrishna V, Kandaswamy D. Endodontic management of a mandibular second premolar with four roots and four root canals with the aid of spiral computed tomography: a case report. J Endod. 2008; 34(1): 104-7.
26. Ross IF, Evanchik PA. Root fusion in molars: incidence and sex linkage. J Periodontol. Nov 1981; 52(11): 663-7.
27. Walker RT. Root canal anatomy of mandibular first premolars in a southern Chinese population. Endod Dent Traumatol. 1988; 4(5): 226-8.
28. Awawdeh LA, Al-Qudah AA. Root form and canal morphology of mandibular premolars in a Jordanian population. Int Endod J. 2008; 41(3): 240-8.
29. Tzanetakis GN, Lagoudakos TA, Kontakiotis EG. Endodontic treatment of a mandibular second premolar with four canals using operating microscope. J Endod. 2007; 33(3): 318-21.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a3

Mandibular first and second premolars with challenging root canal anatomy - Part 2: Endodontic management

SADJ April 2020, Vol. 75 No. 3 p130 - p136

PJ Van der Vyver[1], CH Jonker[2], M Vorster[3]

INTRODUCTION (Part 2)

In Part 1 of this article the authors give a literature review focussed on the complexity and variation in the anatomy of mandibular premolars. In Part 2 of this series the authors, by means of clinical case studies, will illustrate, discuss and give recommendations on diagnostic as well as endodontic clinical management of these, often complexed cases.

CASE REPORT 1

A 22-year-old, male patient presented with an uncomplicated medical history and reported no health problems. A pre-operative radiograph was taken and revealed a lower second premolar with two distinct roots (Figure 1).

After informed consent was obtained, the tooth was anaesthetised and the temporary restoration was removed. A rubber dam was applied and straight-line access (SLA) was achieved. The Dental Operating Microscope (DOM) (Zeiss Germany) was used to identify the pulpal floor map and visualise two distinct root canal orifices.

The orifices were gently enlarged using the ProTaper SX file (Dentsply Sirona, Ballaigues, Switzerland). Length determination was done using an apex locator (ProPex II, Dentsply Sirona) and size 10 K-File (Dentsply Sirona). A reproducible micro-glide path was created for a size 10 K-File and a macro-glide path was completed using the ProGlider (Dentsply Sirona). Both root canals were prepared with the WaveOne Gold Primary file (Dentsply Sirona) using the manufacturer's advocated technique.

Author affiliations:
1. **Peet J van der Vyver:** *BChD, PG Dip Dent (Endo), PG Dip Dent (Aesthet Dent), MSc, PhD (Pret),* Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa. ORCID Number: 0000-0003-1951-6042
2. **Casper H Jonker:** *BChD (Pret), Dip Odont (Endo), MSc (Pret),* Division of Endodontics, Department of Operative Dentistry, Sefako Magatho Health Sciences University, Ga-Rankuwa, South Africa. ORCID Number: 0000-0002-9110-5208
3. **Martin Vorster:** *BChD, PG Dip Dent (Endo), MSc (Pret),* Department of Odontology, School of Dentistry, University of Pretoria, Pretoria, South Africa. ORCID Number: 0000-0003-4470-1530

Corresponding author: Peet J van der Vyver
Postal address: PO Box 2609, Cresta, 2118, South Africa.
Tel. no.: +27 (0)11 781 1020
Fax no.: +27 (0)11 781 1392
Email: peetv@iafrica.com

Author contributions:
1. **Peet J van der Vyver:** Scientific writing and editing - 40%
2. **Casper H Jonker:** Scientific writing and editing - 30%
3. **Martin Vorster:** Scientific writing and editing - 30%

Regular irrigation was done using 3.5% sodium hypochlorite activated with the EndoActivator (Dentsply Sirona). Patency was maintained during cleaning and shaping, and recapitulation and re-irrigation were done to remove debris. Once cleaning and shaping were completed, the canals were dried with appropriate paper points.

A combination of WaveOne Gold Primary gutta percha cones (Dentsply Sirona), BioRoot RCS sealer (SeptoDont, Lancaster, USA) and warm vertical condensation Obtura Max II (Obtura Spartan) was used (Figure 2 and Figure 3). Post-operative instructions were provided and the patient was rescheduled for crown preparation as final restoration to ensure cusp protection.

CASE REPORT 2

The patient, a 40-year-old male, presented with a history of an emergency root canal treatment after irreversible pulpitis on his mandibular left second premolar. A pre-operative radiograph revealed a large root canal in the coronal aspect of the tooth that suddenly disappeared in the midroot area (Figure 4).

The tooth was anaesthetised, a rubber dam was placed and the temporary filling removed from the access cavity. A pre-curved, size 08 K-File (Dentsply Sirona) was introduced into the first root canal system. An attempt was made to locate a second root canal, without any success. The access cavity was modified in a buccal-lingual direction using a Start-X tip no. 1 (Dentsply Sirona).

Under high magnification and LED illumination using the DOM (Global, USA) a second canal orifice was located on the buccal aspect of the root using a size 10, 4% tapered Micro-opener (Dentsply Sirona). Both canals were negotiated to working length using the size 08 C+ and K-files (Dentsply Sirona), and length determination was done with an electronic apex locator (Propex Pixie, Dentsply Sirona) and confirmed radiographically (Figure 5).

On closer inspection of the canal orifices under the DOM, it was noted that there was evidence of another possible orifice towards the buccal aspect of the located buccal root canal. The access was modified with a Start-X tip no. 2 (Dentsply Sirona) and the Micro-opener was used to locate the third root canal orifice (Figure 6). It was noted that the 2 buccal canals join at the junction of the midroot and apical third of the root.

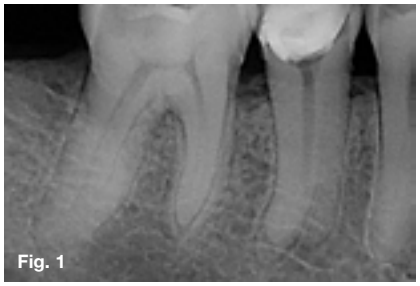


Figure 1. Pre-operative periapical radiograph revealing evidence of two separate roots on the mandibular right second premolar.

Figure 2. Obturation of the two separate roots and root canals with WaveOne Gold Primary gutta percha cones and sealer using the Obtura Max II Obturation Unit (Obtura Spartan).

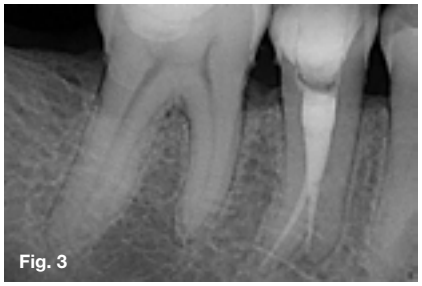


Figure 3. Completed obturation with temporary restoration.

Figure 4. Pre-operative periapical radiograph of a mandibular left second premolar. Note that the main large root canal disappears in the coronal aspect of the root, indicating the possibility of more than one root canal system.

Figure 5. Periapical radiograph confirming the working length in the buccal and lingual root canal.

Figure 6. High magnification view at the level where the main root canal system divides into three root canals.

Figure 7. (**A**) Periapical radiograph showing the final result after obturation. Note the additional third buccal canal merging with the main buccal root canal at the junction of the midroot and apical third. (**B**) There was also evidence of a lateral canal (arrow) branching off from the lingual root canal system in the midroot area and joining again with the main root canal system at the junction of the midroot and apical third.

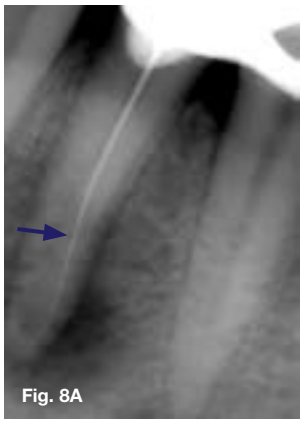


Figure 8. (**A**) Length determination radiograph on a mandibular left first premolar. Note that the root canal instrument in the root is off-centre (arrow), indicating the possibility of an additional canal in the root canal system; (**B**) Final result after the second root canal system was located and both root canals were obturated. Note the evidence of a lateral canal branching off the buccal root canal system in the apical third of the root (courtesy of Dr M du Bruyn).

A reproducible glide path was prepared using a size 10 K-File before the glide path was enlarged with a WaveOne Gold Glider (Dentsply Sirona). The three root canals were prepared with a Primary WaveOne Gold file and irrigated with 3.5% sodium hypochlorite and 17% EDTA to remove the smear layer. A cone fit radiograph was taken and thereafter the canals were obturated using Pulp Canal Sealer (Kerr), Calamus Dual Obturation system (Dentsply Sirona) and the continuous wave of condensation obturation technique. Figure 7 shows the immediate post-operative result after obturation.

DISCUSSION

Because of the complex and variable root canal morphology, endodontic treatment of mandibular premolars can be a challenging task. Several authors have recommended careful examination of pre-operative radiographs to identify the possibility of additional root canals.[1-3] Parallel and pre-operative radiographs taken from either 30° mesial or 30° distal are an important starting point.[4] The following criteria can be used for examination of the pre-operative radiographs:[2]

1. The clinician should carefully trace the exterior and interior outlines of the tooth in the radiograph with magnification when the pre-operative radiograph is on film. With digital radiographs it is possible to magnify, emboss, colourise or invert the digital image. Hülsmann[5] recommends looking for intersecting lines that might indicate additional roots or root canals when examining the outlines of the tooth.

2. If a root canal instrument demonstrates an eccentric direction on deeper penetration into the root canal (directional control) (Figures 8A and B), additional root canals should be suspected.[6]

3. If a sudden narrowing or even disappearing pulpal space is detected on the radiograph the clinician can expect that the canal diverges at that point into 2 parts that may either remain separate or merge before reaching the apex.[7]

4. If the midroot image diameter appears equal to or greater than the crown image diameter, a variation in root canal morphology can be expected.[8]

5. If a radiolucent line is detected either mesial or distal from the main root canal, the presence of an additional canal should be suspected (Figure 9).[1]

Cone-beam computed tomography (CBCT) can also be used as a diagnostic imaging modality for effective evaluation of root canal morphology.[9,10] Matherne et al.[11] show that CBCT images result in the identification of a greater number of root canal systems in teeth than does conventional radiography.

The study also concludes that the combination of CBCT scanning and the dental operating microscope was important in locating and identifying root canals. Figure 10 illustrates the important information that was obtained pre-operatively from a midroot axial slice of a CBCT scan of a mandibular right first premolar.

The scan reveals that the premolar presented with one root containing two root canals; there is also evidence of a third orifice at the periphery of the root, indicating the presence of a lateral canal.

The Kodak 9000 3D system generates 3D images that provide clinicians with anatomical detail and diagnostic possibilities in the field of endodontics, implantology and oral maxillofacial surgery, periodontics, general dentistry, forensic dentistry and orthodontics. The application of CBCT technology in endodontics is not limited to determining root canal morphology and the number of roots, canals and accessory canals. It can also be used to establish the correct working length, assess existing root canal fillings, determine the exact position and angulation of fractured instruments and detect the presence and extent of inflammatory root resorption, just to mention a few.[12]

One of the major challenges of treating mandibular premolars with multiple root canals is locating additional canal orifices. Examination of the pulp chamber and pulp chamber floor under high magnification and bright illumination can provide the clinician with valuable information. Figure 11 is a high-magnification view of the inside of a premolar root canal 16mm from the cusp tip of the tooth. Adequate illumination down the root canal system allowed the clinician to observe the orifice of the main root canal (blue arrow) as well as the orifice of an additional root canal (red arrow).

Figure 12 is a high-magnification view of the inside of a premolar root canal 18mm from the cusp tip. LED illumination in combination with a high magnification view of the root canal system allowed the clinician to locate and negotiate three separate root canal systems.

Al Fouzan[13] recommends that if the pulp chamber appears to deviate from the normal expected configuration, if it seems very wide in a mesiodistal plane or if it appears to be triangular in shape, more than one root canal should be expected. If the clinician locates only one eccentric orifice, then the opposite side of the pulp chamber should be inspected for an additional root canal.[14]

Rödig and Hülsmann[2] also suggest that a third root canal in mandibular second premolars should be suspected when the pulp chamber does not appear to be aligned in its expected buccal-lingual relationship. In addition, they point out that lines on the pulp chamber floor, which are visible during examination with magnification and illumination, can give valuable clues about where to locate additional root canals.

In the author's experience, the level at which the root canals bifurcate or trifurcate determines the level of difficulty when treating complex lower premolars (Figure 13).

The deeper the level of bifurcation, the more difficult the case and the higher the demand for adequate illumination of the dentine walls in that part of the main root canal system. This is often necessary for location and negotiation in cases where the additional canal orifices branch off from the dentine walls of the main root

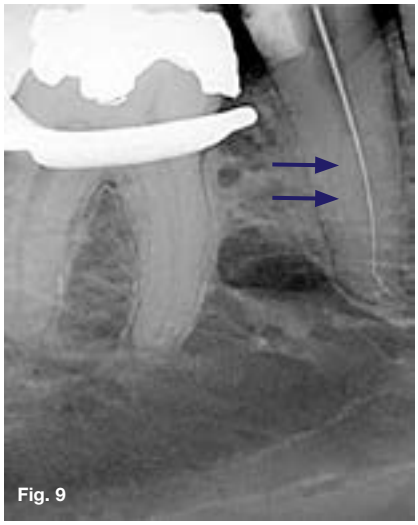


Figure 9. Length determination radiograph for a root canal treatment on a mandibular right second premolar. Note the radiolucent line (arrow) on the distal aspect of the root, indicating the presence of an additional canal.

Figure 10.
(A) Axial slice of a CBCT scan of a mandibular right first premolar at midroot level showing one root containing two root canals.
Note evidence of a third orifice at the periphery of the root (arrow), indicating the presence of a lateral canal.

(B) Final result after root canal treatment.
Note the obturation of a lateral canal that corresponds with the information obtained from the CBCT image.

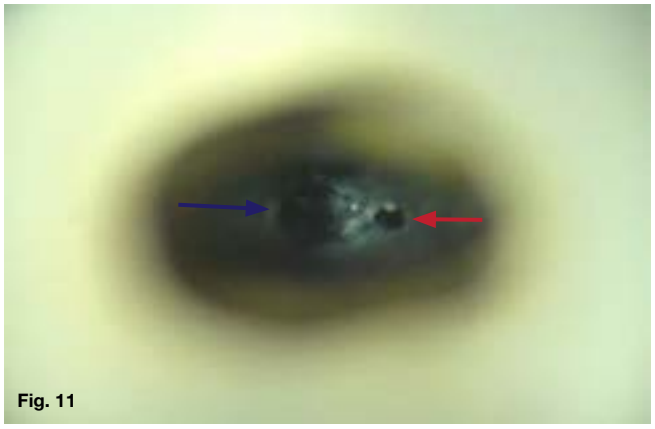


Figure 11. High-magnification view (15x) of the inside of a root canal showing the orifice of the main root canal (blue arrow) and the orifice of an additional root canal (red arrow).

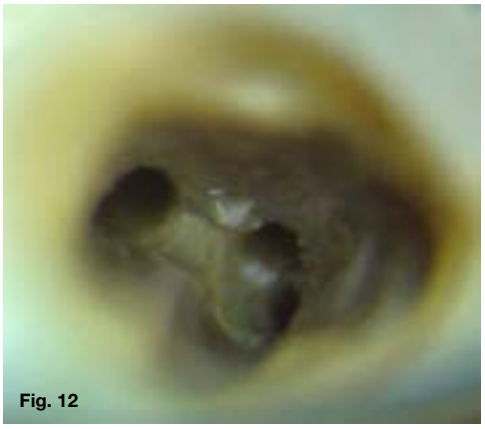
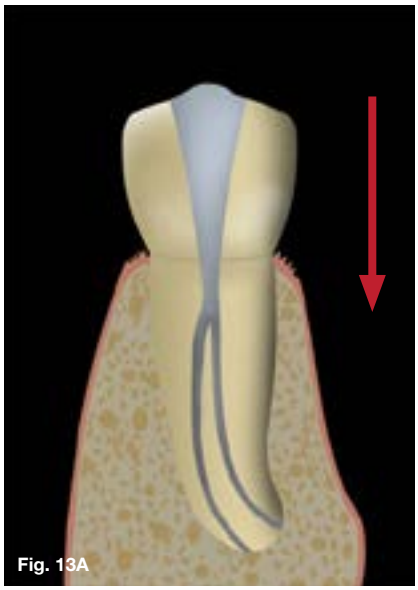
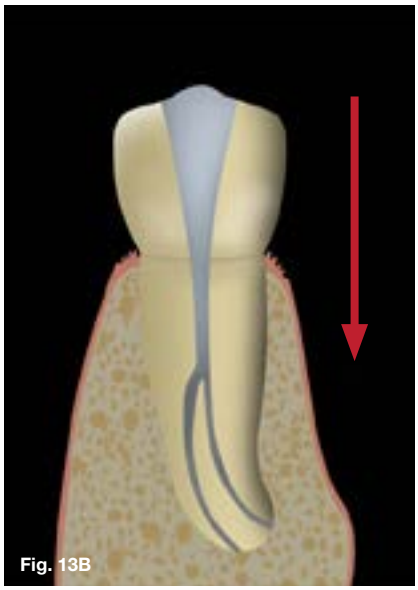


Figure 12. Magnified view (15x) of the root canal system at the level where the root canal trifurcates into 3 separate root canal systems.





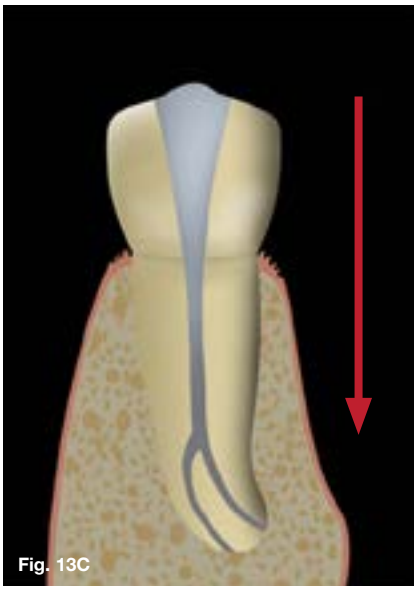


Figure 13. 3 possible levels of canal bifurcation:
(**A**) coronal third, (**B**) mid-root and (**C**) apical third. The deeper the level of bifurcation, the more difficult the clinical case and the higher the demand for adequate illumination and magnification (arrows) of the dentine walls in that part of the main root canal system.

canal system. Conventional halogen and metal halide illumination systems on dental operating microscopes (DOM) often do not provide sufficient illumination of the deep part of the main root canal system to see enough detail to facilitate identification and location of additional canal orifices.

Another clinical challenge when treating mandibular second premolars with multiple root canals is creating SLA in order to negotiate all the root canals to the full root length. There are often intra-radicular dentine interferences present in the main root canal at the point where the additional canal bifurcates from the main canal (**Figure 14**), and because of the lack of SLA, it is very difficult to negotiate these additional canals to the radiographic terminus.

The first step in facilitating location and negotiation of these restricted canals is preparing the coronal part of the root canal. The authors prefer to do the initial pre-flaring of the coronal portion of the root canal with an SX file (Dentsply Sirona) (cutting on outward strokes only).

The preparing of the coronal portion of the root canal is a very important step that enables the clinician to visualise more detail of the pulpal floor at the point where the canals bifurcate or trifurcate under illumination and magnification. Using ultrasonic instruments to obtain clean and refined access cavity walls generally follows this step. The first instrument of choice is the Start-X no. 1 (Dentsply Sirona) (**Figure 15**).

This is a large ultrasonic tip (maximum diameter of 1.6mm tapering to 0.8mm) that is used to refine the coronal area in a specific direction or to remove dentine interferences on the access cavity walls that prevent direct access to the pulpal floor at the level of canal bifurcation.

After removal of the intra-radicular dentine interference, it is much easier to locate additional canal orifices due to the SLA and improved visibility of the deeper part of the root canal system (**Figure 16**).

Cutting dentine with the Start-X tip no. 1 is achieved by activating the 12mm micro-blades on the instrument with an ultrasonic scaler. It is important to note that the micro-blades do not reach the smooth rounded end of the instrument tip (**Figure 17**), which provides the operator with the assurance of reduced dentine removal or modification of the pulpal floor. The secondary dentine on the canal wall is generally whitish or opaque compared to the darker, grey colour of the pulpal floor.[15]

If the additional canal in a root canal system bifurcates from the main root canal system at an acute angle (**Figure 18**), it is even more difficult to locate the orifice of that canal.

The pre-bent tip of a Micro-opener can be used to facilitate canal negotiation in these situations. The tip of the Micro-opener can be slid down and against the canal walls in order to locate additional canal orifices (**Figure 19**). Micro-openers are stainless steel instruments with 7mm cutting flutes that combine the canal-finding capabilities of an explorer with the instrument capabilities of a K-File.

They are available in sizes 10 and 15 with 0.4 and 0.6 tapers. The exaggerated tapers enhance the instrument's tensile strength, making it the ideal tool to locate and penetrate undiscovered canal orifices.

Although the Micro-opener will help with the identification of the entrances of additional canals, it is often not possible to enter the canal with a conventional root canal instrument due to the acute angle of entrance. In these cases the author recommends using a Start-X tip no. 2 (Dentsply Sirona) to remove a small amount of dentine from the canal wall, directly above the entrance of the canal (**Figure 20**), to allow more SLA into the root canal system (**Figure 21**). It is mandatory to do this under magnification and illumination.

The Start-X tip no. 2 has a diameter of 1mm at the tip and a maximum diameter of 1.54 mm at the end of the 8 mm cutting blades. The micro-blades extend to the rounded tip (**Figure 22**) to increase cutting efficiency, making this the ideal ultrasonic instrument for this task.

According to Buchanan,[16] smaller and longer tips should be used to locate canal orifices, especially when working at depths past the middle third of the root canal length. For this task, the author recommends the Start-X tip no. 3 (Dentsply Sirona). This instrument is characterised by 8 mm micro-blades on a tip with a maximum diameter of 0.9 mm, tapering to 0.64 mm, ending in a sharp polished tip (**Figure 23**).

Using a thinner ultrasonic tip facilitates more cutting precision and vision when removing secondary dentine or calcifications. The correct setting on the ultrasonic unit is important when the clinician searches for canal orifices inside a root canal, because aggressive cutting may cause undesired modification of the pulp chamber anatomy or perforation.[15]

According to Clark,[17] the best results are obtained when ultrasonic tips are used with a light brush-touch motion, medium power and under magnification and illumination. The tip should only be activated when it is in contact with the dentine or calcification that the operator wants to remove.[18]

The final impediment when treating mandibular premolars with multiple canals is obturation of the prepared root canal systems. A few clinical problems can be encountered during this treatment phase. As mentioned before, the level at which the root canal orifices are located can vary from coronal to mid-root or the apical region of the root.

The more apical the bifurcation, the more difficult it is to obturate the root canal system. Secondly, the visibility at the point of root canal bifurcation is often limited. The more apical the bifurcation, the more challenging the obturation becomes, and generally these situations require higher magnification and brighter illumination of the pulp chamber floor.

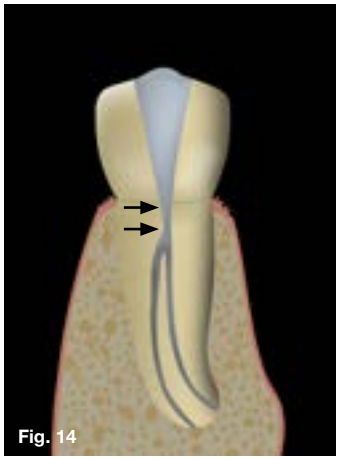
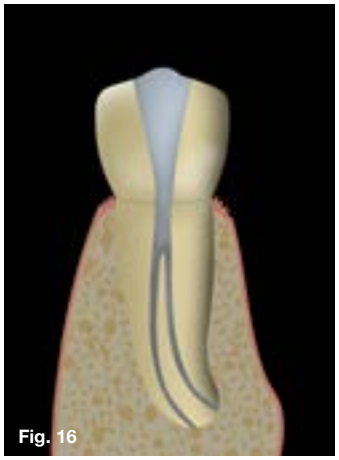


Figure 14. Intra-radicular dentine interference (arrows) in the main root canal at the point where the additional canal bifurcates. Note the lack of SLA to the additional root canal system.

Figure 15. Start-X tip no. 1 (Dentsply Sirona) is used to remove the intra-radicular dentine interference on the access cavity wall.



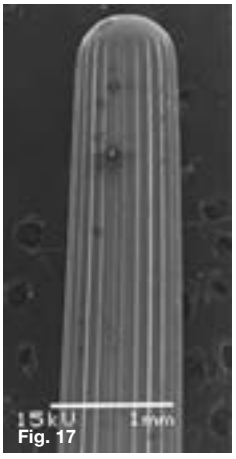
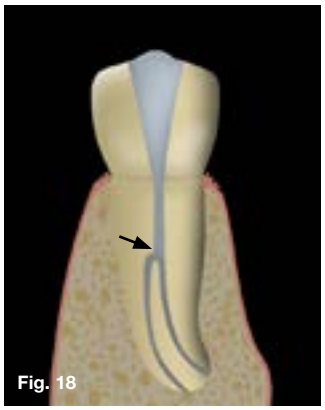


Figure 16. Note the improved directaccess into the 2 root canal systems.

Figure 17. SEM of the tip of a Start-X tip no. 1 (Dentsply Sirona). Note that the micro-blades do not reach the smooth rounded end of the instrument tip, which provides the operator with the assurance of reduced dentine removal or modification of the pulpal floor.



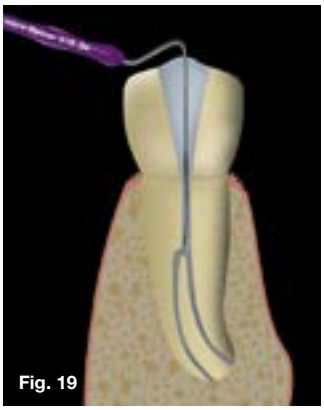
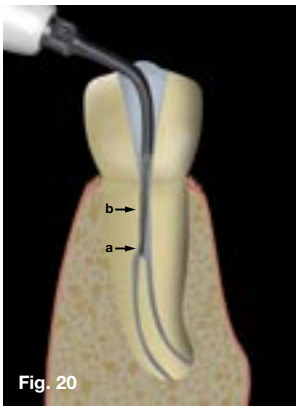


Figure 18. Additional canal (arrow) in a root canal system that bifurcates from the main root canal system at an acute angle.

Figure 19. The pre-bent tip of a Micro-opener is carefully slid down and against the canal walls to help identify the canal orifices of additional root canals.



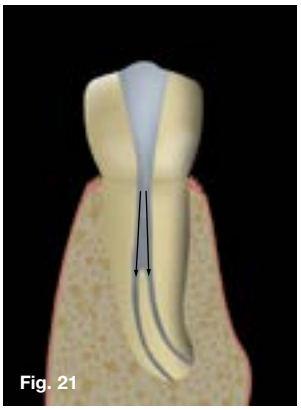
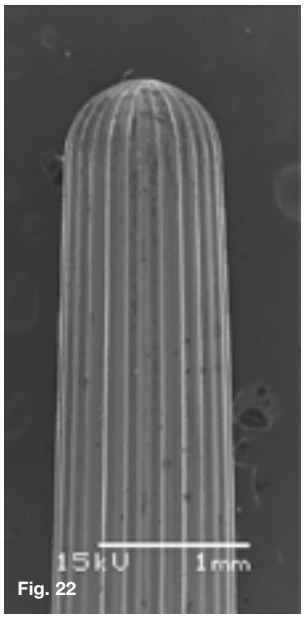


Figure 20. Start-X tip no. 2 (Dentsply Sirona) is used to remove a small amount of dentine from the canal wall directly above the entrance of the canal with the active cutting tip (arrow a) before the micro-blades on the body of the tip are used to remove some dentine from the canal wall (arrow b).

Figure 21. Note the improved direct access into the 2 root canal systems.



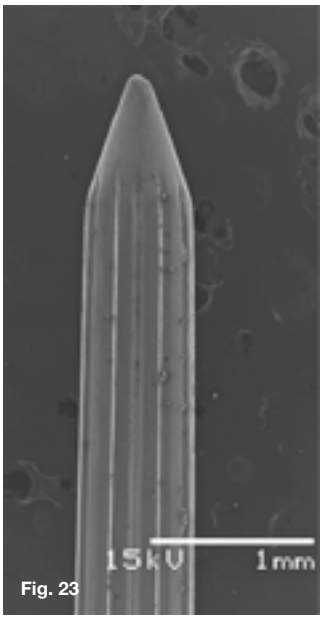


Figure 22. SEM of the tip of a Start-X tip no. 2 (Dentsply Sirona). Note the active cutting tip because the micro-blades reach the rounded end of the instrument tip.

Figure 23. SEM of the tip of the Start-X tip no. 3 (Dentsply Sirona) instrument. Note the narrow shank with micro-blades, ending in a sharp polished tip that facilitates more cutting precision.

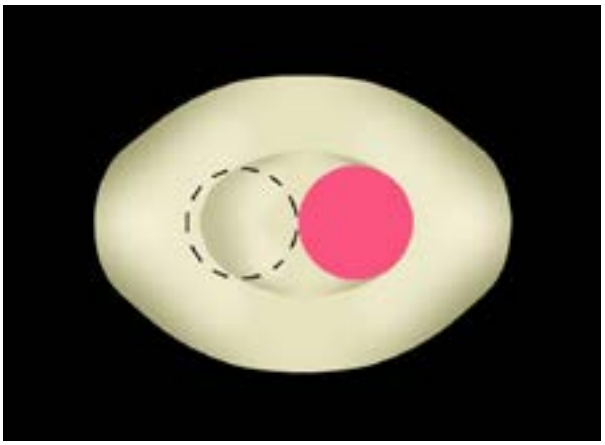


Figure 24. It is often not possible to fit two gutta percha cones simultaneously into the root canal system because of a lack of space in the main root canal coronal to the canal bifurcation.

Lastly, the size of the main root canal coronal to the bifurcation is often not large enough to accommodate two or more tapered gutta percha cones (**Figure 24**) to check radiographically that the cones fit.

To overcome this clinical problem, one gutta percha cone at a time must be fitted and checked radiographically. In the authors' experience, the best clinical control is achieved with the continuous wave of condensation technique using the Calamus Dual Obturation system (Dentsply Sirona) to obturate multiple canals in mandibular premolars.

With the continuous wave of condensation technique, the down-pack handpiece of the Calamus Dual can be used to cut off one gutta percha cone at a time at orifice level. After all the cones have been placed, the down-pack handpiece can be used to soften and condense the gutta percha in each root canal. The backfill handpiece is then ideal to backfill the root canals and the coronal portion of the main root canal system with pre-heated gutta percha.

References

1. Slowey R. Root canal anatomy: road map to successful endodontics. Dent Clin North Am. 1979; 23: 555-73.
2. Rodig T, Hulsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three root canals. Int Endod J. 2003; 36(12): 912-9.
3. Weine FS. Case report: three canals in the mesial root of a mandibular first molar(?). J Endod. 1982; 8(11): 517-20.
4. Walton RE. Endodontic radiographic technics. Dental radiography and photography. 1973; 46(3): 51-9.
5. Hülsmann M. Mandibular first premolar with three root canals. Dental Traumatology. 1990; 6(4): 189-91.
6. Green D. Double canals in single roots. Oral surg, oral med, oral pathol. 1973; 35(5): 689-96.
7. Vertucci FJ. Root canal morphology of mandibular premolars. J Ame Dent Assoc. 1978; 97(1): 47-50.
8. Nakata T. Bifurcated root canals and crown diameter. J Dent Res. 1977; 56: 1425.
9. Patel S, Dawood A, Ford TP, Whaites E. The potential applications of cone beam computed tomography in the management of endodontic problems. Int Endod J. 2007; 40(10): 818-30.
10. Kottoor J, Velmurugan N, Sudha R, Hemamalathi S. Maxillary first molar with seven root canals diagnosed with cone-beam computed tomography scanning: a case report. J Endod. 2010; 36(5): 915-21.
11. Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems *in vitro*. J Endod. 2008; 34(1): 87-9.
12. Alamri HM, Sadrameli M, Alshalhoob MA, Sadrameli M, Alshehri MA. Applications of CBCT in dental practice: a review of the literature. Gen Dent. 2012; 60(5): 390-400; quiz 401-92.
13. Al-Fouzan KS. The microscopic diagnosis and treatment of a mandibular second premolar with four canals. Int Endod J. 2001; 34(5): 406-10.
14. Vertucci FJ, Gegauff A. Root canal morphology of the maxillary first premolar. J Am Dent Assoc. 1979; 99(2): 194-8.
15. Plotino G, Pameijer CH, Grande NM, Somma F. Ultrasonics in endodontics: a review of the literature. J Endod. 2007; 33(2): 81-95.
16. Buchanan LS. Innovations in endodontic instruments and techniques: how they simplify treatment. Dent Today. 2002; 21(12): 52-4, 56-61.
17. Clark D. The operating microscope and ultrasonics; a perfect marriage. Dent Today. 2004; 23(6): 74-6, 78-81.
18. Cantatore G, Berutti E, Castellucci A. Missed anatomy: frequency and clinical impact. Endod Topics. 2006; 15(1): 3-31.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a4

Investigating dental caries rates amongst sentenced prisoners in KwaZulu-Natal, South Africa

SADJ April 2020, Vol. 75 No. 3 p137 - p141

M Radebe[1], S Singh[2]

ABSTRACT

Objective

To establish the prevalence of dental caries amongst KZN sentenced prisoners.

Methods

The frequency and distribution of dental caries were assessed using the DMFT Index (Decayed, Filled, Missing teeth) in non-invasive dental clinical examinations of a sample of sentenced prisoners (n=373) randomly selected from amongst inmates at nine correctional centres located within the eleven health districts in KwaZulu-Natal, South Africa. The recorded data were analysed using SPSS version 24.

Results

The mean DMFT scores were: overall 5.92 (±4.65); 18 to 29 years: 4.14 (±3.49); 30 to 39 years: 6.17 (±4.19); 40 to 49 years: 9.08 (±5.38); older than 50 years: 11.31 (±6.30).

A statistically significant relationship was found between DMFT and age (p-value: 0.000). Decayed Teeth were seen in 64.34% of participants, 71.85% recorded Missing teeth while Filled teeth (FT) were noted in only 8.04% of the study sample.

Conclusion

The results highlight the need to take into account the epidemiological trends in the rates of dental caries when planning oral health services within the KwaZulu-Natal Department of Correctional Services.

Author affiliations:

1. **Mbuyiselwa Radebe:** *Bachelor of Dental Therapy (UDW); MBA (MANCOSA); Dip Project Management (DAMELIN),* PHD Graduate: Discipline of Dentistry, School of Health Sciences, University of Kwa Zulu-Natal, Durban, South Africa.
   ORCID Number: 0000-0001-7201-1524
2. **Shenuka Singh:** *B.OH (UDW), M.Sc. [DENT], PhD (UWC), PG Dip Health Res Ethics (Stell),* Associate Professor, Discipline of Dentistry, School of Health Sciences, University of KwaZulu-Natal, Durban, South Africa.
   ORCID Number: 0000-0003-4842-602X

Corresponding author: Mbuyiselwa Radebe
Postal address: Discipline of Dentistry, School of Health Sciences, University of KwaZulu-Natal; Private Bag X54001, Durban, 4000.
Tel. no.: +27 (0)31 373 5800
Email: mbuyiselwar@dut.ac.za

Author contributions:

1. **Mbuyiselwa Radebe:** Principal Researcher, write up - 75%
2. **Shenuka Singh:** Supervisor, review and revision of write up - 25%

ACRONYMS

DCS: Department of Correctional Services
KZN: KwaZulu-Natal

INTRODUCTION

The target groups in most oral health reviews conducted worldwide have been children, youth and adults from the general population.[1] Several epidemiological studies suggest inequalities in the oral health of poor families and disadvantaged groups of individuals with 'special' healthcare needs.[2] Among these are prisoners, whose health is of considerable concern especially as the number of the individuals under the jurisdiction of correction systems, including those on probation or parole, keeps on expanding.[1,3]

Prisoners are more likely to have disadvantaged backgrounds or to have come from areas with increased levels of social exclusion, with a high proportion being jobless prior to sentencing.[4] As a result, their oral health requirements at admission may be particularly high with a significant amount of unmet treatment needs.[4,5] In addition, the facilities available in prisons may not be at an acceptable level.[6]

In South Africa, the Department of Correctional Services (DCS) recorded in the 2015/2016 financial report that the total inmate population was 161 984, with accommodation capacity (bed-space) of 119 134, translating to an occupancy rate of 135.96%.[7] Of these, 72.06% were sentenced prisoners and 27.94% were as yet un-sentenced. Indubitably, correctional centres across the country are overcrowded.[7] Currently, in the KZN region, there are 42 correctional centres which are located in eleven district municipalities.

The only available dental research involving sentenced prisoners in South Africa is a baseline survey which was conducted at Western Cape correctional centres.[8] This survey aimed to collect information on oral health status, knowledge, attitudes and behaviour of inmates to oral health.[8]

The DMFT index recommended by the World Health Organization was created in 1938 by Klien, Palmer and Knutson to express caries experience.[9,10] The D component is for untreated caries, M for missing teeth (likely due to caries) and F for fillings (dental restorations

for treatment of caries). The T means index per tooth (as opposed to S, per surface). The recommended protocol for oral health surveys is based on clinical examinations only and excludes dental radiographs. Radiographs can contribute provide additional information to epidemiologic data.[11] While there have been calls for the DMF index to be replaced, this index remains the most commonly used epidemiological tool for assessing dental caries.[12]

To date, there has been no official information or figures reported on the prevalence of dental caries amongst inmates in KZN Correctional Service Institutions. Despite improvements in oral health, disparities still exist and are more prominent in deprived groups, particularly prisoners.[3]

Compared with the general population, the oral health status of sentenced prisoners is poor.[5] The current study was therefore designed to determine the oral health status and to establish the prevalence of dental caries amongst sentenced prisoners in KwaZulu-Natal correctional centres through a DMFT survey.

METHODS

The subjects in this cross-sectional descriptive study were drawn from the population of sentenced prisoners incarcerated in correctional centres located in the following KZN districts: Zululand, uMzinyathi, uThukela, uMgungundlovu, iLembe, eThekwini, Ugu, and Sisonke.

The Biomedical Research Ethics Committee of the University of KwaZulu-Natal (BE046/15) approved the study and ethical guidelines were followed to ensure confidentiality in the management of data. Gatekeeper permission was obtained from the Department of Correctional Services Research Ethics Committee. Statistical advice was sought by consultation with a statistician.

The annual DCS report for the 2015/2016 financial year indicated that the total number of sentenced prisoners in KwaZulu-Natal (inmate population) was 21 899. The number of sentenced prisoners required to offer an appropriate sample was determined using a power calculation garnered from the Business Advocacy Network, 2012.

$$n = \frac{N}{1+N(e)2}$$

$$n = \frac{21899}{1+21899(5\%)2}$$

$$n = 393$$

A simple random sampling method was used to select the study participants. A total of 393 sentenced prisoners aged 18-75 years were approached and provided with clear explanations about the aim of the survey and the dental examination. Finally, 373 consented to participate in the study, giving a response rate of 95%.

General demographic information data, which included variables such as gender and age of the participants, were collected by the researcher. Each participant had to undergo a non-invasive dental examination, conducted following the guidelines of the WHO (1997) oral health survey[10] to determine the prevalence of dental caries.

Each participant was requested to sit comfortably on an ordinary chair with a backrest. Visual and visuo-tactile methods were used to assess the presence of dental caries in the oral cavity. DMFT index scores were collected and recorded on a pre-designed data capturing sheet.

Radiographic examination was not undertaken. After the oral examination, participants were escorted by wardens back to their respective cells. Testing intra-examiner reliability was facilitated by repeating every fifth completed oral examination, in accord with World Health Organisation standards for oral health surveys.[10]

The repeated scores were compared for consistency in identifying carious lesions and in recording the data. Recorded data from the sample were transferred onto the Excel spreadsheet and then exported to the SPSS version 24. Descriptive statistics (standard deviation, frequency distribution, and measures of central tendency) were calculated for the variables age, gender, and DMFT of the prisoners.

To determine if there were statistically significant differences between variables, Pearson's chi-square tests were used and statistical significance was noted only when the p-value was less than 0.05.

RESULTS

Of the 373 sentenced prisoners who consented to participate in the study, males were in the majority at 89.28% ($n = 333$) and there were 40 females (10.72%).

Two hundred and eleven participants (56.6%) were incarcerated in correctional centres located in urban areas, one hundred and seven participants (28.7%) in peri-urban areas and fifty-five (14.7%) in rural areas.

Figure 1 illustrates the distribution of sentenced prisoners according to age and gender.

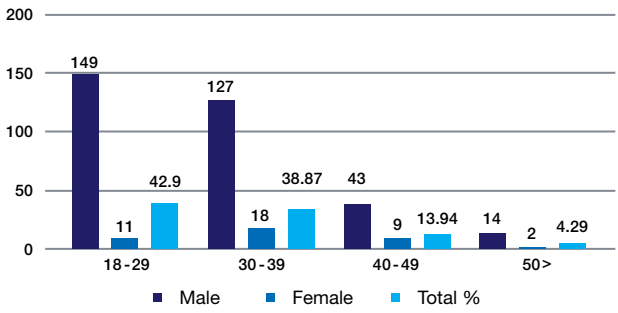


Figure 1. Distribution of sentenced prisoners by age and gender.

The distribution of the mean DMFT (Decayed, Missing, and Filled Teeth) indices among different age groups is shown in Table 1.

The mean DMFT score for the 18 to 29 years age group was 4.14 (+3.49), for age group 30 to 39 years

the mean was 6.17 (+4.19); the 40 to 49 years group recorded a mean of 9.08 (+5.38) and for participants older than 50 years the mean was 11.31 (+6.30). The overall mean DMFT was 5.92 (+4.65). Pearson's chi-square test indicated that there was a statistically significant relationship between DMFT and age (p-value: 0.000).

Table 2 shows the prevalence of dental caries among prisoners in different age categories. Overall, the results indicated that more than two-thirds of the study population had decayed teeth (n=240, 64.34%) while missing teeth (M) were recorded in 268 participants (71.85%). Only 30 participants (8.04%) had any fillings (F).

The distribution of mean DMFT scores by Centres and Districts is illustrated in Table 3. In general, there was a reasonably close agreement between related Centre and District scores. The mean DMFT scores for the districts ranged from a low of 4.72 (iLembe) to a high of 7.29 (Ugu). The mean DMFT scores for Correctional Service Institutions ranged from 4.09 (Westville Medium B) to 7.83 (Westville Medium C).

The M component contributed most to the DMFT values followed by dental caries prevalence, the D component. The mean score of missing teeth was slightly higher amongst older age groups, whereas Decay was mostly seen amongst younger age groups.

The caries experience amongst study participants ranged from 52.50% (Westville Medium E) to 82.71% (Port Shepstone). The overall prevalence of missing teeth varied from 55.56 % (Kokstad) to 80.43% (Westville Medium C).

The lower jaw dentition of most sentenced prisoners suffered a higher incidence of untreated caries compared with the upper dentition (number of teeth affected by caries: 472, lower dentition vs 380, upper dentition).

Similarly, the lower jaw dentition had a higher number of missing teeth compared with the upper dentition (694 vs. 572). The mean DMFT was highest in the Pietermaritzburg (7.07) and Port Shepstone regions (7.29) and lowest in the Stanger region (4.72).

DISCUSSION

Participants were stratified into sub-groups, differentiated according to gender and age. Unsurprisingly, a comparative quantitative analysis of the gender composition of the study sample revealed that males were significantly over-represented amongst the sentenced prisoners.

The literature suggests that men commit a much higher percentage of serious and violent crimes, leading to their arrest and imprisonment, often for longer periods.[13]

Table 1. Distribution of the mean DMFT indices among different age groups of the sentenced prisoners.

Age Group	18-29 years		30-39 years		40-49 years		50> years		Total		p-Value
No:	n = 160		n = 145		n = 52		n = 16		n = 373		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
DMFT	4.14	3.49	6.17	4.19	9.08	5.38	11.31	6.30	5.92	4.65	0.000
D	3.66	2.32	3.97	2.57	4.06	2.78	3.94	2.79	3.85	2.50	0.211
M	1.89	2.24	3.53	3.20	6.10	5.64	8.44	6.95	3.39	3.94	0.000
F	0.14	0.68	0.30	1.26	0.54	1.74	0.50	1.41	0.27	1.15	0.420

Table 2. Count of decayed, missing and filled teeth among sentenced prisoners.

Variables	18-29 years		30-39 years		40-49 years		50> years		Total	
No:	n = 160		n = 145		n = 52		n = 16		n = 373	
	n	%	n	%	n	%	n	%	n	%
Decayed Teeth	102	63.75	96	66,21	32	61,54	10	62,5	**240**	**64,34**
Missing Teeth	88	55	119	82.07	45	86.54	16	100	**268**	**71.85**
Filled Teeth	8	5	12	8.28	8	15.38	2	12.50	**30**	**8.04**

Table 3. Distribution of mean DMFT by Districts and Centres.

District	Correctional Centres	Rural/Peri-Urban/ Urban	Mean DMFT (Centre)	Mean DMFT (District)
Uthukela	Ladysmith	PU	5.83	5.83
Umzinyathi	Pomeroy	R	5.97	5.97
Umngungundlovu	Pietermaritzburg	U	6.82	7.07
	New Hanover	R	7.31	
eThekwini	Westville Medium B	U	4.90	5.66
	Westville Medium C	U	7.83	
	Westville Medium D	U	4.09	
	Westville Medium E	U	5.83	
Sisonke	Kokstad	PU	5.11	5.11
Zululand	Vryheid	PU	5.91	5.91
Ugu	Port Shepstone	U	7.29	7.29
iLembe	Stanger	PU	4.72	4.72

Analysis of the DMFT components reflected the generational differences, indicating a steeper gradient in older age groups particularly in the M (missing teeth) component. This finding could indicate that dental extractions were the only clinical procedure performed in these institutions.

Supporting this view, Singh et al.[14] asserted that in KwaZulu-Natal the focus is currently on curative rather than preventive services, with a priority not given to oral health in budget allocations.[14] These high levels of missing teeth require further research to determine the need for oral rehabilitation.

The present study recorded a comparatively low prevalence of DMFT in contrast with the study conducted in Western Cape correctional institutions.[8] Many factors may have contributed to the differences in the severity of dental caries between the Western Cape and KwaZulu-Natal, but it is suggested that the different fluoride concentrations in the potable water of these provinces may be a confounding variable which could have influenced the disparities in DMFT prevalence.

The levels of fluoride in potable water in the Western Cape are much lower than the optimal level required to prevent the formation of cavities,[15] whilst KwaZulu-Natal has generally higher fluoride concentrations in drinking water, possibly resulting in some protection against decay.[16] Clear evidence exists that fluoride toothpaste application is efficacious in preventing caries.[17]

Perversely, South African sentenced prisoners are permitted to receive only one tube of (fluoridated) toothpaste for a two-month period.[18] This is a clear indication that access to materials for dental care in correctional centres is limited.[19] A scarcity of self-care items such as toothbrushes and dental floss limits preventive measures and could lead to tooth extractions as being the more viable option for pain relief.[20,21]

Limitations

Although findings from this study have important practical and political implications, several limitations should be noted, the primary limitation being the cross-sectional design.

The current study provided a snapshot of dental caries prevalence amongst sentenced prisoners in KZN correctional institutions. As a result, it was difficult to draw any causal inference.

Another limitation identified in this study was a lack of dual-diagnosis in the identification of dental caries. Therefore, there was a possibility of under-diagnosis of proximal lesions. Despite these limitations, the current findings serve as baseline data for sentenced prisoners in the correctional institutions in KZN. This survey demonstrated that dental caries rates were high in the study population. The findings of this study could prove valuable to oral health professionals and to the Department of Correctional Services for developing effective oral health and oral care programmes for incarcerated populations.

CONCLUSION

Given the high prevalence of dental caries in sentenced prisoners, there is need to review the current oral health services for this population to ensure that preventive programmes are prioritized in oral health planning for correctional service institutions.

Declaration

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgments

The authors would like to express their sincere appre--ciation and gratitude to the Department of Correctional Services for their assistance during this research project and would like to thank all the participants in the study who showed much enthusiasm and co-operation.

References

1. Nobile CGA, Fortunato L, Pavia M, Catanzaro IF. Oral health status of male prisoners in Italy. International Dental Journal 2007. 57: 27-35.
2. Gibson G, Rosenheck R, Tullner JB, Grimes RM, Seibyl CL, Rivera-Torres A. A national survey of the oral health status of homeless veterans. J Public Health Dent. 2003; 63: 30-7.
3. Jones CM, Woods K, Neville J, Whittle JG. The dental health of prisoners in the North West England in 2000: Literature review and dental health survey results. Community Dental Health 2005; 22: 113-7.
4. George B. Prosthetic status and treatment needs of prisoners in Central Prison, Chennai. The Journal of the Indian Prosthodontic Society. 2013; 13(3): 265-8.
5. Treadwell HM, Formicola AJ. Improving the oral health of prisoners to improve overall health and well being. American J Public Health 2005; 10:1677-8.
6. Heng CK, Morse DE. Dental caries experience of female inmates. J Public Health Dent. 2002; 62: 57-61.
7. DCS. Annual Report 2015/2016 Financial Year. Depart ment Correctional Services, Republic of South Africa. 2016.
8. Naidoo S, Yengopal V, Cohen B. A baseline: Oral health status of prisoners in Western Cape. SADJ. 2005; 60: 24-7.
9. Mehta A. Comprehensive review of caries assessment systems developed over the last decades. RSBO 2012; 9(3): 316-21.
10. WHO. Oral Health Survey: Basic Methods. World Health Organisation. 1997.
11. Eslamipour F, Borzabadi-Farahani A, Asgari I. The relationship between aging and oral health inequalities assessed by the DMFT index. European Journal of Paediatric Dentistry 2010;11 (4):193-9.
12. Broadbent JM, Thomson WM. For debate: problems with the DMF index pertinent to dental caries data analysis. Community Dentistry and Oral Epidemiology 2005; 33(6): 400-9.
13. Loesche D. The prison gender gap. Statistica.com/chart/11573/Gender of inmates in US Federal prisons and general population. October 23, 2017.
14. Singh S, Myburgh NG, Lalloo R. Policy analysis of oral health promotion in South Africa. Global Health Promotion. 2010; 17(1): 16-24.
15. Mohamed N. Fluoride: to supplement or not. Health 24. Oral Health. 2016. health 24.com/medical/oral health/dental care/Fluoride-to-supplement-or-not-2012721.

16. Ramjatan A, Ahmed F, Hodgson K, Simpson D, Quinn N. The Potential Impacts of Water Fluoridation: A Case Study of the Umgeni Water Operational Area, KwaZulu-Natal. WISA 2000 ; 28 May – 1 June 2000; Biennial Conference, Sun City, South Africa 2000.
17. Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. 2003.
18. SAHRC. The National Prisons Project of the South African Human Rights Commission. South Africa: SAHRC; 1998.
19. Harvey S, Anderson B, Cantore S, King E, Malik F, Bedi R. Reforming prison dental services in England. A guide to good practice. Health Education. 2005; 64 (4): 1-39.
20. Rodrigues ISAA, Silveira ITdM, Pinto MSdA, Xavier AFC, de Oliveira TBS, de Paiva SM, et al. Locked Mouths: Tooth Loss in a Women's Prison in Northeastern Brazil. The Scientific World Journal. Volume 2014 article id 58-7469 https://doi.org/10.1155/2014/587469.
21. WHO. The World Health Report 2008. Primary health care - now more than ever. Geneva, Switzerland: World Health Organization. 2008.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a5

A suggested intentional extraction of a wisdom tooth: Implies capacity for prosocial behaviour in *Homo erectus*

SADJ April 2020, Vol. 75 No. 3 p142 - p148

U Ripamonti[1], JW Hoffman[2], C Ferretti[3], LC Roden[4]

ABSTRACT

Paleopathological assessment of a fossilized mandibular fragment (SK 45) of *Homo erectus*, unearthed at Swartkrans, South Arica, shows new bone formation within the alveolus of the third molar (M3), indicating that the individual lived after loss of that tooth.

As there is no evidence of mandibular maxillofacial damage compatible with acute traumatic expulsion of the tooth, it is possible that M3 was intentionally removed. Evidence of bone formation within the socket is supported by a density map of voxel values, representative of the atomic numbers of bone and breccia, constructed by microfocus scanning X-ray tomography (µCT).

The newly formed material within the M3 alveolus has values less than the alveolar bone proper but which are significantly greater than breccia, indicating that the material is regenerating bone, and pointing to the possibly intentional extraction of M3.

How this was done and whether it was effected by the individual concerned or with the aid of community members, remains in the realms of speculation. The latter is more likely and may be an indication of the early origin of prosocial behaviour at the Plio-Pleistocene boundary, resulting in a concerted action of the Homo clade to assist an individual in severe distress.

Keywords

Homo erectus, Swartkrans, SK 45 mandibular remains, wisdom tooth, intentional extraction, alveolar bone regeneration in hominine evolution, prosocial behaviour.

Author affiliations:

1. **Ugo Ripamonti:** *MD, DDS, MDent, MFS, PhD (Med),* Bone Research Unit, University of the Witwatersrand, Johannesburg, School of Clinical Medicine - Internal Medicine, Faculty of Health Sciences, 7 York Road, Parktown 2193, South Africa.
   ORCID Number: 0000-0002-6567-3594
2. **Jakobus W Hoffman:** *BSc (Hons),* South African Nuclear Energy Corporation (Necsa), South Africa.
3. **Carlo Ferretti:** *BDS, MDent, FCD (SA) MFOS,* Bone Research Unit, University of the Witwatersrand, Johannesburg, School of Clinical Medicine, Faculty of Health Sciences, Parktown, South Africa and Department of Maxillo-Facial and Oral Surgery, University of Pretoria, South Africa.
   ORCID Number: 0000-0002-8862-391X
4. **Laura C Roden:** *BSc, (Hons), PhD,* Bone Research Unit, University of the Witwatersrand, Johannesburg, School of Clinical Medicine, Faculty of Health Sciences, Parktown, South Africa and School of Life Sciences, Faculty of Health Sciences, Coventry University, Coventry, CV1 2DS, UK.

Corresponding author: Ugo Ripamonti
School of Clinical Medicine, Faculty of Health Sciences, 7 York Road, Parktown 2193, South Africa.
Email: ugo.ripamonti@wits.ac.za

Author contributions:

1. **Ugo Ripamonti:** Conceptualised study, carried out data analyses, co-wrote manuscript - 50%
2. **Jakobus W Hoffman:** Carried out Microfocus scanning X-ray tomography and data analyses, contributed to manuscript - 20%
3. **Carlo Ferretti:** Contributed to manuscript - 10%
4. **LC Roden:** Data analyses and co-wrote manuscript - 20%

INTRODUCTION

Clearly, medical and surgical procedures at the Early Pleistocene boundary are unknown and the subject of speculative reasoning only.

One of the behavioural traits of *Homo sapiens* that separates us from our closest primate relatives, and, some paleontologists believe, from early hominins, is that of compassion and pro-social emotions that promote behaviour which will benefit another.[1]

Fossil specimens indicating survival of individuals with severe ante-mortem traumas[2] and tooth loss[3,4] have been interpreted as evidence of compassion and conspecific care in early hominins. However, comparative analyses advise caution in these interpretations as similar disabilities have been observed in non-human primates who have survived without nonspecific care.[5,6]

Unlike the virtually edentulous Dmanisi specimen which displayed extensive ante-mortem tooth loss and extensive alveolar remodelling and atrophy (specimens D3444 and D3900),[4] SK 45 retained M1 and M2, surviving the loss of M3. The survival of the Dmanisi individual for many years after the loss of most of its teeth was attributed to altered diet or care by other individuals.[4]

The concept of 'behavioural modernity' or 'human uniqueness' is an issue which drives the study of human evolution beyond the basic comparison of fossil morphology to seeking an understanding of our origins.

The social behaviour of early Homo species is problematic to measure or envisage as direct evidence is not preserved. Foley and Gamble[7] considered paleontological and archaeological evidence in the context of changing climate and selective pressures to make inferences about human-specific behavioural changes that may have lead to the evolution of 'human society'.

At the Early Plio-Pleistocene boundary (2-1.5 million years Myr B.P.) the inclusion of meat in early *Homo* diet would have provided for a lower seasonal variation in food availability.

Significantly in societal evolutionary terms this relative security promoted a delayed life-history strategy, allowing greater bonding between males and females,[7] and perhaps also between members of the social group. This period was also characterized by the use of tools for hunting, gathering and food preparation, evidence of this gathered from multiple sites including Swartkrans cave, South Africa.[7-11]

Was it at this transition in the social history of Homo that a 'theory of mind' was developed, allowing social engagement with orders of intentionality?[12] Our purpose here is to provide a detailed description of the analytical examination of SK 45, supporting the possible intentional extraction of M3 and thus offering paleopathological and paleobiological evidence for an early origin of pro-social behaviour to relieve pain in another amongst *Homo erectus* at Swartkrans, South Africa.

MATERIALS AND METHODS

Mandibular fossil SK 45, confined on evolutionary and faunal grounds to 1.5 – 1.2 million years before the present (Myr B.P.),[13,14] was unearthed at Swartkrans cave, Krugersdorp, South Africa, and described in detail by Broom and Robinson[15] and Robinson.[16]

Originally designated as belonging to species *Telanthropus capensis*, the specimen was later attributed to *Homo erectus*.[17,18] SK 45 is from an adult individual of *Homo erectus* and consists of the right mandibular fragment with molars 1 (M1) and M2 (**Figs. 1A, 1B**). SK 45 is housed at the Ditsong National Museum of Natural History, Pretoria.

Microfocus scanning X-ray tomography

Scans of SK 45 were initiated with 1000 X-ray projections in 360° using a Nikon XT H 225 System which is housed at the MIXRAD facility at the South African Nuclear Energy Corporation (NECSA).[19] Full-view scans of the whole sample as well as scans focused on the region of interest (the alveolus of M3 distal to M2) were performed at 140 kV and 70 µA which allowed for a spatial resolution of 34 µm. The reconstruction process transformed the 2D projection images into a 3D rendering which was analyzed in volume rendering software (VGStudio MAX, Volume Graphics GmbH, Heidelberg, Germany).

A density map of voxel values representative of the atomic numbers of different materials within the specimen was constructed using µCT. Several rectangular areas were sampled independently on different dates and examined in reformatted sagittal images to determine a densitometry map across the newly formed material in the alveolus of M3 (**Fig. 2C**), the mandibular bone adjacent to the alveolus (**Fig 2**), as well as breccia evidenced coronal to the residual bony housing of M1 and M2 (**Figs. 1B, C, D**) and through the furcations of M1 and M2.

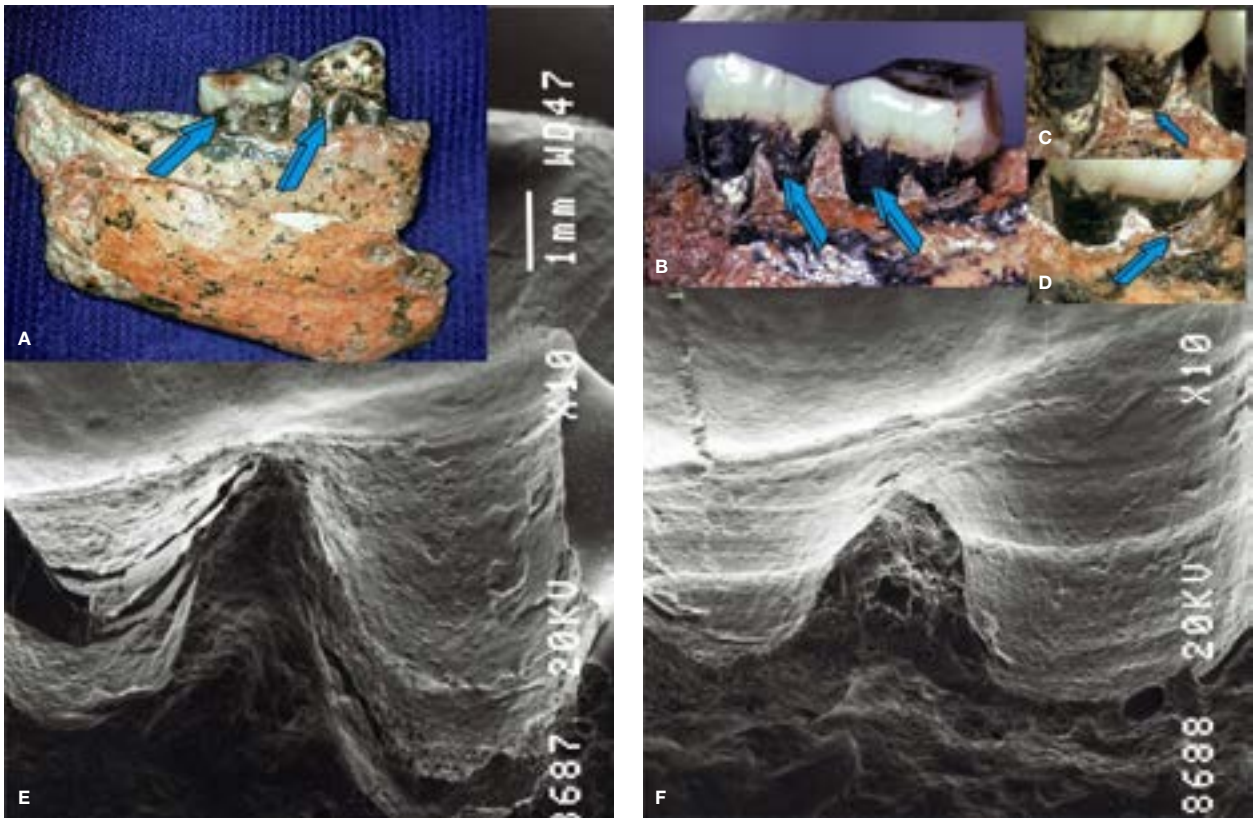


Figure 1. Buccal (**A**), and lingual (**B, C** and **D**) views of SK 45 mandibular fragment of *Homo erectus* highlighting significant vertical bone loss affecting M1 and M2 (light blue arrows) with Class II furcation defects of the affected molars. Arrows in **C** and **D** indicate the remaining alveolar bony housing. (**E, F**): Scanning Electron Macrographs (SEM) of the buccal aspect of M1 and M2 showing the severe alveolar bone loss and Class II furcation exposure of the affected molars.

Scanning Electron Microscopy

After cleaning M1 and M2 with acetone, vinyl polysiloxane impression material (3M Express®, Regular Set, type 1 very low viscosity) was applied to the buccal surfaces of SK 45.

A mixed base and catalyst putty of vinyl polysiloxane (type 1 very high viscosity), previously set in a tray contoured for SK 45, was adapted over the low viscosity material to allow optimal surface distribution and penetration, particularly within the exposed furcations of SK 45.

The negative replica was mounted on a SEM aluminum tub, coated with gold palladium and examined using a JEOL scanning electron microscope.[20] The replicas provided positive and reliable images (**Figs. 1E** and **F**) with no indication of distortion up to 250X.[20]

RESULTS AND DISCUSSION

The specimen from an adult *Homo erectus* individual consists of the right mandibular fragment with M1 and M2 *in situ* (**Figs. 1A, B**) and showing severe attrition of the occlusal surfaces. It will be observed that SK 45 suffered from periodontitis as evidenced by the severity of alveolar bone loss with buccal and lingual furcation exposure (**Fig. 1**).

Loss of alveolar bone, as measured with a periodontal probe from the cemento-enamel junction to the remaining bony housings extended from 4 to 8 mm with severe bone loss lingually (**Figs. 1A, B, C, D**).

The extent of bone loss and furcation exposure, now filled with calcite and breccia (**Figs. 1A, B, C, D**) is pronounced when measured from the cementoenamel junctions of both mandibular molars (**Figs. 1A, B, C, D**).

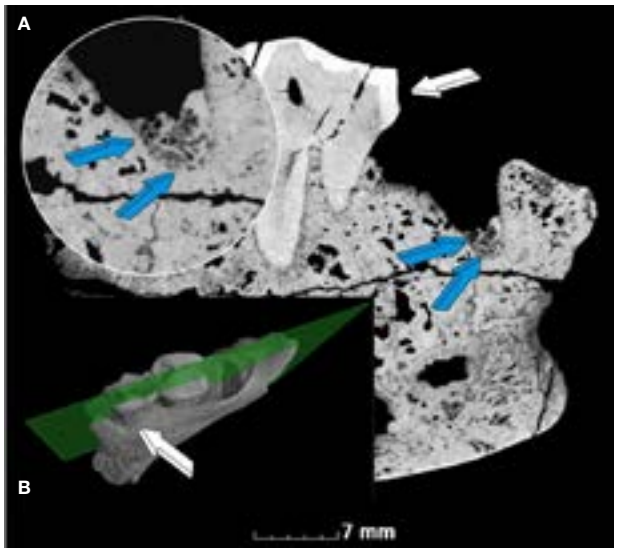


Figure 2. Sagittal µCT reformatted images of SK 45 across the molar area as shown in the 3D virtual image A, analyzing the alveolar bony housings of M2, M3 and the alveolus of the missing M3. White arrow in A indicates the enamel contact point of M2 with the over-extruded and tilted M3. White arrow in B points to severe lingual bone loss affecting the M1 mesial root. Blue arrows in B and C indicate the profile and the well preserved tissue boundaries of the alveolus of M3 (**C** inset) containing mineralized material interpreted as newly generated bone after M3 avulsion.

Exposure was confirmed by non-invasive micro focus X-ray computed tomography (µCT) analyses (**Fig. 3C**).[19] The digitized µCT scan images (**Fig. 2**) reveal the identifiable outline of the M3 alveolus filled with incompletely remodelled but mineralized bone (**Fig. 2B, C**). The 2D projection images were transformed into a 3D rendering (**Fig. 3A**) which shows the alveolus of M3 (**Fig. 3B**).

According to Robinson,[16] M3 could not have exceeded 10.5 mm in length. µCT analyses show that the root was conoidal and distally located (**Fig. 2B**). The tomographic image also shows the occlusal contact point of the previously housed M3 with the distal enamel surface of M2 (**Figs. 2B** white arrow; **3B** light blue arrow).

The retro-molar area shows the regenerating alveolar bone within the alveolus of the missing M3 (**Figs. 2B, C** light blue arrows). Wisdom teeth are often extracted in extant *Homo sapiens* due to painful infections, particularly when the tooth is partially erupted.

In Homo, impaction and misalignment of M3 has also been ascribed to the reduction of the mandibular body during evolution and speciation of the Homo clade at the Early Pleistocene boundary.[16,21] The implication of possible third molar impactions in the hominid fossil record has also been discussed.[22]

Differential diagnosis to determine the cause of M3 loss must include avulsion following severe trauma. However, in the absence of a mandibular fracture an avulsion of a third molar is not feasible and as no evidence of mandibular fracture is seen in SK 45 we may safely discount traumatic avulsion as a cause.

Neither gross nor µCT analyses support traumatic loss, particularly because of the substantial remaining alveolar bone outlining the remaining alveolus (**Figs. 2B, C**).

A further possibility is spontaneous exfoliation following a protracted course of periodontal disease. This scenario is also less likely as this is a protracted event, with ossification and mineralization occurring as the tooth slowly

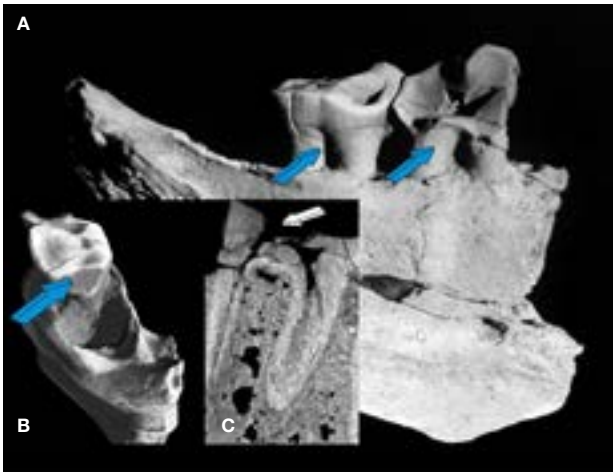


Figure 3. (**A, B**) virtual volume of SK 45 *Homo erectus*. Light blue arrows in (**A**) point to the evidence of periodontal bone loss with substantial furcation exposure; (**B**), occlusal distal view of the alveolus of the missing M3 with the enamel contact point of M2 (arrow). (**C**), sagittal µCT image of M1: (white arrow) indicates severe wear of the enamel with pulp exposure of the mesial root.

exfoliates, eliminating the radiographic picture of a clearly identifiable socket. The radiographic remnant would be a completely healed alveolus without vestiges of the socket.

In addition, the rather large triangular space between the distal root of M2 and the alveolus was likely to have been covered by gingivae which probably also covered most of M3. The presence of such alveolar anatomical structures makes the expulsion or the acute exfoliation of the tooth very unlikely.

Importantly, the presence of a well-defined alveolus as seen by µCT scans with a distinct corticalized bone profile on M3 makes it very unlikely that the periodontal pathology affecting M1 and M2 (Figs. 1A, 1B) would have caused acute periodontal episodes to induce the spontaneous exfoliation of M3. Another possibility is the post-mortem loss of M3 following precipitation of the mandible in the cave deposits of Swartkrans or later during fossilization.

To further investigate the material present within the M3 alveolus, the density map of voxel values representative of atomic number of different materials, constructed using µCT revealed voxel values (±standard error) of the mandibular alveolar bone proper (30250±461), breccia (27018±469) and the M3 alveolar region of interest (28792±930) (Figs. 2B, 2C). These are all statistically significantly different from each other ($p < 0.005$) as was shown in a two tailed Welch's t-test. While the voxel values of the material within the alveolus of M3 are less dense than the alveolar bone ($p = 0.047$), the material is however denser than the breccia ($p = 0.0006$). The differences in density and thus the degree of mineralization of the examined bone and breccia area suggests that the material within the alveolus of M3 may be regenerating alveolar bone.

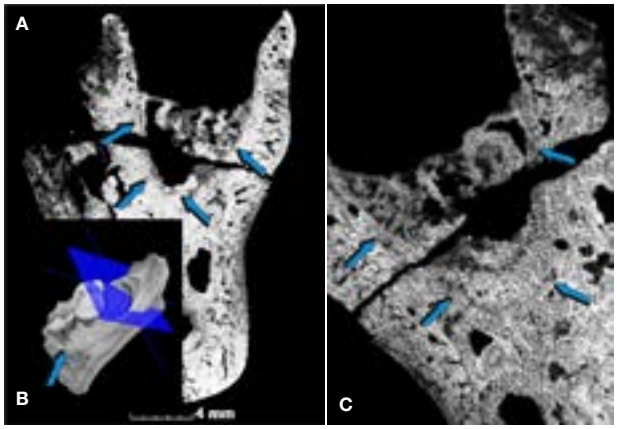


Figure 4. Coronal tomographic reformatted images of SK 45 through the alveolus of M3.

A). 3D tomogram of SK 45 indicating the location of the coronal tomographic reformatted images and the remaining lingual alveolar bony housing: M1 is affected by severe furcation exposure with pronounced mesio-lingual alveolar bone loss (arrow) of the mesial root of M1.

B). Reformatted image as representative of the coronal plane shown blue in A.

C). Coronal reformatted image more distally located and slightly more disto-mesially oriented across the alveolus. Arrows in B and C show the preserved and maintained boundaries of the alveolus with the surrounding mandibular bone, indicating that the mineralized material within the alveolus is not breccia but regenerated alveolar bone after the avulsion of M3; this is also supported by the difference in densitometric grey values as compared to breccia material (see text).

Density maps of voxel values were repeated at different times, and the voxel values of the mandibular alveolar bone proper, breccia and of the region of interest were: 18780±207.14, 16309±296.16 and 17373±72.78 confirming the previous data taken at different regions of interest across different tomograms of the specimen.

The data recorded at different sites from multiple measurements at different time-points show that the region of interest within the alveolus of the missing M3 is statistically different from breccia. The voxel values of the region of interest are also significantly different from the measures of alveolar bone and show smaller values. This indicates that the region of interest is partially filled with mineralizing newly formed bone.

Statistically significant differences do exist between the fossilized regions which were examined, including the region of interest. However, voxel values are often considered unreliable when differences are not truly major, even though statistically significant, particularly when highly fossilized specimens are evaluated. SK 45 fits that context. It may be pertinent that voxel values were also different when measured at different time points.

The first measurements as reported above of voxel grey values are merely representations of the density on a 16-bit grey scale; values were obtained by simply opening the data in the software package VGStudio Max 3.2. Subsequent measurements were designed to maximize the effect of different voxel grey values. The sample data was re-imported into the software with a calibration procedure where the background grey values and highest density material grey values were explicitly specified.

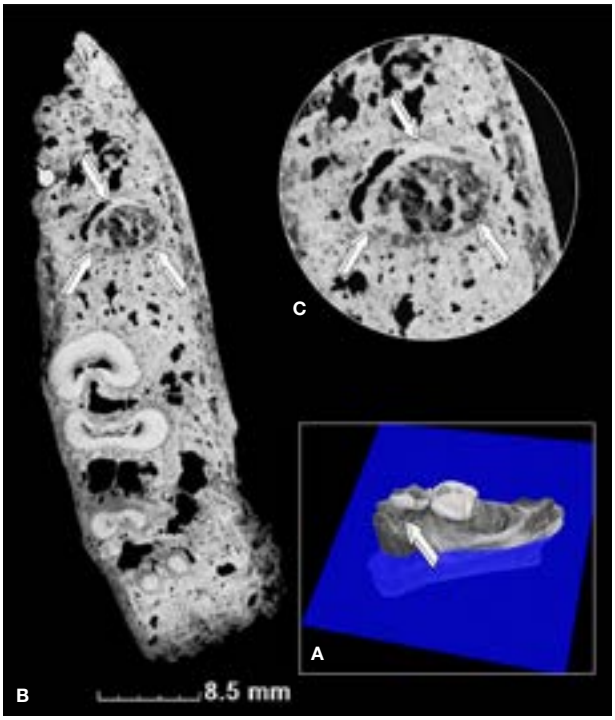


Figure 5. Transverse µCT slice images of SK 45. A, 3D virtual image indicating the location of the transverse tomographic slice as shown in B depicting the severe furcation exposure with alveolar bone loss (arrow) of M1. B, C, Transverse µCT slice images of the alveolus of M3 showing the maintained and well-preserved boundaries (arrows in B and C) of the mineralized material, interpreted as bone, that had formed within the alveolus with surrounding mandibular bone issue.

These values were specified by selecting a region of interest in a view of the sample and were consequently chosen in air pores within the sample with the enamel visible in the same view. Both operations allowed for the same conclusions regarding the densities of the various regions, which were highly reproducible between sets of measurements.

Progressive mesial to distal coronal tomographic slices of the SK 45 mandible distal to M2 shows the presence of preserved anatomical boundaries within the alveolus (Figs. 4B, C). Sagittal (Fig. 2), coronal (Fig. 4) and transverse (Fig. 5) µCT scan images of the region of interest distally to M2 show in more detail the alveolus of the missing M3 with dense mineralized material within the socket and with continuous preservation of the anatomical boundaries of the alveolus (arrows in Figs. 2, 4, 5).

The tomographic images also present a trabecular-like pattern in the region of interest of the M3 alveolus, noticeably different when compared with the appearance of the breccia deposits.

On axial tomograms (Fig. 5) the newly deposited material presents a well-defined corticalized area of the newly formed bone with trabeculations across the alveolus compatible with (or suggesting) deposition and remodelling (Figs. 5B, C).

For comparative purposes, the other Swartkrans *Homo erectus* mandible, SK 15, was also examined and scanned by µCT. Several teeth are missing in SK 15 anteriorly on both hemi-mandibles. The µCT showed the empty alveolus of the left first premolar (P1) with breccia forming within the alveolus (Fig. 6) and merging with the invading breccia that had formed within the intercortical trabecular area of the mandible (Fig. 6A).

Further mesially, coronal tomographic slices showed the total blending of breccia within the intercortical area with no outlines whatsoever of the empty alveoli after post-mortem loss of the premolars (Fig. 6B).

Finally, differential diagnosis must also include the intentional extraction of M3. The tomographic images of SK 45 (Figs. 2B, 3, and 4) confirm that the use of a straight tool inserted between M2 and M3 with appropriate rotational and lever movements would have allowed extraction of the offending third molar.

Indeed, Fig. 2A shows a depression distal to M2 with indentation of the alveolar bone possibly reflecting the tight insertion with rotational movement of an osteodontokeratic tool being used for the extraction of M3.

In-depth studies on hand morphology, tool-making, tool-using and precision grips of early hominids and Homo species at the Early Pleistocene boundary at Swartkrans have suggested not only the use of tools but also that the tools had precision grips.[23-25] The most likely diagnosis is, therefore, the intentional extraction of M3.

If this diagnosis is correct, why in the life of SK 45 did this molar, which was functional for a long time based on the facet contact point with M2 (Fig. 2B), suddenly became a problematic tooth needing extraction? In extant *Homo sapiens*, long quiescent third molars may cause symptoms either due to acute pulpitis secondary

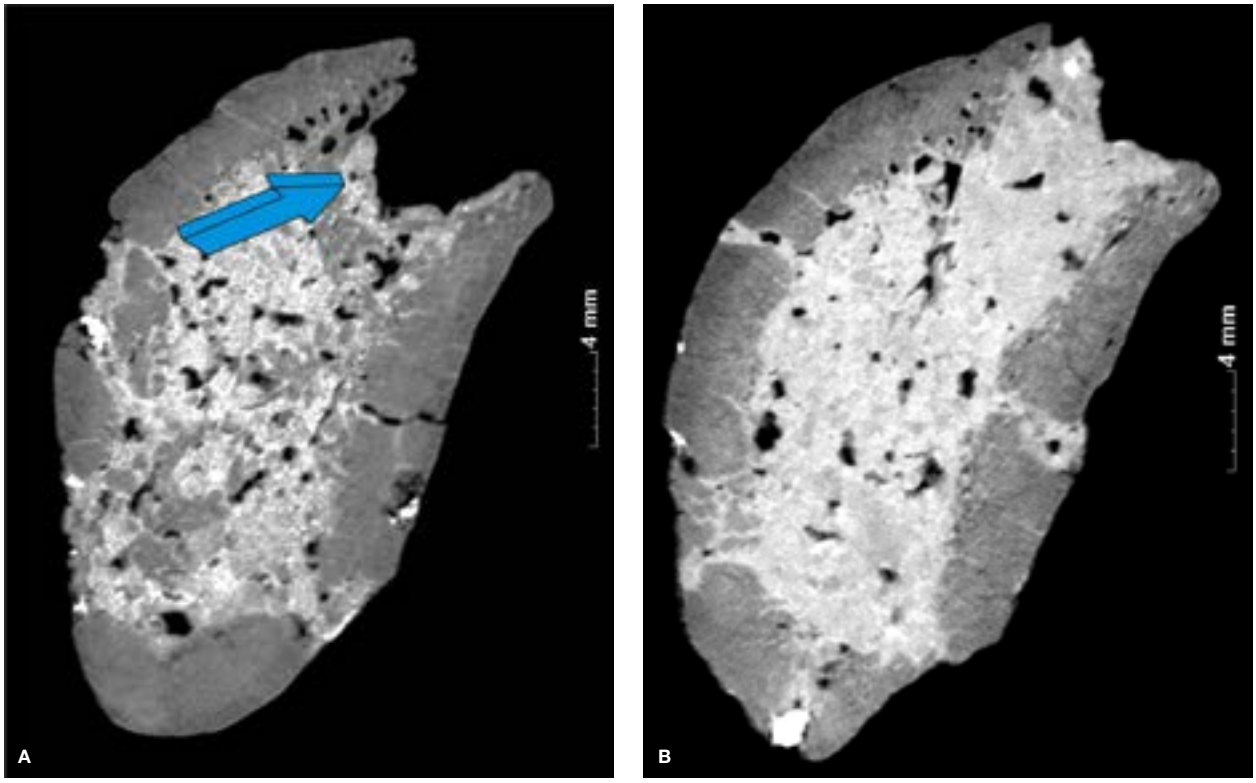


Figure 6. Coronal µCT slices of *Homo erectus* SK 15 mesial to the left M1 showing the alveolus of the missing 2nd bicuspid (arrow A) with some breccia outlining the profile of the alveolus (arrow). (B) further anterior µCT slice to M1 across the edentulous anterior mandible shows breccia penetrating the alveoli and the cortico-cancellous medullary spaces of the body of the mandible, with no evidence of alveolus boundaries.

to decay of a partially erupted third molar or the development of acute pericoronitis. It is thus conceivable that a partially erupted third molar in SK 45 may have become symptomatic.

The angle of the residual socket and the interdental wear facet confirm that M3 was not parallel to M2 (which is the most common relationship in a fully erupted tooth) but rather lying mesioangular and thus likely to have been partially erupted.

The root morphology (single rooted and conical) would also make this tooth less challenging to remove. The paleopathologic evidence of the lost M3 in SK 45, correlated with experience in extant patients, favours the diagnosis of intentional extraction. The hominid SK 45 survived the surgical extraction of M3 as shown by the presence of regenerating bone within the alveolus (Figs. 2B, C).

The hypothesized surgical intervention by the individual or with the assistance of group members would indicate a refined group support and care, suggesting a social community network capable of prosocial acts. This would reflect not only a lack of discrimination but also a strong social cohesion amongst this early Homo species.

The suggestion of a lack of discrimination with possible social integration has been made after the diagnosis of a case of pre-pubertal periodontitis in a juvenile *Australopithecus africanus* specimen.[26]

Tantalizingly, this scenario raises an even more interesting probability: the capacity of the hominids to correlate physical symptoms with anatomical structures, to develop a therapeutic intervention for the resolution of those symptoms and, at the same time, to use a selected tool with precision and power grasping capabilities.

This implies a significantly higher intellectual development than has been considered likely heretofore. The mirror neuron system (MNS), first discovered in non-human primates,[27,28] is activated in an animal in response to the observation of hand or facial gestures in another. The MNS is thought to function in empathy[29,30] which is essential in the development of an altruistic society.[31] Furthermore, the MNS facilitates complex communication through facial expressions and referential vocalizations, in the absence of spoken language.[28,29]

CONCLUSIONS

The presented data indicate new bone formation in the alveolus of a third molar of *Homo erectus*, suggesting an apparent intentional extraction of a wisdom tooth.

This proposal is made on anatomical-pathologic findings as evidenced by µCT ultimately suggesting that *Homo erectus* had not only social structures to assist individuals in discomfort, but also highly evolved problem-solving capacities which extended beyond the development and use of tools for hunting and food preparation.

This supports the idea that the capacity for behavioural variability[32] is a characteristic of more than one hominin species and evolved prior to the origin of *Homo sapiens*. The presented µCT scan images are the first to show induced bone in hominine evolution and speciation at the emergence of the Homo clade.

Acknowledgements

We thank Bona Nyawose and Stephany Potze then of the Ditsong National Museum of Natural History, Pretoria, for cooperation in the examination of SK 45 and SK 15 specimens; F.C. de Beer of Necsa, South Africa, for help with the microfocus X-ray computed tomography; Jean-Claude Petit and Ansuhya Magan for constructive criticism.

The South African National Research Foundation Research Infrastructure Support Programme (NRF-RISP) funded the purchase of the MIXRAD Nikon XT H 225 system: #72310. This work is supported by the University of the Witwatersrand, Johannesburg and by ad hoc grants by the Bone Research Laboratory, School of Clinical Medicine - Internal Medicine, Faculty of Health Sciences.

References

1. Hill K, Barton M, Hurtado M. The emergence of human uniqueness: characters underlying behavioural modernity. Evol Anthropol. 2009; 18: 187-200.
2. Trinkaus E, Zimmerman MR. Trauma among the Shanidar Neandertals. Am J Phys Anthropol. 1982; 57: 61-76.
3. Lebel S, Trinkaus E, Faure M, Fernandez P, Guérin C, Richter D, Mercier N, Valladas H, Wagner GA. Comparative morphology and paleobiology of Middle Pleistocene human remains from the Bau de l'Aubesier, Vaucluse, France. Proc Natl Acad Sci. U.S.A. 2001; 98, 11097–102.
4. Lordkipanidze D, Vekua A, Ferring R, Rightmire GP, Agusti J, Kiladze G, Mouskhelishvili A, Nioradze M, Ponce de León MS, Tappen M, Zollikofer CP. Anthropology: the earliest toothless hominin skull. Nature. 2005; 434: 717-8.
5. DeGusta D. Comparative skeletal pathology and the case for conspecific care in Middle Pleistocene Hominids. J Archaeol Sci. 2002; 29: 1435-8.
6. Hublin JJ. The prehistory of compassion. Proc Natl Acad Sci. U.S.A. 2009; 106, 6429-30.
7. Foley R, Gamble C. The ecology of social transitions in human evolution. Phil Trans R Soc. B. 2009; 364: 3267-79.
8. Blackwell LR, d'Errico F. Evidence of termite foraging by Swartkrans early hominids. Proc Natl Acad Sci. U.S.A. 2001; 98: 1358-63.
9. Brain CK. (Ed.) 1993. Swartkrans: A Cave's Chronicle of Early Man. Transvaal Museum Monograph No. 8.
10. Dart RA. *Australopithecus prometheus* and *Telanthropus capensis*. Am J Phys Anthropol. 1955; 1: 67-96.
11. Wolberg DL. The hypothesized osteodontokeratic culture of the Australopithecinae: A look at the evidence and the opinions. Curr Anthropol. 1970; 11: 23-37.
12. Premack D, Woodruff G. Does the chimpanzee have a theory of mind? Behav Brain Sci. 1978; 1: 515-26.
13. Vrba ES. Chronological and ecological implications of the fossil Bovidae at the Sterkfontein Australopithecine site. Nature. 1974; 250: 19-23.
14. Vrba ES. Some evidence of chronology and paleoecology of Sterkfontein, Swartkrans and Kromdraai from the fossil Bovidae. Nature. 1975; 254: 301-4.
15. Broom R, Robinson JT. Man contemporaneous with the Swartkrans ape-man. Am J Phys Anthropol. 1950; 8: 151-7.
16. Robinson JT. *Telanthropus* and its phylogenetic significance. Am J Phys Anthropol. 1953; 11: 445-87.

17. Robinson JT. The Australopithecines and their bearing on the origin of man and of stone tool-making. S Afr J Sci. 1961; 57: 3-16.
18. Robinson JT. The origin and the adaptive radiation of the Australopithecines. In Kurth G. (Ed.), Evolution und Hominisation. Fischer Verlag, Stuttgart. 1961; 120-40.
19. Hoffman JW, De Beer FC. Characteristics of the Micro-Focus X-ray Tomography Facility (MIXRAD) at Necsa in South Africa. 18th World Conference on Non-destructive Testing http://www.ndt.net/articlewcndt2012/papers/37_wcn-dtfinal00037.pdf
20. Ripamonti U, Petit J-C, Grossman ES. The hard periodontal tissues of the Australopithecinae. Proceedings of the Electron Microscopy Society of Southern Africa.1989; 19: 141-2.
21. Calcagno JM, Gibson KF. In: Kelley, M.A., Larsen, C.S. (Eds.), Advances in Dental Anthropology. Alan R. Liss, New York, 1991; 59-76.
22. Gibson KR, Calcagno JM. Possible third molar impactions in the hominid fossil record. Am J Phys Anthropol. 1993; 4, 517-21.
23. Marzke MW, Shacley SM. Hominid hand use in the Pliocene and Pleistocene: evidence from experimental archaeology and comparative morphology. J Hum Evol. 1986; 15: 439-60.
24. Marzke MW. Precision grips, hand morphology, and tools. Am J Phys Anthropol. 1997; 102: 91-110.
25. Susmann RL. Hand function and tool behaviour. J Hum Evol. 1998; 35: 23-46.
26. Ripamonti U. Paleopathology in *Australopithecus africanus*: a suggested case of a three million-year-old prepubertal periodontitis. Am J Phys Anthropol. 1988; 2; 197-210.
27. Gallese V, Fadiga L, Fogassi L, Rizzolatti G. 1996. Action re-cognition in the premotor cortex. Brain 1996; 119: 593-609.
28. Rizzolatti G, Fadiga L, Gallese V, Fogassi L. Premotor cortex and the recognition of motor actions. Brain Res. 1996; 3: 131-41.
29. Parr LA, Waller BM, Fugate J. Emotional communication in primates: implications for neurobiology. Curr Opin Neurobiol. 2005; 15: 716-20.
30. Rizzolatti G. The mirror neuron system and its function in humans. Anat Embryol (Berl). 2005; 210: 419-21.
31. de Waal FBM. Putting the altruism back into altruism: The evolution of empathy. Annu Rev Psychol. 2008; 59: 279-300.
32. Shea JJ. *Homo sapiens* is as *Homo sapiens* was. Curr Anthropol. 2011; 52: 1-35.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a6

Forensic case book: Mirror image 'selfie' causes confusion

SADJ April 2020, Vol. 75 No. 3 p149 - p151

L Robinson[1], MA Makhoba[2], H Bernitz[3]

CASE REPORT

The body of a decomposed female was found immersed in a water purification plant in a small town. The South African Police Service (SAPS) believed that the body could be that of a person they had been searching for since the missing person report was filed.

Following an autopsy by a forensic pathologist, the forensic odontology team at the University of Pretoria was requested to review the case, as the deceased was noted to have had dental treatment. The warrant officer involved in the case was able to supply two photographs ('selfies') as the only ante-mortem records.

Intra-oral radiographs and digital photographs were taken of the maxillary and mandibular dental arches (Figures 1-2).

Full dental charting with the completion of an odontogram was carried out on the said remains (Figure 3). The ante-mortem photographs (selfies) were compared to the post-mortem dental remains.

At initial inspection of the first selfie photograph (Figure 4), a mismatch was declared. Examination of the second selfie photograph (Figure 5) was more promising, as the gold inlay appeared to correspond with the post-mortem dental remains.

However, the presence of a gold inlay was not considered unique, as this is a relatively common dental finding in the community.

Author affiliations:
1. **Liam Robinson:** *BChD, PDD (Maxillofacial Radiology), PDD (Forensic Odontology),* Department of Oral Pathology and Oral Biology, School of Dentistry, Faculty of Health Sciences, University of Pretoria.
   ORCID Number: 0000-0002-0549-7824
2. **Musa A Makhoba:** *MBChB, FC For Path (SA), Dip For Med (Path),* Department of Forensic Medicine, Faculty of Health Sciences, University of Pretoria.
   ORCID Number: 0000-0003-0684-0003
3. **Herman Bernitz:** *BChD, Dip (Odont), MSc, PhD.,* Department of Oral Pathology and Oral Biology, School of Dentistry, Faculty of Health Sciences, University of Pretoria.
   ORCID Number: 0000-0003-1361-1225

Corresponding author: Herman Bernitz
Department of Oral Pathology and Oral Biology, University of Pretoria, South Africa.
Tel. no.: +27 (0)12 319 2320
Fax no.: +27 (0)12 321 2225
Email: bernitz@iafrica.com

Author contributions:
1. **Liam Robinson:** Primary author - 50%
2. **Musa A Makhoba:** Case information - 10%
3. **Herman Bernitz:** Secondary author & advisor - 40%

Unfortunately, the second selfie photograph showed no mandibular teeth. At this stage it was noted that the first of the selfies was in fact a mirror image of the victim (Figure 6). Realising this, it was concluded that both selfie photographs were of the same individual, and all identified dental features from the photographs could be compared with the post-mortem dental remains.

The following points of dental concordance were noted during the examination:

1. The right mandibular second premolar was missing ante-mortem.
2. The left maxillary lateral incisor had a gold inlay.
3. The crowns of the left maxillary central incisor had similar characteristic shapes.
4. The crowns of the right maxillary central incisor had similar highly characteristic shapes (the tooth had been dentally prepared for some sort of inlay, giving it a mesial and distal parallel appearance).
5. The incisal edge of the right maxillary lateral incisor was concave and shorter than the right central incisor and canine.

In summary, the presence of multiple identifiable dental features and no unexplained discrepancies when comparing the ante-mortem photographs (selfies) and the post-mortem dental records, it could be confirmed with absolute certainty that the body was indeed that of the reported missing person.

In the South African context, selfies are an important tool in identifying unknown bodies, as a large portion of the population does not have access to modern dentistry, but many have smartphones to take selfies.

DISCUSSION

Forensic odontology, as with other methods of identification, involves comparing ante-mortem (AM) data with post-mortem (PM) findings.[1-2] The advantage of teeth as a source of identification lies in their ability to withstand significant environmental influences.[3] The success of dental human identification relies on the availability of AM data[3], emphasising the importance of thorough record keeping with regards to dental charting, procedures performed, plaster models and radiographs.[2]

Figure 1. Post-mortem intra-oral photograph.

Figure 2. Angulated post-mortem intra-oral photograph.

Dental findings in permanent teeth (Notify temporary teeth specifically)			
11	Inlay prep	Sound	21
12	Sound	Gold inlay	22
13	Sound	Sound	23
14	Sound	Sound	24
15	Sound	Sound	25
16	Sound	Sound	26
17	Sound	Sound	27
18	Microdont	Sound	28
	18 17 16 15 14 13 12 11 21 22 23 24 25 26 27 28 Super Numery 48 47 46 45 44 43 42 41 31 32 33 34 35 36 37 38		
48	Missing	Composite - Occlusal	38
47	Composite - Occlusal	Sound	37
46	Sound	Sound	36
45	Missing ante-mortem	Sound	35
44	Sound	Sound	34
43	Sound	Sound	33
42	Sound	Sound	32
41	Sound	Sound	31

Figure 3. Post-mortem odontogram.

Figure 4. First selfie photograph.
(magnified & cropped from original)

Figure 5. Second selfie photograph.
(magnified & cropped from original)

Figure 6. Mirror image of first selfie photograph.
(magnified & cropped from original)

In some instances AM dental data may not be available for various reasons, such as immigrants without clinical histories, patients without restorative dental treatment due to efficient preventative dentistry or no access to a dentist, and cases where the patient's dentist is unknown to their family.[1]

In the absence of dental records, photographs can play an important role in aiding identification. If the individual's anterior teeth are clearly visible in an AM photograph, then individual dental attributes can be compared and matched to PM photographs.

These key characteristics include the shape of the crowns, morphological characteristics, dental anomalies, size, width, outline, distances and alignment, facial profile and the presence of any recognisable fixed prosthetics.[1,4]

Technological advances allow for image manipulation, creating useful forensic techniques for the interpretation of smile photographs. Digital images allow for easy flipping, creating a mirrored image. Commonly applied techniques with scientific validation include direct comparison of morphological dental traits, dental superimposition, and the analysis of the incisal contours of anterior teeth.[2]

With the advent of smartphones and social networks, there has been a growing trend towards so-called "selfie" photographs. The Oxford English Dictionary designated selfie as the International Word of the Year in 2013 and defined the term as "a photo of yourself that you take, typically with a smartphone or a webcam, and usually put on a social networking site."[1]

A selfie is usually taken with an extended arm or a supporting rod, thus the face and smile frequently appear in the photo. In a study of photographs of 1000 individuals, 76.7% showed a smile that could be of value in the identification process.[5]

There has also been a rapid growth in the development of applications for smartphones used to find and locate missing persons. One such application, appropriately named Selfie Forensic ID, employs selfie and face photographs to create a social networking archive of dental data, including the dental features of anterior teeth and smiles of registered individuals.[4]

Photographic analysis for identification purposes has the advantages of low cost, rapid speed and high reliability.[2] However, this method does not come without its disadvantages, including a limited number of visible teeth in the photograph, low image quality and the possibility of morphological changes in the teeth since the AM photo was taken. An AM photograph is crucial when taking PM photographs, as the angulation of the photograph must be reproduced in the X, Y and Z (depth) axes for accurate comparison.[1]

CONCLUSION

This case report highlights the importance of selfie photographs in the identification of unidentified bodies. New methods of identification in forensic odontology should be pursued in order to accommodate technological evolution, particularly in the absence of traditional methods of comparison, such as dental records and radiographs.

References

1. Miranda GE, Freitas SG, Maia LVA, Melani RFH. An unusual method of forensic human identification: Use of selfie photographs. Forensic Sci Int. 2016; 263: 14-7.
2. Silva RF, Franco A, Souza JB, Picoli FF, Mendes SD, Nunes FG. Human identification through the analysis of smile photographs. Am J Forensic Med Pathol. 2015; 36(2): 71-4.
3. Silva RF, Felter M, Tolentino PHMP, Rodrigues LG, Andrade MGBA, Franco A. Forensic importance of intraoral photographs for human identification in dental autopsies: A case report. Bioscience. 2017; 33(6): 1696-700.
4. Nuzzolese E, Lupariello F, Di Vella G. Selfie identification app as a forensic tool for missing and unidentified persons. J Forensic Dent Sci. 2018; 10(2): 75-8.
5. McKenna JJI. A qualitative and quantitative analysis of the anterior dentition visible in photographs and its application to forensic odontology. Master's Thesis. University of Hong Kong; 1986.

No.1 DENTIST RECOMMENDED BRAND FOR SENSITIVE T

*GFK New expert performance tracking 2018.

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

gsk

With clinically proven Dual relief

TEETH*

4.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a7

Indigenizing oral health education in South Africa – radical overhaul or progressive review?

SADJ April 2020, Vol. 75 No. 3 p154 - p156

PD Motloba[1], HD Miniggio[2]

ABSTRACT

For ourselves and for humanity…we must turn over a new leaf, we must work out new concepts.[1]

Indigenization, *decolonization* and *transformation* are not merely catchphrases in the context of higher education. Provided they are properly understood and implemented, these essential notions can forge meaningful engagement and partnerships through the creation of fully transformed, inclusive and diverse educational spaces, thus providing a greater competitive edge in the knowledge economy.[2]

INTRODUCTION

The fierce contestations which erupted a few years ago at South African institutions of higher learning over academic ideology and politics of knowledge, have set in motion a movement in curriculum transformation in South Africa as in other parts of the world and bears testimony to the centrality of radical departure from the educational *status quo*.[1,4]

The audible calls for indigenization, transformation and decolonization of higher education has become a perceptible and inevitable necessity. The South African student movement under the banner of "#RhodesMustFall," "#FeesMustFall," "#OutsourcingMustFall" presented a determined crusade to pressure universities towards transformation.[5]

This growing dispute concerning the inclusion and development of indigenous knowledge in academia has certainly shifted the transformation landscape of higher education.

Author affiliations:
1. **Pagollang D Motloba:** *BDS (Medunsa), MPH (Epidemiology) (Tulane), M Dent (Comm Dent) (Medunsa), MBL (Unisa),* Chief Specialist, Head of Department, Community Dentistry, Sefako Makgatho Health Sciences University, South Africa.
   ORCID Number: 0000-0003-1379-7576
2. **Hilde D Miniggio:** *BDS (UMF, Cluj-Napoca), MScMed (Bioethics and Health Law) (Wits), PGDip (Health Sciences Education) (Wits),* Senior Lecturer, Department of Oral Pathology and Oral Biology, Sefako Makgatho Health Sciences University, South Africa.

Corresponding author: Pagollang D Motloba
Head of Department, Community Dentistry, Sefako Makgatho Health Sciences University, South Africa.
Email: pagollang.motloba@smu.ac.za

Author contributions:
1. **Pagollang D Motloba:** Conceptualization, first draft, revision, final write up and final approval - 60%
2. **Hilde D Miniggio:** First draft, revision, final write up and final approval - 40%

The health sector is similarly experiencing enormous pressure to transform or decolonise. It is estimated that 80% of the population in Africa alone, and 60% in South Africa, consult with traditional health practitioners before going to a primary health care practitioner.[6] Yet mistrust, tension and conflict continue to characterise the relationship between traditional healing and biomedical systems.

The failure to incorporate indigenous health practices, knowledge and cures into the mainstream health system has led to the unwarranted denial and resentment of local and indigenous health practices, including the use of traditional healers. This conflict accounts for delays in referrals and the increase in complicated cases in the hospitals, which in turn drive the cost of care and deplete the resources for the expansion of services. A health service so designed fails to recognise the role that traditional medicine plays in primary health care, and further denies the expression of patient's preferences and choices.[7,8]

In this article we focus on the dual predicament that besets transformation in health sciences education and healthcare provision, specifically focusing on oral health education.

We begin by defining and exploring the meaning of indigenization, decolonization and transformation. We then advance a cogent, and morally valid case for knowledge and cognitive justice in oral health education. This argument is premised on the need to implement a gradual and measured attenuation of Western centric knowledge orientation and inclusion of African and other indigenous knowledge forms.

For the proponents of this initiative, there ought to be intentionality to undermine parochialism in knowledge generation, acquisition and utilization. Similarly, time and efforts should be stepped up to emasculate the superiority of entrenched Western knowledge systems.

This existential imperative for academia is requisite to restore the respect and stimulate the development of the previously excluded knowledge systems. In so doing, this transformation could bring an end to a long history of indigenous epistemicide.[3] In case of South Africa, indigenous African knowledge systems appear to be the obvious preference for inclusion in a transformed curriculum. Clarifying concepts of indigenization, decolonization and transformation.

A deeper understanding of the indigenization, decolonization or transformation project requires a purposeful interrogation of the definitions, meaning and intents of these concepts. This process requires a leap beyond superficial use of language and discourse in education, but recognition of need for intentional inclusiveness, reconciliation and eventually transformation as requisites for lasting change.[9,10]

It is erroneous to use indigenization, decolonization and transformation synonymously.[11] Generally speaking, indigenization refers to localization, a process geared at including indigenous knowledge systems, practices and culture in the existing system.

Decolonization is an over-arching intent to rid the educational system of external influences, whatever they maybe. In other words, decolonization seeks to decenter colonial values, teaching and culture, making it amenable to inclusion of other influences, especially the indigenous ones.

Lastly, transformation presupposes changing from one form to the other; from one system to the next. Transformation signifies an intentional outcome of a changed system.[12,] Epistemicide represents the killing of knowledge systems (Hall and Tandon, 2017).[3]

Simply put, indigenization of universities is a decolonial, transformative process aimed at entrenching indigenous knowledge systems while progressively lessening colonial hold and influence on academe. Decolonization without indigenization is incomplete transformation, and indigenization is a critical aspect of decolonization.

Gaundry and Lorenz[9] advance a comprehensive and unified conceptualization of indigenization as a three phased process, namely (i) indigenization inclusion; (ii) indigenization reconciliation and (iii) decolonial in digenization. According to their framework, transforming institutions must firstly embrace indigenous inclusion.

This means that institutions must develop policies aimed at attracting, developing, supporting and retaining indigenous staff and students in academia.[13,14] Universities have to commit themselves to ease the burden of change from indigenous personnel. Further to this, it is critical for universities to dismantle those structures and obstacles that impede inclusion and representation of the indigenous persons.[15,16] By so doing institutions are able to initiate a transformative process without incurring extensive financial and human costs thereby "growing their own timber" and taking advantage of the locally available talent.[10]

Thus, reconciliation indigenization seeks to undo the influence and assault of colonial knowledge systems on local content.[17,18] Reconciliation indigenization is further aimed at changing how institutions operate both at policy level and scholarship levels. This process is critical towards achieving true transformation as it provides an unambiguously clear direction towards inclusive and indigenised spaces of learning. Conversely, poorly designed processes and policies would be nothing more than rhetoric to indigenization.

Lastly, decolonial indigenization signifies the end stage or ultimate posture of a fully transformed and inclusive university. This phase is characterised by a substantive and often difficult to imagine state of radical transformation of higher education. Decolonial indigenization would mean that universities are dismantled and built "back up again with a very different role and purpose."

Despite the known intention of decolonization, that is to decenter "settlers" perspectives and centre indigenous knowledge systems, most "decolonizing" institutions tend to hurriedly embrace transformation without a clear understanding of the process. In so doing the "ontological and epistemological assumptions and perceptions" of indigenous staff and students are left at the gates of the university. As a result, the faculty and students are forced to abandon their reality and "assume the trappings of a new form of reality" which is foreign and strikingly dissimilar from their own.[10]

Episkenew[19], advocates that true indigenization must go beyond making indigenous people "feel more comfortable", but should seek to undo the perception that indigenous people are deficient and require some intervention to catapult them to the 'desired' academic level in order to fit into 'their world'.

Indigenization remains a means to 'include' indigenous people, in an academic context that is neither natural, neutral nor representative of human knowledge.[20] Decolonised institutions intentionally move from one end of the spectrum to the other. They transition from complacency of the entrenched order to an engaged and inclusive institution.

Decolonizing oral health education in South Africa – one step at a time

Health sciences universities are by design wedged in the dual predicament that besets universities and health services; hence huge expectations for these institutions to indigenize, decolonise and transform. As academic institutions, universities are mandated to produce the much-needed human resources of health, and as such it is incumbent on these faculties to graduate clinicians who are socially grounded and sensitive to the diversity in communities they serve.

This ideal begins with a socially responsive education system, socially attuned faculty and inclusive curriculum. Additionally, the clinical exposure and teaching should reflect inclusivity, non-racialism and plurality of cultural and linguistic diversity in the country. Yet diversity and multiculturism should not be the substitute for transformation.

The bigger question confronting schools of oral health is not whether to decolonise or not, but rather how to decolonize, and what immediate steps to follow? Hence the question: should the decolonization of dental education be a moderately progressive process or a radical overhaul of the system. This paper advocates for a more measured reform which entails incremental inclusion of previously excluded knowledge systems, and progressive thinning of the present educational organizations.

The decolonization of oral health education in South Africa is likely to be a lengthy process requiring will and determination and not mere compliance. Leadership, commitment and deep reflection about identities and practices in the intellectual spaces are necessary ingredients for the successful implementation of this project.

Decolonization starts with the commitment to emasculate, de-racialize, de-gender academic spaces. It calls for support of blossoming indigenous epistemologies, theories, methodologies and ontologies. as well as the co-creation of new and shared knowledge systems and practices.[18,21]

We argue that in the midst of a plethora of transformative models towards an inclusive oral health education, South Africa's approach ought to be steady, measured, deliberate and well thought out. For example, schools of oral health in the country could consider creating inclusive cultural learning spaces and could indigenize, teaching and learning by incorporating African morality and philosophies as part of their ethics curriculum.

The principle of *ubuntu* stands out as an irrefutable attempt to decolonise dental education. The inclusion of this moral thought should entrench the indigenous affective domain which, is especially lacking in South African oral health curriculum. We thus posit a cogent argument that teaching African ethics will go a long way towards the transformation of a monolithic, colonial scholarship in a multicultural and pluralistic society.

The inclusion of the Afrocentric curriculum presupposes that those with indigenous knowledge would be most suitable to inform this education; that students from these backgrounds will, in this way, find their voice and will have the opportunity to share their experiences and become contributors to the process of transformation.

Schools of oral health in the country could adopt pro-indigenous policies; deliberately create faculty positions for indigenous language and practice; create indigenous academic programs and modules; promote researches niches that address indigenous health systems priorities; forge meaningful engagement and partnerships with local communities.

In closing, fully transformed, inclusive and diverse universities have potentially, greater competitive edge in the knowledge economy.

References

1. Fanon F. The Wretched of the Earth. London, United Kingdom: Penguin Books. 2001.
2. Bhambra GK, Gebrial D, Nisancıoglu K. Decolonising the University London: Pluto. 2018.
3. Hall BL, Tandon R. Decolonization of knowledge, epistemicide, participatory research and higher education'. Research for All. 2017; 1 (1): 6-19.
4. Makhubela, M. Decolonise, Don't Diversify: Discounting Diversity in the South African Academe as a Tool for Ideological Pacification. Education as Change. 2018; 22(1): 2965-85. https://doi.org/10.25159/1947-9417/2965.
5. Simone A. Urbanity and Generic Blackness. Theory, Culture and Society. 2016; 33(7-8): 183–203. https://doi.org/10.1177/0263276416636203.
6. Pretorius E. Traditional healers. S Afr Health Rev. 1999; 18: 249-56.
7. Zuma D, Wight R, Moshabela M. The role of traditional health practitioners in Rural KwaZulu-Natal, South Africa: generic or mode specific? BMC Complementary and Alternative Medicine 2016 https://doi.org/10.1186s12906-016-1293-8.
8. Gqaleni N, Moodley I, Kruger H, Ntuli A, McLeod H. Traditional and complementary medicine: health care delivery. South African Health Review. 2007; 175-188.
9. Gaundry A, Lorenz D. Indigenization as inclusion, reconciliation, and decolonization: navigating the different visions for indigenizing the Canadian Academy. AlterNative. 2018; 14(3): 218-27. https://doi.org/10.1177/1177180118785382.
10. Kuokkanen R. Reshaping the university: Responsibility, indigenous epistemes, and the logic of the gift. Vancouver, Canada: University of British Columbia Press. 2008; 2-5
11. Tuck E, Yang WK. Decolonization is not a metaphor. Decolonization: Indigeneity, Education & Society. 2012; 1(1): 1-40.
12. Corntassel J. Re-envisioning resurgence: Indigenous pathways to decolonization and sustainable self-determination. Decolonization: Indigeneity, Education, & Society. 2012; 1(1): 86-101.
13. Mihesuah D. Should American Indian history remain a field of study? In Indigenizing the academy: Transforming scholarship and empowering communities Lincoln, NE: University of Nebraska Press. 2004; 143-59.
14. Wilson A. Reclaiming our humanity: Decolonization and Indigenous knowledge. In Indigenizing the academy: Transforming scholarship and empowering communities. Lincoln, NE: University of Nebraska Press. 2004; 69-87.
15. Alfred T. Warrior scholarship: Seeing the university as a ground of contention. In Indigenizing the academy: Transforming scholarship and empowering communities. Lincoln, NE: University of Nebraska Press. 2004; 88-99
16. Deloria V. Marginal and Submarginal. In Indigenizing the academy: Transforming scholarship and empowering communities. Lincoln, NE: University of Nebraska Press. 2004; 16-30.
17. Sasakamoose J, Pete SM. Towards indigenizing university policy. Education Matters: The Journal of Teaching and Learning. 2015; 3(1).
18. Pete S. 100 Ways: Indigenizing & decolonizing academic programs. Aboriginal Policy Studies. 2016; 6: 81-9. doi:10.5663/aps.v6i1.27455.
19. Episkenew J. Indigenizing university administration of Tawaw ci? (Take 2). In Transforming the academy: Indigenous education, knowledge, and relations. 2013; 64-8.
20. Battiste M, Bell L, Findlay LM. Decolonizing education in Canadian universities: An interdisciplinary, international, indigenous research project. Canadian Journal of Native Education. 2002; 26: 82-95.
21. Ragoonaden K, Mueller L. Culturally responsive pedagogy: Indigenizing curriculum. Canadian Journal of Higher Education. 2017; 47: 222-46.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a8

From Pandemic, to Panic to 'Pendemic'

SADJ April 2020, Vol. 75 No. 3 p157 - p159

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

INTRODUCTION

Medical doctors and dentists working in private practice are generally faced with the situation of "no work, no pay". Although most have some form of indemnity cover to ensure they will receive and income if they are injured or incapacitated, this will be of no benefit if they are unable to work due to non-medical conditions, or for other extraneous reasons such as a lack of patients.

In light of the current C19 pandemic and government restrictions on human contact, it is going to be extremely difficult for dental practitioners who have closed their rooms or scaled down their practices to treating only emergency patients to earn an income. They may have to explore other avenues of staying financially solvent in these difficult and unpredictable times, and leads to the question:

Is Covid-19 (C19) going to be an excuse to justify the indiscriminate and potentially irresponsible issuing of sick letters and prescriptions by healthcare professionals?

SURVEY DESIGN

At a recent dental congress, practitioners were asked to complete a questionnaire in which a number of practice-related ethical scenarios and questions were posed.

Author affiliations:
1. **Leanne M Sykes:** *BSc, BDS, MDent, IRENSA, Dip Forensic Path, Dip ESMEA,* Head of Department of Prosthodontics, University of Pretoria, South Africa.
   ORCID Number: 0000-0002-2002-6238
2. **Elmine Crafford:** *BChD, BChD Hons, Oral Medicine, MChD OMP,* Senior Specialist Department of Oral Medicine and Periodontics, University of Pretoria, South Africa.
3. **Charles Bradfield:** *B Tech, BChD, Dip Aesthetics,* Registrar Department of Prosthodontics, University of Pretoria, South Africa.

Corresponding author: Leanne M Sykes
Head of Department of Prosthodontics,
University of Pretoria, South Africa.
Email: leanne.sykes@up.ac.za

Author contributions:
1. **Leanne M Sykes:** Primary author - 60%
2. **Elmine Crafford:** Secondary author - 20%
3. **Charles Bradfield:** Registrar - 20%

ACRONYM

C19: Covid-19

One question related to the issuing of medical certificates and sick letters and the writing of prescriptions for family members. Over 50 dentists completed the questionnaire, and the results are presented in the Tables below.

RESULTS

In responses to the question "Would you issue a sick certificates for family members? Almost half of the dentists said yes, one fifth a definite no and 34% said it would depend.

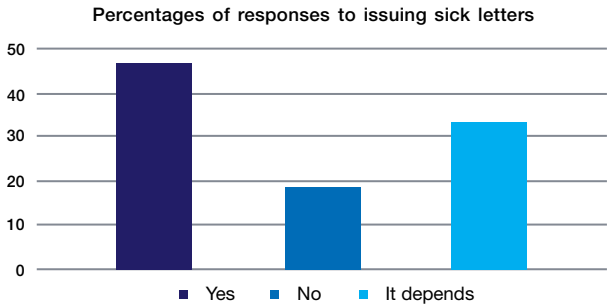


Figure 1. Percentage of responses relating to the issuing of sick certificates.

When asked to elaborate on their answers, many of the comments and opinions were similar thematically and thus not repeated below. All others are presented verbatim.

Comments in the 'Yes' category included:

- If it's true then yes (but you have to be ethical).
- Yes they are all still patients with problems.
- It's practical. Why should I go and pay someone else for something that I can do myself.
- Yes. You will not go and prescribe incorrect medication deliberately!
- You act professionally towards all patients and family in the same manner.
- Yes if you follow the Hippocratic Oath.
- If you have integrity and can be sure of non-attachment.
- Patients are patients and I treat them all the same.

Those who said 'No' gave reasons such as:

- No, it's unethical!
- It's difficult to monitor proper compliance, and human factors must not be discounted.
- No, you can easily become biased.
- They will take advantage. (Especially relatives)
- It sets a precedent and can lead them to expect you to bail them out in the future.

The 'It depends' group generally said 'Yes', but had added provisos like:

- In emergency situations only, otherwise it's better to consult with a colleague or medical practitioner.
- It depends, are you honest and will not abuse the system?
- Only if you also treat those family members then it's OK.
- Also they must have been treated on the day that you issue the letters.
- It depends on the situation. They must have come for treatment, and the treatment should justify a sick note.
- As long as it's not over treatment or over medication.
- As long as I am not prescribing out of my field or for non-dental conditions.
- Only in emergency situations or if you are the most qualified person, or if a referral would be impractical (such as if services are far away).
- As long as treatment was actually performed.

In responses to the question "Would you write prescriptions for medication for family members?, there were more 'Yes' responses with over two thirds saying they would and less than 6% who said a definite 'No'. Just under one third (28%) said it would depend.

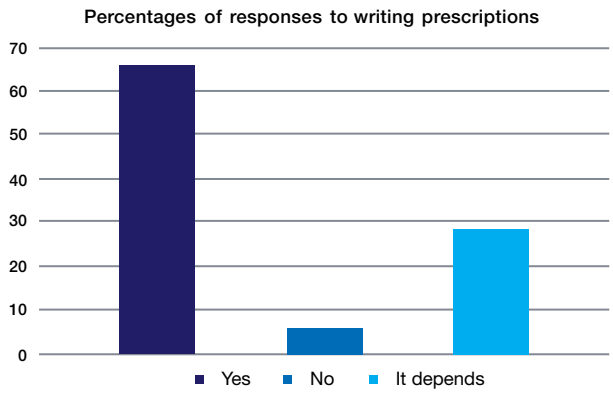


Figure 2. Percentage of responses relating to writing prescriptions.

Many of the comments were similar to those for writing sick certificates, with most of the added opinions being in the "It depends" category.

Under the definite 'Yes' replies were statements such as:

- You have a medical qualification, so why not.
- I'm a doctor and capable so definitely 'Yes'.
- Patients are patients regardless of their relation.
- I see no problem if you are honest and ethical.

The only strong NO's felt that the possibility of bias and abuse was too great (Author comment: they didn't specify if they meant abusing your favours or abusing the drugs!)

The remaining comments all fell under the 'It depends' category

There was a strong emphasis that it must be within the scope of dentistry and be needed for some actual dental treatment or condition. They include:

- As long as it's within your scope of practice and necessary for the diagnosis.
- It depends on the severity of the condition. If it involves any scheduled medication then I will rather send to a colleague.
- Only if the family member is also your patient and the prescription is for the actual treatment you are performing, not for other conditions.
- Only if I'm allowed to prescribe that drugs and I know the pharmacological effects and side effects.
- It must be restricted to your scope of practice but it's OK for emergencies of chronic medication.
- If they are not my patients but I am the only qualified health care professional around and it's an emergency then I will.
- The medicine must be needed and not done as a favour.

DISCUSSION

This survey question asked dentists about writing sick certificates and scripts for family members. However, in light of the current C19 pandemic, it can be anticipated that more and more patients as well as the broader public will be approaching practitioners with requests for letters to justify their absenteeism from work, as well as for a variety of drugs and medicinal products.

At the same time, most clinicians have limited their practices to treating only patients in serious pain or with dental emergencies. This is going to place a huge financial burden on them as these procedures are not

common and generally not well re-imbursed. Dental specialist could be more affected as they do not see walk in patients and generally perform fewer emergency procedures.

Furthermore, clinicians may also want to restrict their contact with people, and could be very tempted to write letters and issue scripts to anyone asking for these, both as a means of generating income and without needing to see or consult with them in person.

They may manipulate Code 8104 which makes provision for limited oral examinations, consultation for a specific problem not requiring full mouth examination, and the issuing of prescriptions.[1]

The problem is that the dentist may never actually see the patient clinically, and thus cannot carry out a comprehensive clinical and oral examination, may not elicit a full medical history and cannot make use of confirmatory radiographs. Their diagnosis will be based on patient - reported signs and symptoms which are bound to be subjective, maybe grossly misleading, and could lead to a completely erroneous diagnosis.

Of more concern is the likelihood that clinicians may over-prescribe antibiotics. This goes against current trends to manage disease and infection conservatively wherever possible, especially when one considers the universal problem of ever-increasing numbers and types of drug-resistant bacteria.

In the United States, not only are over one third of antibiotics prescribed unnecessary, often the selection and duration of treatment are also inappropriate.[2] However, patients often expect and demand scripts for medication, and may place undue pressure on the dentist to comply.

Antibiotic prescribing may also be influenced by psychological factors, perceived or genuine patient expectations, clinical workload, habit, or in some instances, blatant lack of accountability.[2]

It may now become very tempting for practitioners, faced with the uncertainties of the C19 virus and its associated co-morbidities, to think along the lines of "rather be safe than sorry" and prescribe antibiotics "just in case".

Considering the current situation, this may seem like a "win-win" situation for all. However, the Centres for Disease Control and Prevention recommend that clinicians consider the condition carefully before writing scripts for antibiotics, as in many instances delayed prescribing, active monitoring, and the use of relevant diagnostic aids may be more prudent.[2]

Antibiotic stewardship is a term developed to monitor and promote optimization of antibiotic use in order to ensure patient safety and outcomes. It includes "ensuring that antibiotics are only given when necessary and beneficial, that the right agent, dose and duration of treatment are used, and that when needed they should be started promptly.[2]

Remember, the responsibility for potential side effects of a prescription remains with the issuing doctor. Thus if they have not carried out a full consultation, they may be unaware of possible contraindications or drug interactions, especially amongst patients who self-prescribe or are on polypharmacy.

CONCLUSIONS

Now more than ever clinicians are going to be called upon to be calm and rational, to make educated decisions, and to act with honesty and integrity despite the temptation to try and fill their rapidly emptying rooms and pockets.

To quote Roy T Bennett:
"Do what is right - Not what is easy or popular" [3]

References

1. SADA Dental Codes Diagnostics. 2016; 5. Accessed at: https: //www.sada.co.za/clinical-resources/codes/
2. King LM, Fleming-Dutra KE, Hicks LA. Advances in optimizing the prescription of antibiotics in outpatient settings. BMJ. 2018; 12; 363-75.
3. Bennett, RT. The light in the heart. Accessed at: https://www.goodreads.com/author/quotes/15042371.Roy_ T_Bennett.

http://dx.doi.org/10.17159/2519-0105/2020/v75no3a9

Maxillofacial Radiology 179

SADJ April 2020, Vol. 75 No. 3 p160

CJ Nortjé

Below are images of three patients presenting at the department due to the effects of multimodality therapies of childhood cancer on the developing dentition. What are the important developing abnormalities discernible?

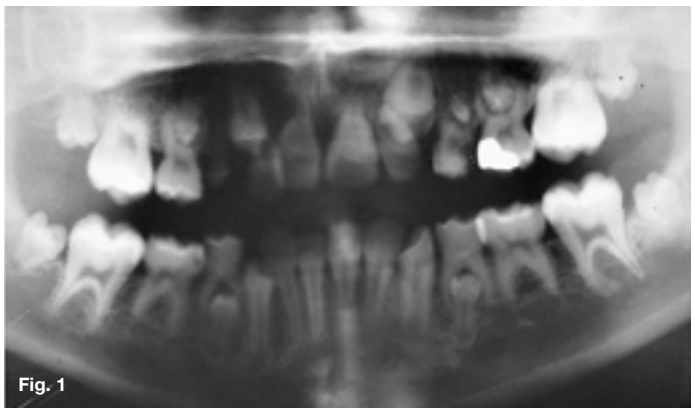


Fig. 1

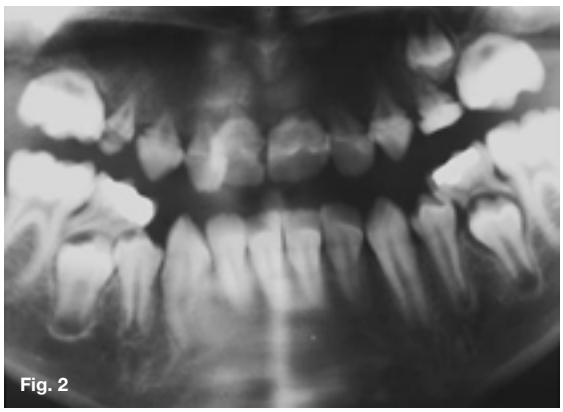


Fig. 2

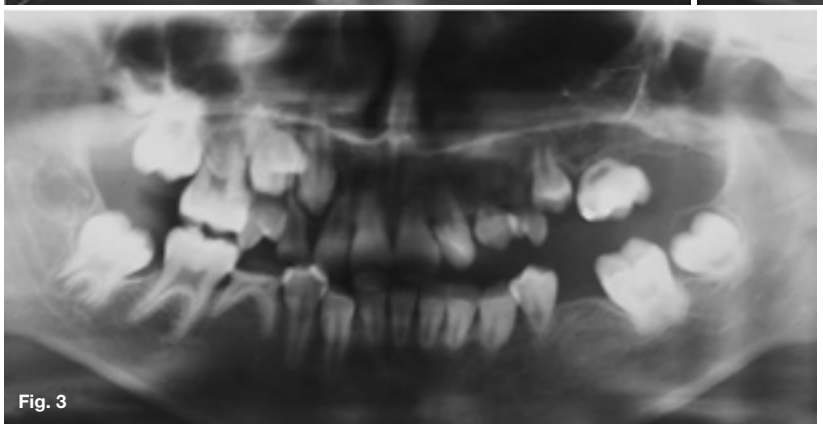


Fig. 3


Fig. 4

INTERPRETATION

Figure 1 is a radiograph of a ten year old female presenting with a history of radiation treatment for a T cell lymphoma. It is a type of cancer that forms in T cells (a type of immune system cell). T-cell lymphomas may be either indolent (slow-growing) or aggressive (fast-growing). Most T-cell lymphomas are non-Hodgkin lymphomas. There are many different types of T-cell non-Hodgkin lymphomas. Reported abnormalities include hypodontia, microdontia, enamel hypoplasia, root stunting, taurodontia, over-retention of primary teeth, an increased caries index and decreased temporomandibular joint mobility. Existing reports have found that children may be at greater risks for odontogenic developmental abnormalities if treated with chemotherapy when younger than 5 years because of proliferation of dental stem cells during this period. Figure 2 is a pantomograh of a ten year old male who had been treated at the age of 2 years for bilateral retinoblastoma. At the time he received a total of 40 Gray at 250 kVp over a 4-week period directed at both orbits. The radiograph shows extensive resorption of the roots of all the maxillary teeth. Figures 3 & 4 are images of a ten year old female who had been radiated at the age of 2 years for a retinoblastoma of the left eye. The exact dosage could not be determed. The clinical and radiographic examination revealed that the permanent teeth in the left maxilla and mandible had been affected. Radiographic examination of the alveolar bone revealed to be more radiolucent on the left side than the right side. Retinoblastoma presents as a rapidly developing carcinoma developing from immature cells of the retina, which is reported to be the most common malignant tumour affecting the eyes during childhood. Sixty five percent of the affected cases present with unilateral retinoblastoma. Treatment includes surgical enucleation of the affected eye, external beam radiotherapy, brachytherapy, cryotherapy and chemotherapy. The side–effects of various cancer treatment modalities especially radiotherapy present as a plethora of skeletal and dental anomalies.

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

Reference

1. Khan M, Maheshwari S, Khan MT, Verma SK: Long term dento-facial effects of radiotherapy in a treated patient with retinoblastoma. Journal of Oral Biology and Craniofacial Research. 2014; 4(3): 214-217.
2. Harris AMP, Nortje CJ, Luchessi AMV: Some effects of radiation therapy during early childhood on facial growth and tooth development. SADJ. 1986; 41: 681-6.

CPD questionnaire

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

GENERAL

COVID-19 pandemic and the dental practice

1. Identify the CORRECT answer. With regards to PPE to combat SARS-CoV-2 transmission, what combination of gear cannot be withheld or left out?
   A. Headwear and goggles
   B. Goggles/visor and N95 mask
   C. N95 mask and gown
   D. N95 mask and footwear

2. Identify the CORRECT answer. An 18-year-old patient who just returned from studying in China attends your practice with a main complaint of severe pain following a back tooth having "broken off" after she had a car accident yesterday afternoon. The best treatment modality for this patient is:
   A. Triage, questionnaire, education, instruct to self-isolate, and call the Department Of Health Corona Virus Hotline
   B. Triage, questionnaire, necessary PPE, intra-oral examination, postpone procedure
   C. Triage, questionnaire, necessary PPE, intra-oral examination, relieve pain/sepsis, definitive treatment postponed
   D. Triage, questionnaire, necessary PPE, intra-oral examination, root canal treatment of tooth with composite filling

3. Identify the CORRECT answer. SARS-CoV-2 can potentially remain viable within aerosols generated during dental procedures for approximately how long?
   A. 3 days
   B. 15.9 hours
   C. 2.74 hours
   D. 3 seconds

4. Identify the CORRECT statement. Which of the following are true for the N95 respirators?
   A. There are no standard test for nanoparticle penetration on respirators
   B. The N95 respirator can filter 100% of airborne particles
   C. Proven to provide protection against nanoparticles
   D. All N95 respirators are manufactured the same and can form a tight seal around the face

5. Identify the CORRECT answer. Which of procedures below can be deemed a dental emergency?
   A. Extraction of un-erupted primary tooth, asymptomatic
   B. Scale and polish
   C. Dental pain on 46
   D. Routine bitewings to identify caries

Mandibular first and second premolars with challenging root canal anatomy - Part 1: Review of the literature

6. Identify the CORRECT statement. Which of the following teeth are associated with the highest failure rate when evaluating non-surgical root canal therapy?
   A. Mandibular first premolars
   B. Mandibular second premolars
   C. Maxillary first premolars
   D. Maxillary second premolars

7. Identify the CORRECT statement.
   According to Cleghorn, Christie and Dong, most mandibular first premolars have a single root with how many canals?
   A. Two canals that join apically
   B. Two separate canals
   C. One canal
   D. High incidence of variation

8. Identify the CORRECT answer. What percentage of mandibular second premolars have authors reported to have single roots with three different root canals?
   A. 1% of cases
   B. 2-4% of cases
   C. 10% of cases
   D. 18% of cases
   E. 0.4% of cases

Mandibular first and second premolars with challenging root canal anatomy - Part 2: Endodontic management

9. Identify the CORRECT answer. In Case Report 2, the access was modified with which Start-X tip in an effort to locate the third root canal orifice?
   A. Start-X number 1
   B. Start-X number 3
   C. Start-X number 2
   D. None of the above

10. Identify the CORRECT statement. According to available literature, the following guidelines can be followed to investigate radiographs and identify additional root canals:
    A. Parallel radiographs taken from either 30° mesial or 30° distal
    B. Parallel and pre-operative radiographs taken from either 30° mesial or 30° distal
    C. Radiographs taken from either 40° mesial or 30° distal
    D. None of the above

Investigating dental caries rates among sentenced prisoners

11. Identify the CORRECT statement.
    A. The snowball sampling method was used to select participants for this study
    B. A simple random sampling technique was used to select participants for this study
    C. A purposive sampling method was used to select participants for this study
    D. All of the above
    E. None of the above

12. Identify the CORRECT answer. How many respondents consented to participate in this study?
    A. 393
    B. 363
    C. 383
    D. 373
    E. None of the above

13. Identify the CORRECT statement.
    A. SPSS version 24 was used for data management and analysis
    B. SPSS version 22 was used for data management and analysis
    C. NVIVO version 12 was used for data management and analysis
    D. All the above
    E. None of the above

A suggested intentional extraction of a wisdom tooth: Implies capacity for prosocial behaviour in Homo erectus

14. Identify the INCORRECT statement. It has been surmised that the development of intentional social engagement amongst *Homo erectus* individuals was associated with:
    A. by the use of tools for hunting, gathering and food preparation
    B. the refinement of an upright posture during ambulation
    C. the inclusion of meat in early *Homo erectus* diet
    D. upright bonding between males and females

15. Identify the INCORRECT statement. Maps of the voxel values of the tissues in the region of the M3 socket showed:
    A. no differences between the materials in the socket and surrounding the root
    B. significantly different values between bone, breccia and the material in the socket of M3
    C. the material in the socket of M3 to be less dense than the alveolar bone
    D. the material in the socket of M3 to be denser than the breccia surrounding the specimen

Forensic case book: mirror image “selfie” causes confusion

16. Identify the CORRECT statement. Photographs play an important role in aiding identification, whereby common forensic techniques include:
    A. Direct comparison of morphological dental traits
    B. Dental superimposition
    C. Analysis of incisal contours of anterior teeth
    D. All of the above

17. Identify the CORRECT statement. Which of the following statements are most accurate with regards to identification from photographs?
    A. SnapChat dental ID is an example of a new smartphone application utilising photographs to create a social networking archive of dental data.
    B. Teeth are poor sources of identification, as they tend to decompose
    C. An ante-mortem photograph is crucial when taking post-mortem photographs
    D. Photographic analysis for identification purposes has only one advantage of minimal storage space

Maxillofacial Radiology 179

18. Identify the CORRECT statement. Which of the following statements are the MOST accurate regarding childhood malignancy:
    A. Most T-cell lymphomas are Hodgkin lymphomas
    B. Retinoblastomas are largely uncommon malignancies affecting the eyes during childhood
    C. Children may be at greater risks for odontogenic developmental abnormalities if treated with chemotherapy when younger than 5 years
    D. None of the above

Indigenizing oral health education

19. Identify the CORRECT statement. Indigenization refers to the:
    A. overall intention to incorporate indigenous knowledge and experience in an educational system
    B. overall intention to remove external influences from an educational system
    C. overall intention of changing an educational system
    D. customization of external concepts for local educational systems

20. Identify the CORRECT statement. Transformation of higher education institutions is NOT:
    A. necessary for competitive advantage
    B. a moral imperative for higher education
    C. obligatory and good for its own sake
    D. Any of the above

ETHICS

From Pandemic, to Panic to 'Pendemic'

21. Identify the CORRECT statement. In this survey, most dentists felt it was OK ethically to prescribe medication for family if:
    A. the family member needed it for flu or other medical symptoms
    B. the family member was afraid to go to a doctor
    C. the prescription was for an actual dental condition
    D. the prescription was not for an incorrect dose or time period

22. Identify the CORRECT statement. Ethically, a dentist could issue a sick certificate based on:
    A. A telephonic conversation with a patient
    B. If the patient reported that their toothache had kept them away from work
    C. If the patient had been seen on that day in question
    D. If the patient had been seen a few days earlier but said the tooth was still painful

23. Identify the CORRECT answer. According to Code 8104 a dentist can:
    A. carry out a limited oral examination
    B. consult for a specific problem only
    C. charge for issuing of a prescription
    D. All of the above
    E. Only A and C above are correct

24. Identify the CORRECT answer. The authors of this paper feel that ethical problems with a telephonic consultation include:
    A. Dentists may overcharge
    B. Dentists can't carry out a comprehensive clinical and oral examination
    C. Patient reports may be subjective
    D. B and C above are concerns

25. Identify the CORRECT answer. "Just-in case" prescription of antibiotics:
    A. is justified if the dentist is unsure of their diagnosis
    B. can lead to the development of drug resistant microorganisms
    C. is allowed if the dentist is worried the patient may have C19 infection
    D. is justified if the dentist does not want to physically consult with the patient
    E. All of the above apply

Online CPD in 6 Easy Steps

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

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

3 Select the CPD navigation tab.

4 Select the questionnaire that you wish to complete.

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

6 View and print your CPD certificate.

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

Instructions to authors

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

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

We shall be obliged if your submission is prepared respecting all the details listed in these Instructions. This facilitates our process and ensures more rapid responses to you. Please use and submit the Checklist for Authors suplied on page 167 for confirmation. Thank you.

Address for submission of articles

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

Language

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

Clinical Research

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

Clinical Trials

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

Authors

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

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

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

Title

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

Abstract

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

Text

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

Length of the article

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

Illustrations/graphics/photographs

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

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

Continuing Professional Development

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

References

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

Journal references should appear thus:

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

Book references should be set out as follows:

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

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

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

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

Declaration

All sources of funding, possible financial interest/s or incentives in products or services mentioned in the article must be disclosed. Authors are kindly requested to read and sign the attached declaration **on page 519**.

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

Ethics

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

Conflict of interest

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

Copyright

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

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

Submission

The paper should be submitted in one file including all Tables and Figures and their accompanying Legends Figures should also be submitted separately file in JPEG. format.
Please submit the paper in electronic format in Word along with separate Figures in JPEG. format to: ngoeped@sada.co.za and to bill.evans@wits.ac.za, accompanied by a covering letter and the Declaration **on page 166** signed by all the author(s).

Galley proofs

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

Editorial Policy

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

Enquiries

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

Declaration by Author/s

Title: _____

_____

Author/s: _____

_____

I/We, the undersigned confirm and declare that:

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

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

Author's Checklist

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

Smalls advertising and placement procedure

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

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

SADA
THE SOUTH AFRICAN DENTAL ASSOCIATION

www.sada.co.za