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Our Front Cover for this Issue...

Yellowwood (Podocarpuslatifolius)

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Reimagining dental care funding in South Africa: A call for equitable healthcare

SADJ JUNE 2024, Vol. 79 No.5 p235-237

Prof NH Wood, Managing Editor, SADJ - BChD, DipOdont(MFP), MDent(OMP), FCD(SA), PhD

INTRODUCTION

Dentistry, often perceived as an ancillary branch of healthcare, is in reality a critical pillar in the overall health and wellbeing of individuals. The integral role of dental care extends beyond the prevention and treatment of oral diseases; it significantly impacts systemic health, quality of life and socioeconomic productivity. Despite its importance, dental care frequently receives inadequate attention in terms of subsidies and government funding, resulting in substantial disparities in access and outcomes.

In South Africa, the challenge of underfunded dental care is compounded by a healthcare system that has historically favoured curative over preventive services, often sidelining oral health in the process. Current funding models, heavily reliant on out-of-pocket payments and private insurance, fail to adequately cover much of the population, leaving many without necessary dental care. This systemic neglect not only exacerbates oral health issues but also places a greater burden on the overall healthcare system due to the interlinked nature of oral and general health.

As South Africa stands on the cusp of a transformative shift in its healthcare landscape with the implementation of the National Health Insurance (NHI) Act, there lies a significant opportunity to readdress and restructure the funding mechanisms for dental care. The NHI aims to provide universal health coverage, ensuring that all South Africans, irrespective of their socioeconomic status, have access to comprehensive healthcare services. This editorial seeks to explore the implications of the NHI for dental care, emphasising the necessity for equitable funding and the critical role of dental health in achieving holistic health outcomes.

In this piece I aim to highlight the urgent need for a more inclusive and well-funded approach to dental care within the broader framework of national healthcare reform. By integrating dental care into the NHI and ensuring adequate funding, South Africa can take a monumental step towards a more equitable and efficient healthcare system that recognises and values the importance of oral health.

THE CURRENT STATE OF DENTAL CARE FUNDING

Analysis of existing funding models

In South Africa, the funding for dental care is primarily characterised by a heavy reliance on out-of-pocket payments and private insurance schemes. The public healthcare system, which serves the majority of the population, is significantly underfunded and overstretched, resulting in limited access to dental services. According to the Council for Medical Schemes, only a small proportion of the population is covered by private medical aids that offer comprehensive dental benefits, leaving a large segment of the population to either pay out-of-pocket or forgo necessary dental care altogether.

IMPACT OF INSUFFICIENT SUBSIDIES AND GOVERNMENT FUNDING ON DENTAL CARE ACCESS

The perceived lack of adequate government funding for dental care has profound implications for public health. Inadequate subsidies mean that public dental services are often limited to emergency care, with preventive and restorative services being significantly underprovided. This neglect results in higher incidences of dental diseases, which could otherwise be mitigated through timely and preventive care. The disparity is evident when comparing dental care to other healthcare services, which tend to receive more substantial funding and resources. For instance, chronic conditions and hospital-based care receive priority funding, often at the expense of preventive dental services.

Comparison with funding in other healthcare sectors

When examining funding allocations, it becomes apparent that dental care is disproportionately neglected compared to other healthcare sectors. The NHI's proposed funding model aims to address this imbalance by integrating dental services into the broader healthcare funding pool. Currently, the fragmented funding model not only undermines the efficiency of dental care delivery but also exacerbates health inequities. For example, under the existing system, general healthcare services are more robustly funded through various government schemes and private insurance coverage, while dental care often remains a secondary consideration. This systemic issue is further compounded by the lack of specific policies aimed at enhancing dental health, unlike other sectors which benefit from dedicated programmes and substantial investments.

The current funding model for dental care in South Africa is inadequate and inequitable, leaving many without access to necessary dental services. By addressing these funding disparities and integrating dental care more comprehensively within the NHI framework, South Africa can move towards a more balanced and fair healthcare system.

NATIONAL HEALTH INSURANCE (NHI) AND ITS IMPLICATIONS

Overview of the NHI legislation and its objectives

The National Health Insurance (NHI) Act, signed into law by President Cyril Ramaphosa on May 15 2024, marks a pivotal shift in South Africa's healthcare landscape. The primary objective of the NHI is to ensure universal health coverage, providing all South Africans with access to quality healthcare services regardless of their socioeconomic status. The NHI aims to address the significant inequalities

in the current healthcare system, which disproportionately favours those with access to private healthcare while the majority rely on an underfunded public system.

Detailed explanation of how NHI aims to provide universal healthcare

Under the NHI, funding for healthcare will be centralised into a single pool managed by the NHI Fund. This fund will be financed through a combination of general revenue allocations, payroll taxes and surcharges on taxable income. The NHI model is designed to eliminate out-of-pocket payments at the point of service, ensuring that healthcare is delivered free of charge to the most vulnerable populations. This approach aims to pool risks and resources, enabling cross-subsidisation where the healthy and wealthy subsidise the care of the sick and poor, thereby ensuring equitable access to healthcare services.

Specific provisions related to dental care under NHI

The NHI framework explicitly includes dental care as part of its comprehensive healthcare coverage. This integration is crucial given the historical neglect of dental services in public healthcare funding. By incorporating dental care into the NHI, the government aims to enhance access to preventive, restorative and emergency dental services. This move is expected to reduce the prevalence of untreated dental conditions, which are often linked to more severe health issues, thereby improving overall public health outcomes. The NHI Fund will contract both public and private dental care providers, ensuring a broad network of services available to all citizens.

Further considerations

While the NHI presents significant opportunities for improving dental care funding, it also faces substantial challenges. The successful integration of dental care into the NHI will require robust infrastructure, effective governance and efficient allocation of resources. There is a need for clear guidelines and policies to ensure that dental care providers are adequately compensated and that services are delivered efficiently. Moreover, there is an opportunity to leverage the strengths of both public and private sectors, fostering collaboration that can lead to better service delivery and health outcomes.

The National Health Insurance Act represents a transformative step towards achieving equitable healthcare in South Africa. By incorporating dental care into the NHI, the government acknowledges the critical role of oral health in overall wellbeing and aims to address longstanding disparities in healthcare funding.

CHALLENGES AND OPPORTUNITIES

Potential challenges in integrating dental care into the NHI framework

The integration of dental care into the NHI framework presents several challenges that need to be carefully navigated to ensure successful implementation. One of the primary challenges is the existing disparity in infrastructure and resource availability between urban and rural areas. Rural areas, which are often underserved, may face significant hurdles in accessing the improved dental care promised by the NHI due to limited facilities and healthcare professionals. Addressing these disparities will require substantial investment in infrastructure and incentives to attract dental professionals to underserved areas.

Another challenge lies in the administrative and operational capacities of the NHI Fund. Effective management of

a centralised healthcare fund that incorporates diverse services, including dental care, necessitates robust governance structures, transparent processes and efficient allocation of resources. There is also the risk of corruption and mismanagement, which has historically plagued various public sectors in South Africa. Implementing stringent oversight mechanisms and leveraging technology for transparency and efficiency will be crucial in mitigating these risks.

Opportunities for improving dental care through NHI funding

Despite the challenges, the NHI framework offers significant opportunities to transform dental care in South Africa. One of the most promising aspects is the potential for increased access to comprehensive dental services. By removing financial barriers, the NHI can ensure that preventive, restorative and emergency dental care is accessible to all South Africans, regardless of their socioeconomic status. This increased access is expected to lead to better oral health outcomes and, by extension, improved overall health.

The NHI also provides an opportunity to standardise the quality of dental care across the country. By establishing national standards and guidelines for dental services, the NHI can ensure that all providers, whether in the public or private sector, adhere to the same high standards of care. This standardisation can help reduce disparities in service quality and ensure that all patients receive the best possible care.

Moreover, the NHI's emphasis on preventive care aligns well with the needs of dental health. Preventive dental care, such as regular check-ups, cleanings and early treatment of dental issues, can significantly reduce the incidence of more severe and costly dental problems in the future. By funding and prioritising preventive dental services, the NHI can contribute to a healthier population and reduce the overall burden on the healthcare system.

Case studies or examples from other countries with similar healthcare models

Examining international case studies provides valuable insights into how South Africa can navigate the integration of dental care into its NHI framework. Countries such as the UK and Australia, which have implemented universal health coverage models that include dental care, offer useful lessons. For instance, the UK's National Health Service (NHS) provides a model for integrating dental services into

a comprehensive health system, demonstrating the importance of adequate funding, effective management and continuous evaluation to ensure service quality and accessibility.

Australia's Medicare system also includes dental services, primarily for children and disadvantaged adults, highlighting the benefits of targeted funding and the importance of preventive care. These international examples underscore the need for South Africa to tailor its NHI implementation to local conditions while learning from the successes and challenges experienced by other countries.

The NHI presents a historic opportunity to redefine dental care funding and delivery in South Africa. By addressing the challenges and leveraging the opportunities presented by the NHI, South Africa can ensure that dental care is no longer a neglected aspect of healthcare but an integral part of a comprehensive and equitable health system.

THE ROLE OF DENTAL CARE IN OVERALL HEALTH

The interconnectedness of dental health and general health

Dental health is intricately connected to overall health, impacting various systemic conditions and influencing overall quality of life. Poor oral health is associated with numerous chronic diseases, including cardiovascular disease, diabetes, respiratory infections and adverse pregnancy outcomes. For example, periodontal disease has been linked to an increased risk of heart disease and stroke. The bacteria and inflammation associated with periodontal disease can enter the bloodstream, contributing to the development, or negatively influencing, these serious conditions.

Moreover, untreated dental issues such as caries and periodontal diseases can lead to severe pain, infections and tooth loss, which in turn affect nutrition, speech and self-esteem. The inability to chew food properly due to dental problems can result in poor nutrition and gastrointestinal issues, highlighting the far-reaching implications of oral health on overall wellbeing. In children, dental health is crucial for proper development, learning and social interactions. Poor oral health in childhood can lead to missed school days and reduced academic performance, further emphasising the need for comprehensive dental care.

Evidence-based arguments on why dental care should be a priority

The evidence supporting the prioritisation of dental care within healthcare systems is robust. Studies have shown that preventive dental care can significantly reduce the incidence and severity of oral diseases, leading to better health outcomes and lower healthcare costs. For instance, regular dental check-ups and cleanings can prevent the progression of dental decay and gum disease, avoiding the need for more expensive and invasive treatments later on.

Integrating dental care into broader healthcare initiatives also supports the early detection of systemic conditions. Dentists are often the first to notice signs of systemic diseases such as diabetes, which can manifest as oral symptoms such as dry mouth, gum inflammation and slow healing of oral tissues. By prioritising dental care, healthcare systems can leverage this early detection capability, improving the management and outcomes of systemic diseases.

Call to action for policymakers and stakeholders

Given the substantial evidence linking oral health to overall health, it is imperative for policymakers and stakeholders to prioritise dental care within the healthcare system. The integration of dental services into the NHI framework is a critical step towards achieving this goal. Adequate funding, effective implementation and continuous evaluation are essential to ensure that dental care is accessible, affordable and of high quality for all South Africans.

Policymakers should also focus on public health initiatives that promote oral health education and preventive care. Increasing public awareness about the importance of oral hygiene, regular dental check-ups and healthy dietary habits can significantly reduce the burden of dental diseases. Collaboration between dental professionals, healthcare providers and community organisations is crucial in implementing these initiatives effectively.

Dental health is an integral component of overall health, influencing various systemic conditions and significantly impacting quality of life. The NHI presents an unprecedented opportunity to prioritise dental care within South Africa's healthcare system, ensuring that all citizens have access to comprehensive and preventive dental services. By recognising the interconnectedness of oral and general health and committing to equitable funding and resource allocation, South Africa can achieve significant improvements in public health outcomes.

CONCLUSION

The journey toward equitable healthcare in South Africa is at a pivotal juncture with the implementation of the NHI. This bold initiative embodies a commitment to universal health coverage, promising to bridge the longstanding disparities that have plagued our healthcare system. Dental care, often sidelined in funding and policy discussions, must be recognised as a vital component of this transformative vision.

As this editorial has explored, dental health is not an isolated facet of wellbeing but a foundational element that intersects with various systemic health outcomes. The neglect of dental care exacerbates chronic diseases, undermines overall health and perpetuates socioeconomic inequities. The NHI offers a historic opportunity to rectify these oversights by ensuring comprehensive dental services are accessible to all, regardless of economic status.

However, the realisation of this vision demands more than legislative change; it requires a collective commitment to reimagining and restructuring our healthcare priorities. Policymakers, healthcare providers and the broader community must collaborate to build a robust, integrated healthcare system where dental care is not an afterthought but a priority. This entails adequate funding, strategic resource allocation and an unwavering focus on preventive care and public health education.

The potential for the NHI to transform the healthcare landscape is immense, but it will only be realised through diligent implementation and continuous evaluation. We must learn from international models, adapt their best practices to our unique context, and remain vigilant against the pitfalls of mismanagement and corruption.

In conclusion, as South Africa embarks on this ambitious journey, let us seize the opportunity to redefine our healthcare system. By prioritising dental care within the NHI framework, we can foster a healthier, more equitable society where every individual's right to comprehensive healthcare is upheld. The integration of dental services into the NHI is not just a policy adjustment; it is a profound affirmation of the value we place on the health and dignity of every South African.

This moment calls for visionary leadership and a steadfast commitment to health equity.

SADA's concern on delays in inquiry into racial profiling by medical schemes

SADJ JUNE 2024, Vol. 79 No.5 P238-239

Mr KC Makhubele – CEO, South African Dental Association

INTRODUCTION

The South African Dental Association (SADA) acknowledges the ongoing concerns and frustrations expressed by its members regarding the indefinite delay in the release of the final report on racial profiling by medical schemes. This issue affects not only the medical profession at large but also our members in oral health, who are deeply concerned about the implications of these delays.

BACKGROUND

The investigation into claims of racial profiling by medical schemes was initiated in 2019 following serious allegations by a group of healthcare workers. These workers claimed that medical administrators and schemes were engaging in discriminatory practices by disproportionately targeting black and Indian doctors and therapists for fraud investigations, while white healthcare providers were rarely subjected to such scrutiny. These allegations raised significant concerns about racial bias within the medical schemes, prompting calls for a thorough and transparent inquiry to address the issue.

The Council for Medical Schemes (CMS) responded to these allegations by appointing an independent investigation panel in July 2019. The panel, chaired by prominent legal figures Adila Hassim, Tembeka Ngcukaitobi, and Kerry Williams, was tasked with examining whether there was evidence of racial profiling in the investigation practices of medical schemes and administrators. This inquiry was a critical step towards understanding and addressing potential systemic racism within the healthcare industry.

The scope of the inquiry was broad, focusing on the application of Section 59 of the Medical Schemes Act. This section allows medical schemes to recover payments made in error or due to fraud, theft, or misconduct discovered after the fact. The central question was whether this legal provision was being applied discriminatorily against black and Indian healthcare providers.

The investigation involved a series of hearings that began in July 2019 and concluded in January 2020. These hearings provided a platform for affected healthcare providers to present their experiences and for medical schemes to explain their investigative processes. The panel received extensive submissions, including from major players like Discovery Health and Medscheme, which were critical to understanding the practices and methodologies employed in fraud detection.

Throughout the inquiry, there was considerable public and professional interest, as the outcome had the potential to influence regulatory practices and restore trust in the fairness of medical schemes. The findings of the investigation were initially scheduled for release on December 16, 2020. However, just before the scheduled media conference, the release was halted at the request of Health Minister Dr. Zweli Mkhize, who indicated that he had not yet reviewed the report's findings.

This last-minute intervention led to a significant delay. The panel of advocates agreed to meet with the Health Minister and the medical scheme regulator to discuss the findings. Despite their willingness to engage, the panel was not granted meetings with either the Minister or the Council for Medical Schemes. This lack of communication has contributed to the indefinite delay in the report's release, causing frustration and concern among healthcare providers and stakeholders who are eagerly awaiting the inquiry's conclusions.

The delay has been further compounded by financial issues, with the CMS reportedly spending R11.3 million in unbudgeted funds on the investigation. This expenditure has put additional pressure on the regulator, which is now considering legal action to compel the panel to complete and release the final report.

As the healthcare industry continues to grapple with these unresolved issues, the importance of finalizing and publishing the report cannot be overstated. The findings are expected to provide crucial insights into whether racial discrimination exists within the investigative practices of medical schemes and to recommend measures to ensure equitable treatment of all healthcare providers moving forward.

CURRENT STATUS

Despite the completion of the hearings and the preparation of an interim report in January 2021, the final report has yet to be published. The release has been stalled due to an ongoing impasse between the investigation panel and the Council for Medical Schemes (CMS), with both parties attributing the delays to each other.

Key Points of Contention

1. **Ministerial Involvement:** Health Minister Dr. Zweli Mkhize requested a delay in the report's release, stating he needed more time to review the findings and seek clarifications from the panel. This step has contributed significantly to the delay.
2. **Financial Constraints:** The CMS, having spent R11.3 million on the inquiry, has faced budgetary pressures, adding to the complexity of finalizing the report.
3. **Allegations of Obstruction:** Accusations have been made that the CMS is intentionally blocking the release of the report. However, the CMS contends that it is the panel's responsibility to finalize the document.
4. **Panel's Stance:** The panel, led by Adv Tembeka Ngcukaitobi, maintains that they have presented a detailed plan and budget for completing the report, which has not been accepted by the CMS. They assert that the delay is due to a lack of communication and support from the CMS.

Impact on the Medical Community

The indefinite delay has caused significant distress among healthcare providers, especially those who believe they have been unfairly targeted. The interim report indicated that black healthcare practitioners were more likely to be accused of fraud, waste, or abuse compared to their white counterparts. This finding underscores the urgency of resolving the matter to ensure fairness and transparency in the industry.

SADA's Position

SADA remains committed to supporting all its members and addressing their concerns with the utmost seriousness. We urge for the swift resolution of this matter to bring finality and clarity, which is crucial for maintaining trust and integrity within the healthcare sector.

Conclusion and Call to Action

We sympathize deeply with those affected by these unresolved issues and acknowledge the stress and uncertainty this prolonged delay has caused. SADA calls on all parties involved—the CMS, the investigation panel, and the Health Minister—to expedite the release of the final report. This is essential to address the allegations of racial profiling, ensure equitable treatment of all healthcare providers, and uphold the standards of justice and transparency within our profession.

Final Note

SADA will continue to monitor the situation closely and provide updates to our members as new information becomes available. We advocate for transparency, fairness, and prompt resolution to restore confidence in our medical and dental healthcare systems.

NOTICE OF POSTPONEMENT OF THE SOUTH AFRICAN DENTAL ASSOCIATION (SADA) 2022 ANNUAL GENERAL MEETING

The SADA FYE 2022 Annual General Meeting (AGM), previously set for 25 April 2024, is postponed due to finalisation of the auditing procedures. The majority of the work has been finalised, but the last lparts are only being finalised in early April 2024. A new date will be communicated soon. We apologize for any inconvenience.

Dr N Osman

SADA Board of Directors
2 April 2024

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Radiographic methods: The way forward in age estimation in the Western Cape, South Africa

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S Chandler[1], KC Bailie[2], R Laubscher[3]

ABSTRACT

Introduction

Age assessment of human remains is essential in forensic and anthropological settings, based on age-related alterations in bones and teeth. Teeth are crucial for identification, especially in decayed or charred corpses. Gustafson's approach, frequently employed in the Western Cape, South Africa, has demonstrated inaccuracies among the local population.

Aims and objectives

The study aimed to provide a more accurate and easy-to-use approach for estimating the dental age of adults. The goals were to calculate pulp-to-dentine size ratios from periapical radiographs and to establish their relationship with chronological age.

Design and methods

The study performed radiographic measurements on 74 mandibular central incisors and 72 mandibular lateral incisors from 45 cadavers aged 21-95 years, in both mesiodistal and buccolingual orientations.

Results

Stronger relationships were seen between measurements in buccolingual-orientated radiographs and age than in mesiodistal ones. This novel strategy was found to be superior when compared with Gustafson's method.

Conclusion

This method demonstrates superior accuracy in estimating the age of the tooth samples compared to Gustafson's method. This development has the potential to have a major impact on forensic and anthropological practices, especially in populations where Gustafson's method has proven to be inadequate.

Keywords

Forensic dentistry, dental age estimation, teeth.

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Author's contribution

1. Susan Chandler – 60%
2. Keané Catt Bailie – 20%
3. Ria Laubscher – 20%

INTRODUCTION

Forensic pathology agencies in African nations currently deal with a growing humanitarian dilemma related to identifying unidentified decedents.[1] When an individual dies, a death investigation usually ensues. This death investigation consists of several components, including the manner of death, the cause of death and the identification of the deceased.[2]

Teeth can be vital in identifying unidentified decedents, predominantly when the remains are severely decomposed or badly burnt. Teeth are used in these cases as they are frequently preserved, even if most of the other tissues from the body have disintegrated. Dental age estimation is then used to decrease the list of possible identities (eg from a missing person's database). Furthermore, dental age estimation can also be used in mass disasters or multiple fatality cases.[3,4,5]The visual dental method primarily used for dental age estimation in the Western Cape was described by Gustafson.[6] However, this method is invasive and destructive, and the forensic dentist preferably uses mandibular incisors for this process. The method suggested that six age-related changes (ie attrition of the enamel and dentine, the change in the level of the periodontal attachment, the extent of the secondary dentine deposition within the pulp, the apposition of secondary or cellular cementum on the root surface, the resorption of the root apex and the translucency of the root) be used in combination to estimate the chronological age of a person.[6] Other researchers and investigators have scrutinised Gustafson's method as they were convinced there were errors in the age estimation method. As a result, several studies have been conducted to prove or disprove this age estimation method. Several of these researchers thought Gustafson's method was based on assumptions that were probably incorrect.[2,7,8]

Subsequently, the author conducted a study to determine the accuracy of Gustafson's method of dental age estimation of adult teeth in the Western Cape.[9] A total of 55 teeth, consisting of maxillary central incisors and mandibular central and lateral incisors, were used in the study. (The incisors were chosen as they are the teeth used regularly for age estimation in the Western Cape.) The teeth were harvested from cadavers and patients (as part of routine dental treatment) of whom the chronological ages were known. The mean difference between the individual's chronological and estimated age was 11.6 years, with a standard deviation of 8.52 years. It was therefore proven that this method is not accurate when applied to the people of the Western Cape.[9] This might be because the population of the Western Cape is made up of many different ethnic groups, as listed by the Department of Statistics of South Africa.[10]In contrast, in 1995, Kvaal et al. used full-mouth dental radiographs to

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estimate the chronological ages of adults by measuring the size of the dental pulp on the radiographs. First, Kvaal et al. (1995) selected periapical radiographs of six different types of teeth from both the maxilla and the mandible. These included central and lateral incisors and second premolars from the maxilla, and lateral incisors, canines and first premolars from the mandible. Next, they calculated the tooth/root length, the pulp/root length, the pulp/tooth length and the pulp/root width at three different levels of each tooth. Finally, Kvaal calculated regression formulae using all six teeth from the maxilla and the mandible, three teeth from the maxilla, three teeth from the mandible and the individual teeth. The best results were found when ratios of all six teeth from both the maxilla and the mandible were included with a standard error of 8.6 years.[11]Adult dental age estimation is undertaken regularly by a forensic dentist as part of the standard procedure to identify unidentified decedents. Currently, DNA analysis is not utilised for all forensic cases. In most cases, the use of DNA is also impossible because of a lack of comparative material. In addition, financial constraints in South Africa for forensic services are also a limiting factor in the identification process. Dental age estimation, therefore, is a significant part of the identification process.

MATERIALS AND METHODS

A descriptive observational study on the mandibular four anterior teeth was conducted. Permanent mandibular central incisors (teeth numbers 31 and 41) and lateral incisors (teeth numbers 32 and 42) were used to conduct this study, as they are usually among the group of permanent teeth to appear in the mouth first.[12,13] Ethical approval was obtained from the University of the Western Cape Research Ethics Committee (Project registration number 15/3/27). In addition, permission was obtained from the Anatomy and Histology Department of the University of Stellenbosch to use the teeth harvested from the cadavers.

The teeth were analysed using radiographs to estimate age at death. A total number of 74 mandibular central incisors and 72 mandibular lateral incisors were harvested from 45 cadavers donated to the Anatomy and Histology Department of the University of Stellenbosch, Faculty of Medicine and Health Sciences. The age of the samples varied from 21-95 years old. Furthermore, the details of the individuals, including date of birth, date of death and gender, were obtained. However, these details were kept confidential, and the personal identification of the cadavers was not disclosed.

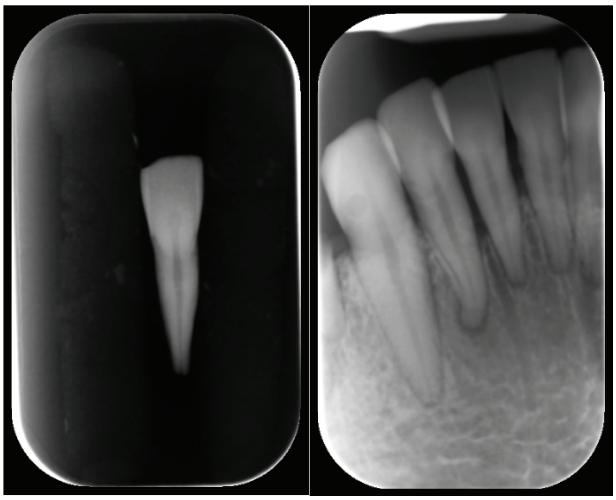
Prior to extraction, the 45 mandibles were subjected to a boiling process to remove all soft tissue. Next, the level of the alveolar bone was marked with a black permanent marker on each tooth while the teeth were still intact in the mandibles. This was completed to indicate the vicinity where the periodontal ligament attachment was (before the mandibles were boiled). In this way, the process of finding the periodontal ligament attachment was standardised.

Permanent mandibular central incisors (teeth 31 and 41) and mandibular lateral incisors (teeth 32 and 42) were included in the study. The Federation Dentaire Internationale Numbering System (FDI) was used in this study. Upon clinical examination, seven of the mandibular central incisors and nine of the mandibular lateral incisors were excluded from the study. The exclusion criteria included: the unknown birth date of the donor, carious teeth, teeth with restorations or root canal treatment, teeth with more than one root, and fractured roots. This resulted in 42 mandibles, with 67 mandibular central incisors and 62 mandibular lateral incisors being used for the study. Twenty (20) cadavers were male and 22 were female.

Periapical radiographic images, using digital phosphor plates, were taken of the teeth while they were still intact in the jaws. Change to: These indirect digital anterior periapical radiographic images were taken using anterior phosphor plates and an exposure of 65kV and mA.s of 3 per tooth. A DIGORA OPTIME® phosphor plate scanner by SOREDEX® was used to develop the anterior digital periapical radiographic images.

The teeth were then extracted from the jaws and placed in containers labelled with the cadaver number and the tooth numbers. Indirect digital periapical radiographic images of the extracted teeth were subsequently taken, both in a mesiodistal and buccolingual position. The process was the same as that described above. First, the extracted teeth were stabilised with sticky wax on a flat surface to ensure the position of all the teeth was the same. Next, the radiographic tube was placed perpendicular to the flat surface, with the attached tooth on, at exactly 11cm away. The mandibular central and lateral incisors were used in two separate groups to conduct the measurements.

The digital radiographs of the extracted teeth were used (Figure 1), as the pulp was much more evident on these radiographs than on the ones where the teeth were still intact in the mandibles (Figure 2).



Figures 1 and 2: Digital radiographic image of an extracted tooth compared to the digital radiographic image of teeth still intact in the mandible.

In the digital periapical radiographic images (phosphor plate images) taken of the intact teeth, there was a chance that the crowns might overlap, making the measurement of that specific tooth impossible. However, it was also possible to take mesiodistal-orientated images of these extracted teeth, which resulted in a better view of the dental pulp (Figure 3).

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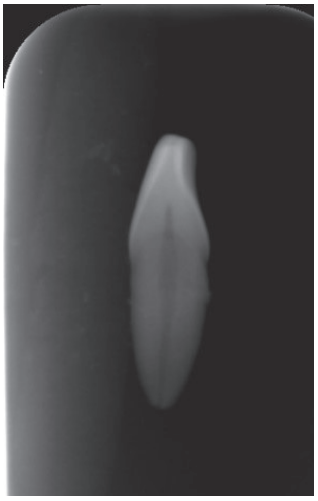

Figure 3: A digital radiographic image (phosphor plate image) of tooth 41 taken with a mesiodistal orientation.

The indirect digital periapical radiographic images were used to compare the total area of the dentine (both within the crown and the root of the tooth) with the area of the pulp of the tooth of teeth 31, 41, 32 and 42. A program called Autocad® for Electrical Components (By Autodesk®) 2012 was used for these measurements. First, the indirect digital radiographic images of the extracted teeth (taken with mesiodistal and buccolingual orientation) were inserted into the Autocad® program. Next, each radiograph was "scaled" in the Autocad® program, and "35" was chosen as the new length. This was done to ensure that each image's scale and size were identical. Next, the "spline fit" function was used to measure the area of the dentine and the area of the pulp for each tooth (Figure 4). Next, the ratio between the dentine and pulp areas was calculated for each tooth. This ratio was then compared with the chronological age of the individual from whom the tooth was extracted to create a new regression equation.
Teeth 31, 41, 32 and 42 were statistically analysed independently. The p-value was calculated between age and all the variables tested. An alpha level of 5% (0.05) was chosen for this study. The data were analysed using the Stata Statistical Software Version 15 (from the Stata Corporation) by the MRC.

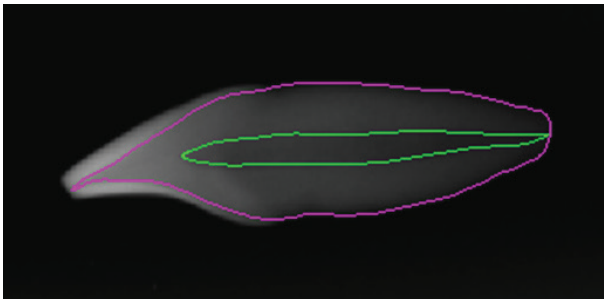

Figure 4: The area of the dentine and area of the pulp as measured with the Autocad® Electrical (2012) program.

To ensure validity and reliability, intra- and inter-examiner analysis were conducted, 10 central and 10 lateral incisors were re-examined by the primary investigator (intra-examiner) and another examiner (inter-examiner). In addition, the operators were blinded to the results of the previous measurements.

Lastly, the original Gustafson's method of dental age estimation was undertaken on the same teeth samples by an expert forensic odontologist who has been using this method for many years. The aforementioned forensic odontologist was chosen to do the analysis to ensure the results were as accurate as possible. The investigator was blinded to the chronological age of the person from whom the tooth was extracted. The chronological age was only revealed during the comparison process of the chronological and predicted ages.

CALCULATIONS

An overall model was fitted with the ratio Area Pulp to Area Dentine MD (MD_Pulp to dentine ratio) and Area Pulp to Area Dentine BL (BL_Pulp to dentine ratio), sex at birth and tooth type. In addition, the model was adjusted for the clustering of tooth types within the same individual. (Clustering means more than one tooth was extracted from the same individual.) This way, a better predictive model for age was identified.

The model used tooth 31 and males as the reference. This means that for females, a specific numerical value (9.45057) should be subtracted, and specific values should be added for the other tooth types.

It was shown the BL_Pulp to dentine ratio was statistically significant predictor of age in this model with $p<0.05$ ($p<0.001$).

The equations that were created were as follows:

Tooth 31: Estimated Age = 78.4035 – 91.4515 x (MD_Pulp to Dentine Ratio) – 187.638 x (BL_Pulp to Dentine Ratio) – 9.4506 (If Female)

Tooth 41: Estimated Age = 78.4035 – 91.4515 x (MD_Pulp to Dentine Ratio) – 187.638 x (BL_Pulp to Dentine Ratio) – 9.4506 (If Female) + 1.8250 (If tooth 41)

Tooth 32: Estimated Age = 78.4035 – 91.4515 x (MD_Pulp to Dentine Ratio) – 187.638 x (BL_Pulp to Dentine Ratio) – 9.4506 (If Female) + 5.1024 (If tooth 32)

Tooth 42: Estimated Age = 78.4035 – 91.4515 x (MD_Pulp to Dentine Ratio) – 187.638 x (BL_Pulp to Dentine Ratio) – 9.4506 (If Female) + 6.8540 (If tooth 42)

RESULTS

Boxplots were created to show the difference between age and the predicted mean age for males and females when the overall radiographic model is used (Figure 5).

The overall radiographic model – ie both the ratio Area Pulp to Area Dentine MD (MD_Pulp to dentine ratio) and the ratio Area Pulp to Area Dentine BL (BL_Pulp to dentine ratio) – was used to calculate the predicted age. This predicted age was then compared to the chronological age of the individual from whom the teeth were extracted.

The number of teeth, the mean difference between predicted age and real age, and the standard deviation of age estimation for the different teeth when the overall radiographic model is used are summarised in Table I.

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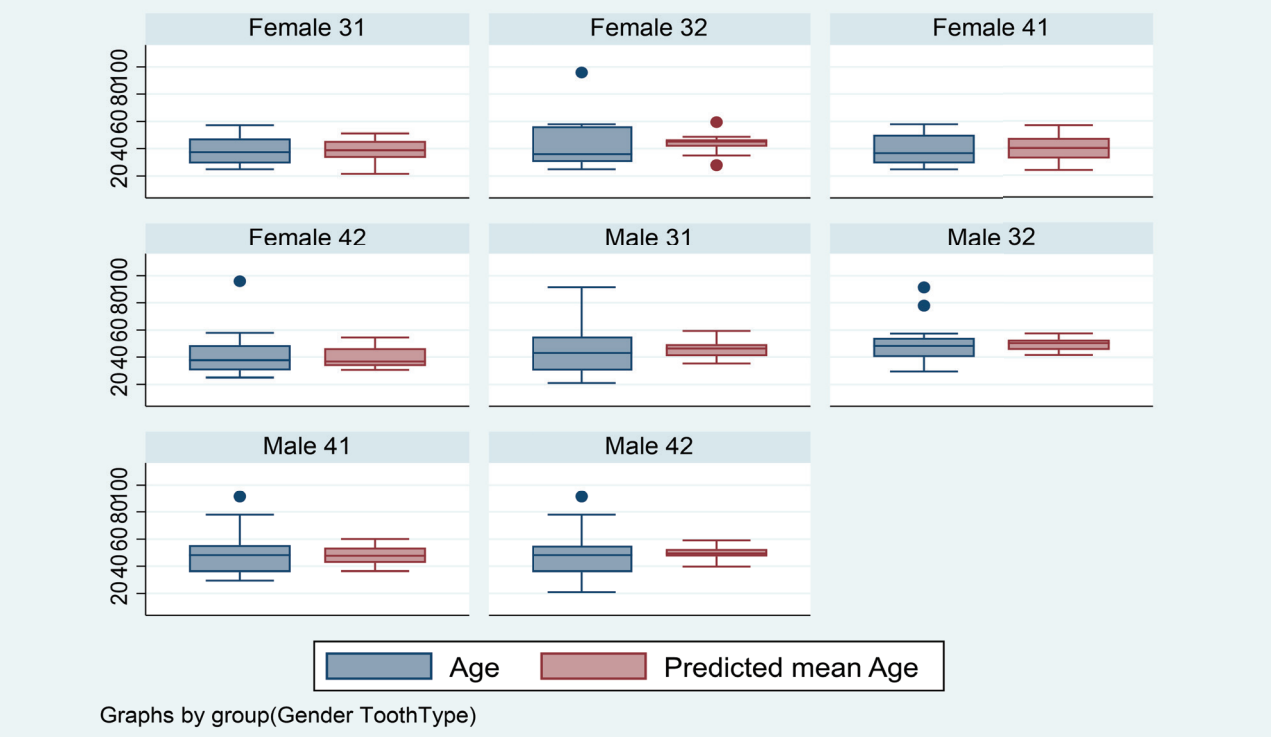

Figure 5: Boxplots to show the comparison between the chronological ages and the predicted mean ages using the overall radiographic model for teeth 31, 32, 41 and 42 and for males and females.

Sex and tooth type	N	Mean difference between predicted age and real age	sd
Male 31	15	0.9979	17.07
Male 41	15	1.4133	15.642
Male 32	16	-0.1563	15.567
Male 42	17	-2.0483	17.756
Female 31	19	-0.7947	8.126
Female 41	18	-1.1833	8.236
Female 32	13	0.1032	15.203
Female 42	16	2.1763	12.571
Total	129		
Average		0.0635	13.771

Table I: The number of teeth, mean difference between predicted age and real age, and standard deviation of age estimation for the different teeth, divided into males and females when the overall radiographic model is used.

The results demonstrate the absolute age difference within five years, within 10 years and more than 10 years, summarised in Table II. The analysis was done in three groups, namely males, females and the combined sex group.

Absolute age difference for overall radiographic model			
Age difference (Years)	Males	Females	Combined sex
0-<5	29	20	49
	46.03%	30.3%	37.98%
5-<10	12	26	38
	19.05%	39.39%	29.46%
10+	22	20	42
	34.92%	30.3%	32.56%
Total	63	66	129
	100%	100%	100%
Within 5 years	46.0%	30.3%	38.0%
Within 10 years	65.1%	69.7%	67.4%

Table II: The absolute age difference between the predicted age and the chronological age for the overall radiographic model.

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When the chronological age was compared to the predicted age, the predicted age was overestimated in some cases and underestimated in others. The results are summarised in Table III.

Overall radiographic model: Analysis of estimation of age				
Age interval	Over-Estimated	%	Under-Estimated	%
<30	21	16.3	2	1.6
30-<40	25	19.4	11	8.5
40-<50	20	15.5	6	4.7
50-<60	7	5.4	27	20.9
60-<70	0	0	0	0
70-<80	0	0	4	3.1
80-<90	0	0	0	0
90-<100	0	0	6	4.7
Total	73	56.6	56	43.4

Table III: A summary of the results showing over- and underestimation of predicted age when the overall radiographic model was used.

This showed that the predicted age was overestimated in 56.6% of the 129 (73 + 56) cases and underestimated in 43.4% of the cases.

DISCUSSION

The present study employed a novel overall radiographic method to evaluate age estimation, specifically on a Western Cape population. Notably, the BL_Pulp to Dentine Ratio and the MD_Pulp to Dentine Ratio yielded the most promising outcomes when used togehter.

When the two ratios (ie BL_Pulp to Dentine Ratio and MD_Pulp to Dentine Ratio) were applied to the digital periapical radiographic images, a meticulous comparison was undertaken. The comparison depicted that there was a statistically significant correlation between both ratios and age for all the teeth in the female group. On the contrary, no statistically significant correlation was found between the two ratios and age in the male group. The boxplots in Figure 5 portrayed that the predicted mean ages compared to the chronological ages for females were more accurate than that of males. In addition, the predicted mean age for females was the most accurate when using teeth 31 and 41. Furthermore, the correlation between age and the radiographic ratios (ie MD_Pulp to Dentine Ratio and BL_Pulp to Dentine Ratio) was negative, rendering that as the individual's age increased, the size of the pulp decreased.

When the novel overall radiographic model was employed, the highest degree of precision was obtained in estimating age for males, as demonstrated by Table I. Teeth 41 and 32 were utilised in males, with a standard deviation of 15.642 and 15.567, respectively. Conversely, the highest degree of precision was obtained in estimating age for females when teeth 31 and 41 were utilised. These teeth had a standard deviation of 8.126 and 8.236, respectively.

Aligned with a previous study done by Bosmans et al. (2005), the present investigation revealed slight differences when examining the comparisons. Bosmans et al. (2005) used the Adobe Photoshop® 6.0 computer program on digital panoramic radiographs. Utilising Kvaal's method, the results demonstrated a slightly less accurate prediction, with a standard error of 9.5 years.[14]The data obtained were analysed in three groups: male, female and the combined sex group. When the overall radiographic model was utilised, the predicted age was within 10 years of the chronological age for 65.1% of males, 69.7% of females and 67.4% for the combined sex group, as seen in Table II. The data demonstrated a statistically significant correlation between both ratios and the chronological age for all the teeth in the female group. Contrarily, no statistically significant correlation was found between the two ratios and the chronological age in the male group. The female group, therefore, appears to be more accurate than the male and combined sex group. These results are in direct contrast to a study done by Igbigbi and Nyirenda. Igbigbi and Nyirenda (2005) established that more accurate results were achieved when teeth from male individuals were utilised.[15] Some of the other studies that used radiographs to estimate age did not distinguish between males and females and analysed all the teeth by tooth type.[11,14,16,17] These results emphasise the significance of differentiating between various sex groups to ensure the highest level of accuracy.

Upon application of the overall radiographic model, most cases of overestimation of predicted age occurred in individuals younger than 50, as demonstrated by Table III. Conversely, the majority of the cases of underestimation of predicted age occurred in individuals older than 50. All cases where the individuals were older than 70 years were underestimated. Age and the predicted mean age are significantly correlated ($p<0.001$) with $r=0.5417$. Afify et al. (2014) also used panoramic radiographs, but they used Autocad® 2010. The investigators obtained a high correlation with age when three mandibular teeth were used with $r=-0.956$.[18] The highest level of correlation for the current study was $r=-0.7282$ between the mesiodistal pulp to dentine ratio and age for females, using tooth 32. The negative correlation was similar for both studies.

Through comparison of the novel overall radiographic model to Gustafson's method, the results demonstrated that the new model was more accurate than Gustafson's method for dental age estimation. These results are consistent with the results of the previous study done by the author, which proved that the original Gustafson's method of dental age estimation does not give accurate results when applied to a sample of the Western Cape population.[9]This study used digital periapical radiographic images of extracted teeth specifically so that a radiographic image could be created of the teeth in a mesiodistal orientation. It was thought that the measurements of the area of the dentine and pulp in this orientation would give a more accurate result in estimating an individual's age. Unfortunately, most previous studies using radiographs were more accurate than this study. Some of the studies used pantomographs, which used intact teeth and, as such, the teeth could only be viewed in the buccolingual orientation. The crown height and the coronal pulp height were measured and used to estimate the individual's age.[15] Another study that used digital radiographic periapical images measured the reduction in pulp chamber size in the buccolingual orientation. The outcomes of their investigation surpassed the accuracy level achieved in this study.[17] Nonetheless, this overall radiographic model still surpassed the results in comparison to the method currently being used at the Salt River mortuary in Cape Town in the Western Cape (South Africa).

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CONCLUSION

This research was undertaken to attempt to improve the method of dental age estimation currently used in Cape Town in the Western Cape, South Africa. In an ideal world with unlimited resources and funding, a more advanced technique such as DNA analysis or biochemically-based methods could have been used. But, unfortunately, this is not currently an option for the work being done in the Western Cape. Therefore, this research fundamentally contributes to a more accurate method of dental age estimation that can realistically be used with the resources and funding available in the Western Cape.

In conclusion, this study has successfully developed a novel model for dental age estimation known as the overall radiographic model. The results of the dental age estimation obtained using this newly developed model were more accurate than the original Gustafson's age estimation method for this specific sample of teeth. The results proved that the overall radiographic model of dental age estimation was more accurate when applied to a sample of the Western Cape population. Though the accuracy has been determined, the model still has some limitations.

The main limitations of this study include the relatively small sample size and the small demographical area in which the teeth were harvested. This small sample size resulted from the strict exclusion criteria and the limited availability of suitable cadavers to harvest the teeth from. Another limitation is that only central and lateral mandibular incisors were used. Therefore, it is imperative to conduct further studies that encompass a broader demographical area in order to acquire teeth samples, which would consequently lead to an increased sample size. These subsequent studies are crucial for obtaining more comprehensive and representative data, thereby enhancing the validity and generalisability of the findings related to dental age estimation.

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CONFLICT OF INTEREST

None

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Educators and caregivers' oral health knowledge, attitudes, and practices in special education schools in the eThekwini District, KwaZulu-Natal

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S Gumede, S Singh, M Radebe

ABSTRACT

Introduction

Disability often leaves individuals reliant on caregivers for care and oral hygiene, particularly the young, severely impaired and institutionalised. However, these caregivers may lack adequate knowledge on oral hygiene and proper diet, leading to unhealthy eating habits or cariogenic snacks and increasing the risk of oral diseases throughout their lifetime.

Aims and objectives

To ascertain educators' and caregivers' oral health knowledge, attitudes and practices within the identified special schools, by means of a self-administered questionnaire.

Design

A cross-sectional KAP survey design.

Methods

This study was conducted in 22 out of 33 special schools located in eThekwini district which consented to participate in the study. On average, each of the 22 special schools had about 40 educators and caregivers combined. A self-administered questionnaire was used to collect the data. Twenty questionnaires – which is 50% of the targeted population – were sent out to each school, and participation was voluntary. Ultimately, 440 questionnaires (20 questionnaires per school) were sent out.

Results

Only 312 of the 440 questionnaires were completed, yielding a response rate of 70.90%. Just over half of the study participants (n=161; 51.6%) believed that brushing twice daily and rinsing with mouthwash is the most important dental self-care practice. Only 46.8% of participants believed that sugar consumption contributes to tooth decay due to bacteria turning sugar into acid. Most respondents (n=205; 65.7%) strongly agreed that brushing and flossing their teeth reduces tooth decay risk, with 221 participants (70.8%) believing they have a responsibility to prevent tooth loss. However, 51.3% of study participants disagreed with the statement that dentures are less troublesome than taking care of natural teeth. About 83.1% of participants brushed their teeth twice daily, with 61.54% brushing for 2-3 minutes. Furthermore, 71.8% of participants used medium bristles and 47.76% replaced their toothbrush every 1-3 months. Most participants agreed that visiting a dentist is necessary, with a small percentage (2.24%) having never visited before. The majority of participants (85.6%) stated that their oral health practices, attitudes and knowledge could influence how oral health education is given to school students.

Conclusion

The results of the present study showed some inconsistencies in the knowledge, attitudes and practices of the educators and caregivers. Oral health awareness among these individuals is essential and should be done on a regular basis.

Keywords

Oral health, caregivers, educators, attitudes, practices, knowledge

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1. S Gumede – study conceptualisation, data analysis, manuscript preparation, writing and final editing (60%)
2. S Singh: – data analysis, manuscript preparation and editing (20%)
3. M Radebe – data analysis, manuscript preparation and editing (20%)

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None

Conflict of interest

The authors declare that there is no conflict of interest

INTRODUCTION

Special schools are schools that offer education for students and individuals with special educational needs because of learning difficulties which may be physical or behavioural in nature.[1] These disorders may include dyslexia, attention deficit hyperactivity disorder (ADHD), Osteogenesis Imperfecta, cerebral palsy, muscular dystrophy,spina bifida, Friedreich's ataxia, Asperger syndrome, autism, intellectual disability, and many other disabilities.[1] Studies have shown that individuals with special health care needs exhibited higher caries rates, poor oral health, unhealthy periodontal

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status and unmet dental needs than children in the same age general population.[2]

The disability makes most of them dependent on parents, siblings and caregivers for general care as well as oral hygiene, especially the young, severely impaired and institutionalised.[4] Most of these caregivers may not have the required knowledge to recognise the importance of oral hygiene and proper diet. This lack of knowledge may result in these individuals being pampered with unhealthy eating habits or cariogenic snacks.[5] People with disabilities deserve the same opportunities for oral health and hygiene as those who are healthy; these people may be at an increased risk for oral diseases throughout their lifetime. Therefore, its neglect gives rise to negative health consequences and unpleasant social lives of these individuals.[6] Unfortunately, oral health care is one of the greatest underserved health needs of disabled people. This may be because of inadequate dental care or poor dental public health measures that may have a negative influence on their oral health status.[7] Additionally, there is limited published information on strategies addressing the barriers to dental treatment in children with special needs in South Africa (SA). Although oral health education has shown improvements in attitudes and knowledge towards dental health care, especially among the caregivers of special needs patients,[8] this is still not evident in many special schools in SA, especially in KwaZulu-Natal (KZN).

Therefore, the need to conduct a study that would ascertain educators' and caregivers' oral health knowledge attitudes and practices within the setting of the 22 special schools, by means of self-administered questionnaires using a Knowledge, Attitude and Practices (KAP) study. This paper forms part of a larger study titled "Oral health care for children attending schools for special needs in eThekwini district, KwaZulu-Natal, South Africa". This study explored oral health needs for schoolgoing children with disabilities in eThekwini district, KZN through a systematic collection of commonly occurring oral health-related epidemiological data and by implementing and evaluating an oral health promotion intervention in selected schools so as to inform a framework for oral health care for children with special needs.

METHODS AND MATERIALS

Study settings

This study was conducted in 22 special schools located in eThekwini district in KwaZulu-Natal, South Africa.

Study design

A cross-sectional KAP survey was used to conduct the study.

Sample

This study was conducted in 22 out of 33 special schools located in eThekwini district which consented to participate in the study. The study population included service providers (educators) and caregivers who are health- and non-health related (healthcare workers and other school staff) who take care of the learners with special needs attending the 22 special schools in eThekwini district. On average, each of the 22 special schools had about 40 educators and caregivers combined. A self-administered questionnaire was used to collect data. Twenty questionnaires, which is 50% of the targeted population, were sent out to each school and participation was voluntary. Ultimately, 440 (20 questionnaires x 22 schools) questionnaires were sent out.

Ethical approval

The study was approved by the University of KwaZulu-Natal's Biomedical Research Ethics Committee (BREC00003814/2022), and ethical procedures were followed to protect participants' rights, interests and dignity. Thus participants' autonomy, confidentiality and privacy were upheld. Gatekeeper permission was obtained from the KZN Department of Education.

Recruitment methods

Participation was voluntary. Those who were willing to participate were first given informed consent forms and, only when these were signed, the questionnaires were then given until the desired populated was obtained in each school.

Intervention details

Predefined questions organised in a standardised questionnaire were used to collect data. The questionnaire was adapted from previous studies titled "Oral health care for sentenced offenders in KwaZulu-Natal, South Africa"[9] and "Oral Health Knowledge, Attitudes, and Behaviors : Investigation of an Educational Intervention Strategy with At-Risk Females".[10] Multiple-choice questions were used in the questionnaire to evaluate oral health knowledge, attitudes and practices of the caregivers and educators. One of the questions in the questionnaire was an open-ended question and there were four sections with self-reported questions.

Section one comprised general demographic and professional background information. The first part of the questionnaire focused on demographic information (age, gender, experience, and oral health literacy).

The second part of the questionnaire focused on educators, and caregivers knowledge regarding the importance of oral health. Some of the questions included reported knowledge on the role of sugar in dental caries, dental plaque, gingivitis, the importance of flossing and the most important dental health habits, oral hygiene practices, cause of tooth decay, significance of fluoride, common oral problems and need for oral health education. The oral health knowledge questions also included the following questions: Does sugar contribute to tooth decay, and why? Does fluoride in toothpaste make any difference to the health of teeth? What is the truth about flossing? What is plaque? What is gingivitis? What are the two most important dental health habits?

The questions in section three were designed to evaluate participants' attitudes towards oral health care. Oral health attitudes were measured using statements, each of which had Likert scale responses. Likert-like responses involve a sequence of response statements that the respondent may choose from in order to rate their responses to the evaluative questions. It is commonly used to measure attitudes, knowledge, perceptions, values and behavioural changes.[11] The responses in this study included: (a) I agree completely, (b) I agree partially, (c) I disagree partially and (d) I disagree completely. The oral health attitudes statements included the following: I believe that only a dentist can prevent cavities; I believe that tooth loss is a normal part of

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growing old; I believe that I am responsible for preventing the loss of my teeth; I believe dentures are less trouble than taking care of my natural teeth; If my gums bleed when I floss, this usually means that I am hurting my gums and I should stop flossing my teeth; and I believe visiting the dentist is only necessary when I am experiencing pain.

The questions in section four were designed to assess participants' oral healthcare practices. These include questions such as: How often do you brush your teeth on average? How long do you spend brushing your teeth? How often do you replace your toothbrush? What type of toothbrush do you use? If you fall short of your brushing, how do you feel? How long do you think you could go on without brushing your teeth? Do you think it is necessary to visit a dental practitioner? How often do you go to the dental practitioner? How frequently do you snack between normal meals? How often do you consume sugary drinks?

Data analysis

The data acquired through the completed questionnaires was computed and analysed. The data gathered from the quantitative responses were analysed with using SPSS version 29. Variables of interest such as oral health practices, knowledge of basic dental hygiene and oral health attitudes were measured. Descriptive statistics were used to analyse all variables of interest, for example demographic details of participants (age, race and gender). The chi-square test was performed to determine whether there was a statistically significant relationship between variables from the quantitative data obtained. Statistical significance was noted only when the p-value was $p<0.05$.

Thematic analysis was used to analyse the data responses from the open-ended question. These were read through and initial notes taken just to be familiar with the data. The initial set of codes representing the meaning and patterns were refined and coded. Links were formed between the codes and supporting data; codes were further grouped into themes and the themes were reviewed and revised. The conclusions drawn from the analysed data and the results were then presented as a narrative. The data analysis process was conducted in four stages: finding initial concepts, coding the data, sorting the data by theme and interpreting the data. Techniques such as paraphrasing and summarisation were used to clarify participants' answers.

RESULTS

Social demographic

Only 312 of the 440 questionnaires were returned, generating a response rate of 70.90%. Participants in this study were 102 (32.7%) males and 210 (67.3%) females. The average age of the study participants was 27.86 (SD ± 5.582). The majority of participants (n=85; 27.2%) were between the ages of 30 and 39. There were 69 (22.1%) and 243 (77.9%) study participants from peri-urban and urban settings, respectively. Participants came from two educational subdistricts in the eThekwini district: Umlazi (195%) and Pinetown (117%).

Oral health knowledge

Just over half of the study participants (n=161; 51.6%) believed that brushing twice daily and rinsing with mouthwash was the most important self-care practice. Most of the caregivers and educators (n=238; 76.3%) defined "dental plaque" as a germ-containing substance that collects on the surface of teeth. The majority of the participants (235; 75.3%) believed that fluoride in toothpaste has hugely improved oral health status by decreasing cavities. More than two-thirds of the survey participants (225; 72.1%) defined gingivitis or gum disease as inflammation of the gums that involves swelling and bleeding. Only 84 (26.9%) said that "regular flossing is an important part of your dental health routine and you shouldn't worry if your gums bleed a bit at first". Only 46.8% of participants believed that sugar consumption contributes to tooth decay due to bacteria turning sugar into acid.

Oral health attitudes

Most respondents (n=205; 65.7%) strongly agreed that brushing and flossing their teeth reduces the risk of tooth decay, with 221 participants (70.8%) believing they have a responsibility to prevent tooth loss. However, n=160; 51.3% of participants disagreed with the statement that dentures are less troublesome than taking care of natural teeth. Just over 60% (n=209; 67.0%) of participants acknowledged knowing how to brush their teeth. Just below half (137; 43.9%) of the study participants strongly agreed to the statement "If my gums bleed when I floss, this usually means that I am hurting my gums and should stop flossing my teeth." Only 100 (32.1%) of the participants completely disagreed with the statement "I believe that as long as I brush my teeth, I can eat anything."

Oral health practices

About 83.1% (n=259) of participants brushed their teeth twice daily, with 61.54% (n=192) brushing for 2-3 minutes. Furthermore, 71.8% (n=224) of participants used medium bristles and 47.76% (n=149) replaced their toothbrush every 1-3 months. Most participants agreed that visiting a dentist is necessary, with a small percentage (2.24%) having never visited before. Just over half (54.8%; n=171) of the respondents claimed that they snack at least once a day. Approximately 61.22% (n=191) of participants reported consuming sweetened beverages at least once per day. Table 4 displays the complete results.

The majority of participants (85.6%) stated that their oral health practices, attitudes and knowledge could influence how oral health education is given to school learners. The data from the open-ended question had four key emergent themes.

One came from those who said "Yes (86.6%) their toothbrushing practices, attitudes and knowledge influence how oral health education is given to school learners which is oral health awareness".

Oral health awareness. Those who said "Yes" claimed they do so to promote good dental hygiene and to increase learners' oral health awareness. While others stated that they teach what they practice.

Does the same practices, attitudes and knowledge information form the bases of oral health education given to school learners that are under your watch? Please explain.

Yes, "Because I want to encourage them to take good care of their teeth"

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Oral Health Knowledge Inventory (n=312)		
Questions	**Responses**	**Frequency (%)**
What are the two most important dental health habits?	Brushing twice daily and rinsing with mouthwash after each brushing	161 (51.6)
	Brushing after every meal and using a water-pick device daily	17 (5.4)
	Brushing twice daily and flossing once a day	121 (38.8)
	Flossing every day and rinsing with mouthwash after each flossing	13 (4.2)
What is plaque?	The protective coat that naturally occurs on teeth	29 (9.3)
	A harmless substance that can be removed completely with brushing	31 (9.9)
	A germ-containing substance that collects on the surface of teeth	238 (76.3)
	A whitening substance that makes your teeth shine	5 (1.6)
	I don't know	9 (2.9)
Does fluoride in toothpaste make any difference to the health of your teeth?	No, it makes no difference at all, and fluoride is now being phased out because it isn't safe	15 (4.8)
	Fluoride in toothpaste has hugely improved oral health by decreasing cavities	235 (75.3)
	It isn't dangerous, but toothpaste without fluoride is just as effective at preventing cavities	27 (8.7)
	Nobody really knows because there haven't been many studies in the area	24 (7.7)
	I don't know	11 (3.5)
What is the truth about flossing?	Flossing is bad for your teeth	9 (2.9)
	It is OK to floss, but you should stop immediately if your gums start bleeding	171 (54.8)
	Flossing is fine if it makes your mouth feel fresher but it doesn't improve the health of your mouth	44 (14.1)
	Regular flossing is an important part of your dental health routine and you shouldn't worry if your gums bleed a bit at first	84 (26.9)
	I don't know	4 (1.3)
Sugar contributes to tooth decay because….?	Sugar directly harms tooth enamel	115 (36.9)
	Sugar combines with proteins in saliva to create a hard layer on teeth.	28 (9.0)
	Sugar is changed by bacteria into acid that harms tooth surfaces	146 (46.8)
	I don't know	23 (7.3)
	Poor support of the bone that supports the teeth	16 (5.1)
	A condition where the teeth stain	19 (6.1)
	Inflammation of the gums that involves swelling and bleeding	225 (72.1)
What is gingivitis?	The name given to germs that inhabit the mouth	19 (6.1)
	A name made up by advertising agencies to scare consumers into buying their products	2 (0.6)
	Another name for having several cavities at the same time	7 (2.2)
	I don't know	24 (7.7)

Oral Health Attitudes (n=312)				
Questions	**Frequency (%)**			
	I agree completely	**I agree partly**	**I disagree partly**	**I disagree completely**
I believe that only the dentist can prevent cavities.	43 (13.8)	66 (21.2)	63 (20.2)	140 (44.9)
I believe that by brushing and flossing my teeth, I am less susceptible to tooth decay.	205 (65.7)	87 (27.9)	13 (4.2)	7 (2.2)
I believe that tooth loss is a normal part of growing old.	76 (24.4)	135 (43.3)	57 (18.3)	44 (14.1)
I believe that I am responsible for preventing the loss of my teeth.	221 (70.8)	81 (26.0)	8 (2.6)	2 (0.6)
I believe that by flossing my teeth I can prevent gingivitis.	127 (40.7)	146 (46.8)	19 (6.1)	20 (6.4)
I believe dentures are less trouble than taking care of my natural teeth.	46 (14.7)	66 (21.2)	40 (12.8)	160 (51.3)
I believe I know how to brush my teeth correctly.	209 (67.0)	94 (30.1)	7 (2.2)	2 (0.6)
If my gums bleed when I floss this usually means that I am hurting my gums and I should stop flossing my teeth.	137 (43.9)	91 (29.2)	39 (12.5)	45 (14.4)
I believe visiting the dentist is only necessary when I am experiencing pain.	42 (13.5)	60 (19.2)	41 (13.1)	169 (54.2)
I believe that as long as I brush my teeth, I can eat anything.	57 (18.3)	84 (26.9)	71 (22.8)	100 (32.1)
Cronbach's alpha		0.715		

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Yes, "If I practice good dental hygiene, and respect the rules therefore I can input this knowledge to the learners under my watch"

Yes, "We allow surveys such as this to better inform as we are open to giving oral health knowledge to students"

Yes "What I practice is what I teach. But not in full details"

Three come from those who said "No" (14.4%) their toothbrushing practices, attitudes and knowledge does not influence how oral health education is given to school learners, which is school's curriculum, time and special needs".

School's curriculum. Those who said "No" said so because the school's life skills curriculum includes oral health. Others said oral health is not part of the school curriculum.

Time. Others said that there is no time set out for oral health education.

Special needs. Others stated that people with special needs differ and require independent and unique treatment, so each individual must be evaluated separately.

Does the same practices, attitudes and knowledge information form the basis for oral health education given to school learners that are under your care? Please explain.

No, "The life skills lesson incorporates oral health in its curriculum. We do have a life skills curriculum"
No, "Oral health education is not taught in this school, it not part of the curriculum"
No, "I don't have direct input but I just advise"
No, "There is no opportunity or allocated time to provide this kind of training in the timetable"
No, "Because individuals with special needs differ and every case is unique and needs to be considered separately"

Oral Health Practices (n=312)		
Questions	**Responses**	**Frequency (%)**
How often do you brush your teeth on average?	Once a day	29 (9.0)
	Twice a day	259(83.1)
	Three times a day	21 (6.7)
	More than 3 times a day	2(0.6)
	Don't brush at all	-
How long do you spend brushing your teeth?	60 seconds	66 (21.15)
	2-3 minutes	192(61.54)
	4-5 minutes	44 (14.10)
	More than 6 minutes	10 (3.21)
How often do you replace your toothbrush?	1-3 months	149(47.76)
	3-6 months	124(39.74)
	6-9 months	39 (12.50)
What type of toothbrush do you use?	Hard bristles	28 (9.0)
	Medium bristles	224 (71.8)
	Soft bristles	60 (19.2)
Do you think it is necessary to visit a dental practitioner?	Yes	305 (97.76)
	No	7 (2.24)
How often do you go to the dental practitioner?	Regularly every 6-12 months	119 (38.14)
	Occasionally	119 (38.14)
	When I have dental pain	67 (21.47)
	I've never visited a dental practitioner	7 (2.24)
How frequently do you snack between normal meals?	Snack once a day	171 (54.8)
	Snack twice a day	90 (28.8)
	Snack 3 times or more per day	38 (12.2)
	I do not snack at all	13 (4.2)
How often do you consume sugary drinks?	Once a day	191 (61.22)
	Twice a day	70 (22.44)
	Three times a day	36 (11.54)

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DISCUSSION

The purpose of this study was to ascertain educators' and caregivers' current oral health knowledge, attitudes and behavioural practices within the identified special schools in KZN. The majority of participants were female (n=210; 67.3%). Women are the primary caregivers for those with long-term medical illnesses or disabilities, providing both formal and informal care, accounting for up to 81% of caregivers and spending up to 50% more time on care than male counterparts.[12] This aligns with Stats SA data, which also indicates that women make up 63.8% of all educators in South Africa.[13] Evidence suggests that there are strong societal and cultural pressures on women to take on the role of caregiver.[12] According to UNESCO, teaching at lower levels of education is frequently regarded as a women's job due to cultural norms and gender biases surrounding educational and child care responsibilities.[14]

This study revealed that only 84 (26.9%) of the participants knew that "Regular flossing is an important part of your dental health routine and you shouldn't worry if your gums bleed a bit at first". This is consistent with the results of a previous study, where only 105 (37.4%) of the respondents gave the same answer.[15] On the other hand, 137 (43.9%) participants strongly agreed with the statement "If my gums bleed when I floss this usually means that I am hurting my gums and I should stop flossing my teeth", with only 45 (14.4%) of the participants disagreeing completely with the statement. This was similar to attitudes noted in another study where 199 (70.8%) of the participants were also in agreement with this statement.[15] Furthermore, results of the study conducted in Saudi Arabia reported that 46 (23%) of the participants strongly agreed with the statement and only 5 (2.5%) strongly disagreed with this statement.[16] This superficiality of the knowledge and attitude regarding flossing among the study participants highlights the need to offer adequate oral health education about the importance of dental flossing in maintaining oral hygiene and dental care among caregivers in this setting.[17]

The results of this study in the knowledge section revealed that most of the caregivers knew the definition of "dental plaque" and "gingivitis or gum disease" – (76.3%) and 225 (72.1%) respectively, which is similar to the results of a study conducted in the Western Cape where 208 (74.0%) and 238 (84.7%) of respondents knew the definition of "dental plaque".[15] However, a few participants didn't know these definitions, suggesting that there is still a need for continued oral health education within this population. This includes focusing on oral condition with the emphasis on prevention and treatment, which will help participants understand that good oral health practices lead to optimum oral health. Good oral health practice can be achieved primarily through self-initiated practices such as maintaining dental hygiene, limiting unhealthy diet, particularly sugar intake, using fluoridated products and taking advantage of available dental services such as regular dental check-ups and oral health education.[18]

In the current study, the analysis of oral health attitudes and practices on "maintenance of dental hygiene" revealed that a large proportion of participants reported brushing their teeth twice daily for 2-3 minutes. This is consistent with results of other studies.[15,19,20] Professional recommendations suggest brushing teeth for at least 2-3 minutes, twice daily.[5] More than 50% of the participants agreed that brushing twice daily and rinsing with mouthwash after each brushing are the two most important self-care practices. This is similar to a study conducted in a hospital in Malaysia, although a much higher number was reported since the majority (96.3%) of the caregivers knew that brushing and rinsing their child's teeth after every meal is important in order to prevent dental decay.[19] Furthermore, most of the participants 235 (75.3%) in the current study agreed that fluoride in toothpaste has significantly improved oral health status by decreasing cavities. This is consistent with other studies, where 66.7% of the caregivers knew that fluoride helps in strengthening the enamel layer of the teeth,[19] more than two-thirds of the 181 respondents (64.4%) agreed that fluoride in toothpaste has greatly benefited oral health by reducing cavities,[15] and almost three in five acknowledged that fluoride prevents caries.[5] However, in Turkey, only 9.6% of participants had complete knowledge about fluoride's functions and only 15% believed fluoride made teeth strong in a study conducted in Dhulikhel Hospital.[20,22] Many individuals understand the necessity of toothbrushing; however, they may not know why fluoride toothpaste is recommended. The decline in dental caries incidence since the 1970s has been attributed to fluoride toothpaste, either alone or in conjunction with water fluoridation.[24]. The FDI recommends using fluoride at an adequate concentration and dose to manage dental caries in children and adults by preventing and/or treating early lesions.[25] It is also advised to rinse with mouthwash after toothbrushing.

Regarding dietary habits, more than half (54.8%; n=171) of the study participants claimed that they snack at least once a day and about 61.22% (n=191) of participants reported consuming sweetened drinks at least once a day. The recommended diet and lifestyle for optimal dental health is to eat healthy meals rich in fruits, vegetables, high fibre foods and dairy products, avoid empty snacking, prevent repeated bingeing between meals and minimise sticky sugars and candies.[26-28] Concerning dental visits, the majority of the study participants completely disagreed with the statement "I believe visiting the dentist is only necessary when I am experiencing pain" at 169 (54.2%). This is consistent with the results of another study where 203 (72.2%) of respondents disagreed with this statement.[15] On the other hand, more than one-third (119; 38.14%) of participants reported visiting a dental practitioner regularly every 6-12 months. Regular dental check-ups are essential for preventing dental problems and encouraging healthy home dental care. Caregivers should understand and appreciate the need of frequent dental check-ups for preventing dental conditions and maintaining oral health.[5]at a comprehensive rehabilitation centre.

According to Nicolau, institutional venues such as schools, recreation centres, correctional facilities and workplaces should be effectively utilised for the formation of education groups based on participatory, dialogical and processual knowledge construction.[29] However, there is a dearth of information on the oral health practices, attitudes and knowledge of this population in this context. Therefore, more research in a larger geographic area is required, particularly using a provincial or nationally representative sample. The researchers believe that caregivers will be able to place a high value on health and be more inclined to pursue health-promoting behaviours if they have improved knowledge and attitude changes towards oral health.

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Strengths and limitations

The current study provided a better understanding of oral health care knowledge, attitudes and practices of the caregivers and educators of the learners with special needs attending special needs schools in eThekwini District, KZN. A number of limitations may have influenced the study's outcome. This study concentrated on caregivers and educators within schools, leaving out caregivers outside of schools, such as parents or who may be caring for the learner at home or outside of the school environment. Self-report data can be influenced by social desirability bias, which can affect the validity of the results. Furthermore, participants may misinterpret questions or respond in an incomplete or erroneous manner. Future research is needed to compare the perspectives of school educators/caregivers with parents and other caregivers outside the school environment about their current oral health KAP in order to improve the sample's representativeness and gain input from people who take care of the learners living with disabilities.

RECOMMENDATIONS

First and foremost, basic oral health education should be provided to caregivers and educators through workshops. Secondly, oral health care management programmes should be embedded into educators' and caregivers' curriculum; and, finally, educators and caregivers should actively participate in oral health awareness campaigns.

CONCLUSION

The results of the present study showed some inconsistencies in educators' and caregivers' knowledge, attitudes and practices a lack of knowledge on flossing and the role of sugar in tooth decay. Most respondents had positive attitudes towards oral health, believing it enhances optimum oral health. However, they had mixed or negative attitudes towards oral health practices, such as bleeding gums while flossing, believing tooth loss is a normal part of growing up and believing that as long as they brush their teeth, they can eat anything. The oral health practices of the caregivers were fair, with most of them having the correct daily oral hygiene practices. Furthermore, most caregivers believed their oral health knowledge (KAP) influenced how oral health education is conducted in the school.

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Evaluation of different baseplate materials on casts with various palatal vault depths

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MB Sitoe, LM Sykes, C Bradfield

ABSTRACT

Introduction

The choice of baseplate material for a trial complete maxillary denture is a critical decision in prosthodontic practice. One significant factor to consider is the depth of the palatal vault, which can influence the suitability of the baseplate material. Close adaptation of the denture base is essential in preventing lateral denture movement and enhancing denture retention and support.

Aims and objectives

This study was undertaken to evaluate and determine the most suitable baseplate material to use on casts of various palatal vault depths.

Methods

A total of 120 casts with varying palatal vault depths categorized as shallow, moderate, and deep were fabricated (40 per group). Denture bases, all designed to a uniform 2-mm thickness, were created using four different commonly used materials: pink baseplate wax, self-cured acrylic resin, light-cured acrylic resin, and 3D-printed photo-polymerized resin. Both the casts and the fabricated denture bases were sectioned down the midline. Measurements of adaptation were taken from the left halves. Readings were taken of the gap between the denture bases and the casts at three predefined positions (I – incisive papilla, II – mid-palatal area and III – posterior palatal seal area).

Results

For shallow palates the best material (i.e., most closely adapted) in position I was light-cured acrylic, in position II was self-cured acrylic and in position III was light-cured acrylic. For moderate depth palates the best material in position I was light-cured acrylic, in position II was self-cured acrylic and in position III was light-cured acrylic. For deep palates the best material in position I was self-cured acrylic, in position II was self-cured acrylic and in position III was light-cured acrylic.

Conclusions

For all three palatal depths, the material with the closest adaptation in position II (mid-palate) was the self-cured acrylic resin and in position III (the post-dam area) was the light-cured acrylic. In position I (incisive papilla) the light-cured resin performed slightly better in shallow and moderate palates and the self-cured resin in deep palates. It would thus seem that based on this study technicians and clinicians should consider using firstly light-cured acrylic resin or self-cured acrylic resin as opposed to the more commonly used pink baseplate wax for trial denture base plates.

Keywords

Baseplate materials, palatal vault shape, adaptation, dimensional stability.

INTRODUCTION

Removable dental prostheses can have a profound impact on a patient's physical, emotional, and social well-being.[1,2,3] They play an important role in restoring both oral function and self-confidence, ultimately improving the overall quality of life for those who require them.[1,2,3] Denture bases hold significant importance in various stages of the denture fabrication process, including the recording of jaw relations, the arrangement of artificial teeth, and the trial fitting of the setup within the oral cavity of the patient before the acrylic denture processing phase.[4,12].

The stress-bearing areas in the maxilla play a crucial role in providing support for the denture base and can be categorised as primary or secondary, based on the underlying bone and anatomical structures. The fit or adaptation of the denture bases has a significant impact on the overall quality of complete dentures, and can influence factors such as retention, stability, support, comfort, speech, and masticatory function.[4] During denture fabrication, the more dimensionally stable and precise the fit of the denture base, the better the final outcome should be..[4,13] The bases themselves are subsequently discarded during the final processing steps, but will have served the purpose of recording accurate jaw relationships and assessing the fit of the completed trial denture. Consequently, the correct choice of an appropriate baseplate material is of paramount importance during these critical stages. The success of dentures depends on many factors that are both patient and denture related.[5] The depth of the palate is believed to play a significant role in the retention and stability of maxillary dentures. Therefore, the consideration of various palatal vault depths on the fit of different baseplate materials and production techniques is important.[6,7,8] One of the

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main problems during the manufacturing procedure for a complete denture is adherence of the baseplate the dental cast, and fit intra-orally.[6]

Many studies have explored the influence of palatal vault depth on the retention of maxillary denture bases.[4,13] However, there remains a significant gap in the literature concerning the effects of all three categories of House's Classification of palatal vault depths on both conventional and modern 3D printing materials. The current study aimed to investigate the relationship between shallow, moderate and deep palatal vault depths, and denture base materials at three pre-determined positions. Results may guide clinicians in their choice of the most appropriate denture baseplate materials according to each individual patient's anatomy.

The goal is to enhance final denture retention, fit, support and accuracy, to improve patient comfort and satisfaction, and at the same time minimise the need for post-fitting adjustments and relines.

METHODS

The study was an in vitro laboratory-based experimental design. To ensure robust internal validity and reliability, re-measurement of half of the samples was done, amounting to 60 samples out of a total of 120 as part of a cross-validation process.

External validity and reliability were carried out in the measurement process by having two trained clinicians measure a random sample of all casts. This approach aimed to safeguard the quality and credibility of the research findings. One-way analysis of variance was applied to means of each sample to investigate if there were any significant differences. Measures of central tendencies i.e., the mean and median were also applied to summarise each component.

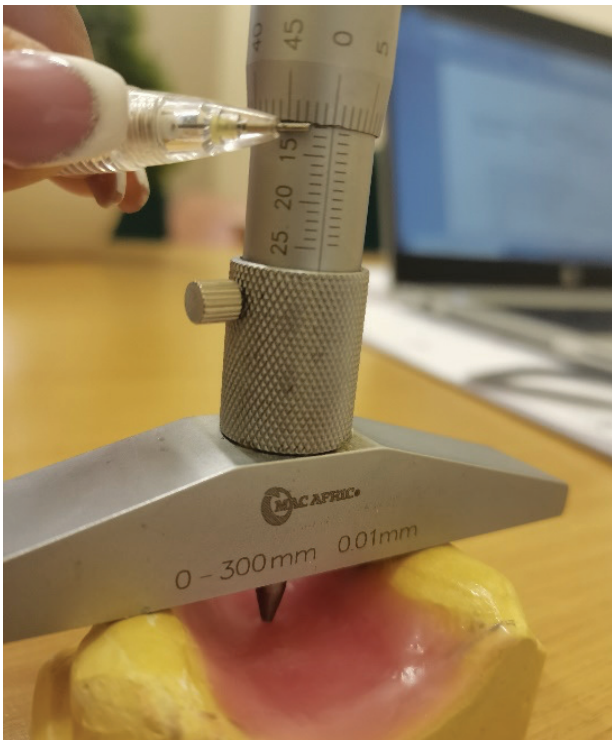

Figure 1: Wax adaptation of master casts to produce a medium and shallow depth palate.

Three identical master maxillary casts were modified by adapting baseplate wax to the palatal vault depth area.[6] The final casts then had one with a shallow vault depth (12 mm) the second moderate (16 mm), and the third deep (20 mm). Wax was only added to the mid-palatal areas thus the rest of the casts and ridge configuration remained unchanged (Figure 1).[4,6] The casts were duplicated using silicon elastomer moulds (interduplicast A & B) to obtain three silicon elastomer moulds. Type 3 hard modelling plaster was measured to a ratio of 30 ml of water in a glass measuring cylinder and 100 g Type 3 powder using a digital scale. A vacuum mixer-twister was used to reduce bubbles, with a rotational speed of 270 rmp for 30 seconds according to methods suggested by Laughlin et al. (2001).[4] The viscous mixture of Type 3 hard modelling plaster was then gently poured into the moulds and left to harden for 24 hours, to obtain 40 shallow, 40 moderate and 40 deep palatal vault casts.

The MAC AFRIC 9" Magnetic Torpedo Water Level was used to determine whether the alveolar ridges were parallel horizontal (level) before using the Vernier depth gauge. The edge of the tool was cleaned at the bottom edge and placed on the crest of the maxillary edentulous alveolar ridges to obtain the true horizontal (horizon) of the ridges. The bubble was allowed to flow on top of the spirit tube and was in the centre. Three reference lines were drawn to establish fixed points on the palate. The first line extended vertically from the central position of the incisive papilla (I) to the posterior palatal seal (III). The second line intersected the first one at its midpoint (II), and the third line spanned horizontally between the two hamular notches situated in the posterior palatal seal area (Fig 2).[10] The depth of the vestibule (deepest part of the sulcus area) was outlined providing relief of frenal attachment before fabrication of bases.

In the fabrication process of the bases, a single layer of baseplate wax measuring 1.75 mm in thickness (metrodent-metrowax NO 4) was adapted by manual means onto the casts.[6] For the group subjected to self-curing, the process involved the initial application of a single layer of cold mold seal onto the cast, which was subsequently allowed to air-dry before commencing the base fabrication procedure. Subsequently, a mixture of monomer (liquid) and powder (comprising Cold Cure Repair Monomer and Powder) was prepared in a 1:1 ratio.

Initially, the monomer was poured onto the cast, and an equivalent amount of powder was introduced in the same region where the monomer had been placed. This method was employed to facilitate the dissolution of the powder by the monomer. Subsequently, the cast, in conjunction with the self-cure acrylic, was immersed in a water-filled container (temperature maintained at 20°C for 5 minutes), until the bases had cured. For the light-cured specimens sheets of Urethane-Dimethacrylates (UDMA)(special tray LC intertray) were manually adjusted to the casts. These were then polymerized using a visible light source unit, (Light curing unit DDL Dental) for 2 minutes. For the3D printed bases a Desktop scanner inEos X5 was used to capture precise digital images of the cast. This was executed through the inLab software version 22.0, which possessed the capability to identify essential anatomical landmarks on the cast, facilitating the subsequent design of the denture base.

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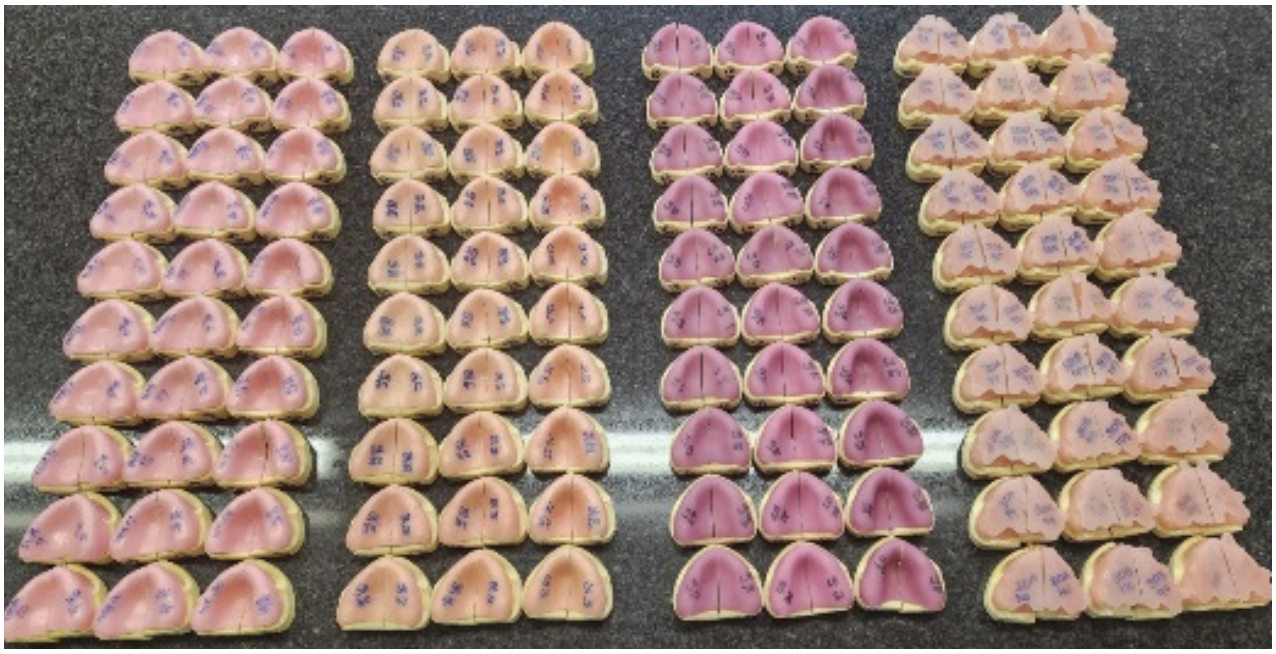

Figure 2: Fabricated casts and baseplates prior to sectioning and measuring.

Upon completion of the digital design phase for the denture base, the fabrication was carried out using a recommended acrylic resin (Asiga DentaBase resin). This was poured into the carbon container of the ASIGA MAX printer. This unit was chosen due to its impressive build speeds (60 mm/hr) and exceptional resolution of 62 microns. Additionally, it incorporates Asiga's unique Smart Positioning System (SPS) technology. The actual printing process involved the application of ultraviolet projection to cure the baseplate material onto the cast at the precise locations required, and this was executed on the high-tech carbon ASIGA MAX printer. The thickness of all bases was measured using a Iwanson Wax Calliper Gauge by Smile baseplates to ensure an even thickness across the entire palatal area.

Once all the base plates had been fabricated (Figure 2), a digital Vernier calliper was used to accurately measure the linear distance between the two hamular notches (recorded as 44 mm). This was then used to determine the exact midpoint of the casts at 22 mm. A vertical reference line was then marked on the casts, extending from the incisive papilla through the mid-palatal region to the posterior palatal seal area (Figure 3). This line served as a critical cross reference line where the cuts would be made. Cutting was then carried out using a Globe KB-36 band saw, with a blade width of 3.175 mm. This blade was used to cut both the casts and the baseplates simultaneously. Throughout the cutting process, the blade speed selector was set at a constant value of 47 blade speed units per minute. It must be noted that due to the continuous operation and friction generated by the saw blade, it produced heat during the cutting process. As a preventive measure, cutting was paused for 2 minutes between each cast to allow the blade to cool, and in addition, the blade was changed after every tenth cast to maintain the accuracy and precision of the cuts.

A digital Vernier calliper was used to obtain even measurement points of the left half of all casts and baseplates. The measurement of the distance from the incisive papilla (I) to the posterior palatal seal area (III) was 40 mm. Half the distance of 40 mm was measured on the same area and provided a mid-palatal area point of 20 mm (II). The digital Vernier calliper was used to measure the gap between baseplates and casts on the three predetermined points (I, II and III) for the four different baseplate materials on casts of the three palatal vault depths (Figure 4).

Figure 3: Cast and baseplate sectioned down the midline.

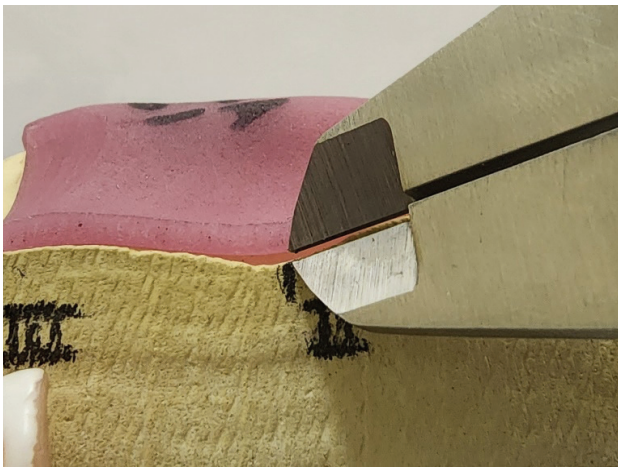

Figure 4: Measuring the gap distance between the baseplate and the cast at position II.

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RESULTS

Table I presents the difference in Means between the four baseplate materials. The results showed no significant mean difference in fit between different baseplate materials of baseplate wax (mean= 0.01; p=0.53), self-cured acrylic (p=0.75), and light-cured acrylic (p=0.91). However, the results showed a significant difference for the 3D-printed (p=0.00) and wax bases (p=0.00).

Results show that baseplate wax, self-cured acrylic resin, and light-cured acrylic resin show no significant difference between various depths (p-value>0.05).

In the evaluation of baseplate wax (Table I), the F-value for shallow vs. moderate vs. deep is 0.6318 with a p-value of 0.5393, suggesting no statistically significant difference in means among these depths for baseplate Wax. The F-value of 21.1316 with a very low p-value (<0.0001) in the overall section indicates significant differences in means across different depths of the baseplate wax, with the deep depth group having the lowest mean (0.0105), indicating closer adaptation. There was a significantly difference with the measurements from the shallow (0.0122) and moderate depths (0.0170). For the self-cured acrylic (Table I), the F-value for shallow vs. moderate vs. deep was 0.2802 with a p-value of 0.7578. This suggests that there are no statistically significant differences in means among these depths for self-cured acrylic. Table I also shows that the deep depths (mean=0.0145) had the closest adaptation when compared to moderate (mean=0.0162) and shallow (mean=0.0164). Both baseplate wax and self-cured acrylic show no statistically significant differences in means among these depths. (baseplate Wax: p-value = 0.5393, self-cured acrylic: p-value = 0.7578).

For light-cured acrylic, the deep depth demonstrated the least amount of mean gap (0.0123) compared to moderate (0.0133) and shallow depths (0.0131). The F-value for shallow vs. moderate vs. deep is 0.0902 with a p-value of 0.9140. This suggests that there are no statistically significant differences in means among these depths for light-cured acrylic. The findings of the current study further indicate that light-cured acrylic resin shows a more significant difference (mean=0.0129, p-value<0.001) between the groups, suggesting that it may be the better baseplate material overall.

Material that had an overall least mean value was light-cured acrylic resin (mean=0.0123, p-value<0.0001).

There was a significant difference between the three groups (shallow, moderate, and deep) for the 3D-printed resin baseplate material (p-value<0.0001). The shallow had the least means compared to moderate and deep, mean=0.0125, p-value<0.0001. Post-hoc comparison using the Turkey HSD test indicated that the mean for shallow (mean 0.0215, SS=0.0025) and moderate (mean 0.0242, SS=0.0025) in terms of depth, did not show a statistical difference. There was a statistical difference between shallow (mean 0.0215, SS=0.0025) and deep (mean 0.0420, SS=0.0050).

When the four baseplate materials were compared, that the light-cured acrylic resin had the lowest mean of all the groups (mean 0.0129; p-value<0.00001).

DISCUSSION

House's Classification divides palatal forms or vaults into three categories namely, Class I, Class II, and Class III.

Table I: ANOVA results for Baseplate Materials

Groups	Number	Mean (mm)	SS	df	MS	F	P-value
Baseplate wax							
S	10	0.0122	0.0002	2	0.00011	0.6318	0.5393
M	10	0.0170	0.0049	27	0.00018		
D	10	0.0105	0.0051	29			
Self-cured acrylic							
S	10	0.0164	0.0000	2	0.00001	0.2802	0.7578
M	10	0.0162	0.0010	27	0.00004		
D	10	0.0145	0.0011	29			
Light-cured acrylic							
S	10	0.0131	0.0000	2	0.00000	0.0902	0.9140
M	10	0.0133	0.0009	27	0.00003		
D	10	0.0123	0.0009	29			
3D-printed							
S	10	0.0215	0.0025	2	0.00124	13.1226	0.00001
M	10	0.0242	0.0025	27	0.00009		
D	10	0.0420	0.0050	29			
Overall							
Baseplate wax	30	0.0133	0.0018	3	0.00060	21.1316	<0.0001
Self-cured acrylic	30	0.0157	0.0010	36	0.00003		
Light-cured acrylic							
3D printed	30	0.0129					
	30	0.0292	0.0028	39			

Table I. Statistical analysis of results for all four materials in each palatal vault depth

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In general, Class I have a shallow palatal vault depth and provide acceptable retention for maxillary dentures. Class II have moderate palatal vault depths and are the best for maxillary denture retention. Class III have deeper V-shaped (deep) palatal vault depths and provide poorer retention for maxillary dentures due to the pronounced elevation in the palate, accompanied by a steep decline and significant mobility in the soft palate.[5,7,9] In the current study, Class I represents shallow, Class II represents moderate, and Class III represents deep palatal vault depths.

Baseplate waxes are composed of a blend of paraffin, microcrystalline waxes, and both natural and synthetic ingredients and have drawbacks, such as limited stability and a tendency for volume instability after the heating and cooling process.[12] According to a study by Zbigniew et al. (2019),[12] the properties of these waxes, such as their flow characteristics and volumetric shrinkage, can change the re-melting process within wax warmers due to thermal degradation. In addition, MacMillan and Darvell (2000)[13] conducted research on the rheological properties of dental waxes. They observed that the field of wax rheology has been relatively understudied, and their uses are not widespread, which may be due to the challenges involved in handling these materials. The results of the present study concur with the findings and observations of Zbigniew et al. (2019)[12] and MacMillan and Darvell (2000),[13] in that baseplate wax did have a close and consistent adaptation to deep palatal vaults but performed less well compared to the light cured acrylic resin for medium and shallow palate depths.

Self-cured acrylic resins are versatile and used in many fields of dentistry.[14] They are preferred for their biocompatibility, lack of flavour or odour, satisfactory thermal properties, excellent polishing capabilities, and ease of use.[14] Given their wide use, it is crucial to assess their resistance to fractures, especially as repairing acrylic prostheses can be time consuming, inconvenient for patients and clinicians, and adds to costs.[14] Silva et al. (2021),[14] compared the fracture resistance of heat-cured and self-cured acrylic resins. Their results indicated that, on average, heat-cured resins exhibited greater resistance to fracture than self-cured resins. While the latter offer the advantage of reduced processing time,[6,14] they also come with drawbacks, such as the potential for denture tooth movement during polymerization and a lack of bonding between denture teeth and the base material. In another study by Akaltan et al. in 2020,[6] the authors investigated the denture base adaptation performance of the pour technique involving self-cured acrylic resin, in comparison to other conventional fabrication methods like light-polymerization, injection, and compression molding. The findings revealed that the pour technique for self-cured acrylic resin consistently demonstrated similar mean gap distances, regardless of the location on the denture bases. The findings of the current investigation concur with those of Akaltan et al. (2020),[6] where the mean gap distances in all palates are relatively consistent. Although innovative techniques for complete denture fabrication have emerged, cost efficiency and ease of production remain critical factors.

Light-cured acrylic resin denture materials represent an advancement in polymeric acrylic denture bases.[15] These materials are available in sheet and strip forms, as well as in powder and liquid systems.[15] They are versatile and can be used for a range of dental applications, offering swift service at an economical cost.[6,15] The manufacturers state several other advantages, such as the absence of residual methyl methacrylate monomer, ease of handling and manipulation, and improved dimensional precision.[19] However, Akaltan et al.(2020), observed that light-cured acrylic resin displayed the highest average gap distance between the denture base and the cast, regardless of whether the palatal vault depth was shallow or deep, in most of the tested locations.[6] In a study conducted by Wahab et al. in 2012,[15] a comparison was made between the tensile strength of heat-cured and visible light-cured acrylic resin denture bases. The findings revealed that the heat-cured acrylic denture base resin exhibited superior tensile strength values when compared to the visible light-cured acrylic denture base material.

Recent advances in 3D printing are promising. Advantages include cost-efficiency (with regards material and time, but initial outlay for equipment is costly), the absence of rotary tool wear, reduced waste of raw materials, and the ability to simultaneously produce multiple items which can lead to quicker patient rehabilitation times.[15,16] Gad (2021)[16] studied the strength and surface properties of a 3D-printed denture base polymer, and found that the 3D-printed resin exhibited lower flexural strength, impact strength, and hardness values compared to heat-polymerized resin.[15,16] However, it displayed superior surface roughness. The primary drawbacks associated with heat-cured resins for removable dentures are their dependence on specialized equipment and skilled personnel.[16] In a recent study conducted by Dimitrova (2022),[16] a comparative analysis was performed between conventional polymethyl methacrylate (PMMA) and 3D-printed resins for denture bases. They highlighted certain limitations of 3D printed materials, including issues related to aesthetics and retention, the inability to achieve occlusal balance, and lower printer resolution. In contrast, heat-cured PMMA demonstrated superior flexural strength, bonding properties, and impact resistance compared to 3D-printed materials for removable dentures. It was observed that 3D-printed resins exhibited better surface roughness and lower hardness values when compared to conventional materials. Additionally, in comparison to heat-cured acrylics used for denture bases, the 3D-printed materials demonstrated enhanced colour stability over time.

CLINICAL APPLICATION

This finding of this study highlights the importance of evaluating patients' palatal vault shapes before choosing which baseplate material to use. From a clinical perspective, prolonged heating, and re-melting of baseplate waxes, particularly at elevated temperatures, is not advisable.[12] And although the result of the current study shows no significant difference between the shallow, moderate, and deep groups, it is recommended to refrain from using baseplate wax in situations where they may be exposed to elevated temperatures that could potentially cause material distortion.

In evaluating four different baseplate materials on various palatal vault depths, the 3D-printed resin had the least mean on shallow compared to other depths. While self-cured acrylic resin showed the lowest mean on deep palatal vault depth compared to other depths. In this study, the recommended baseplate material is light-cured acrylic resin since it had the least gaps compared to other materials. This study indicates that light-cured acrylic resin closely followed by self-cured acrylic resin may be the best material to use for denture bases in terms of adaptation

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and stability in changing temperature environments. The disadvantage is that both materials are more costly and take longer to fabricate than conventional pink baseplate wax. While 3D printing is promising and offers many advantages, including customized designs and accurate details, it is important to consider the associated costs. The decision to use 3D-printed base plates should be made with an understanding of both the benefits and challenges posed by this advanced manufacturing technology.

CONCLUSION

For all three palatal depths, the material with the closest adaptation in position II (mid-palate) was the self-cured acrylic resin and in position III (the post-dam area) was the light-cured acrylic. In position I (incisive papilla) the light-cured performed slightly better than the self-cured resin. It would seem that based on this study technicians and clinicians should consider using firstly light cure acrylic resin or self-cured acrylic resin as opposed to the more commonly used pink baseplate wax for trial denture base plates.

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Ethical considerations for artificial intelligence in dentistry

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ABSTRACT

The incorporation of artificial intelligence (AI) is accelerating in the dental field and even patients are catching on to the trend. There is a form of perceived pressure mounting on practitioners to incorporate modern dental equipment and online services to accelerate treatment time or supplement the diagnosis with visual treatment planning. Many of these applications utilise AI as part of the software to process the inserted data. The use of these products in practice presents various ethical dilemmas the clinician would need to mitigate. Practitioners who own or are considering adding applications and equipment that are AI-based to their treatment repertoire have an ethical and legal responsibility to ensure that the best interest and safety of the patient are observed. Patient autonomy and protection of all information become a paramount consideration over and above improving profit or personal gain. By no means could the ethical dilemmas in this communication be exhausted, as the rapid AI innovation and the dynamic nature of technological advances have the potential to raise even more debate. As a fraternity, we need to be vigilant and remain grounded with the basic ethical principles underpinned by autonomy, patient confidentiality/privacy and the practitioner-patient relationship.

Keywords
Artificial intelligence, ethics, dentistry, autonomy, treatment, diagnosis.

INTRODUCTION

The use of digital workflow and various 3D-based technologies has become synonymous with modern dental practices. Many of the applications and data processing software are based on algorithms and machine learning to achieve the data processing leading to a diagnosis. The incorporation of artificial intelligence (AI) is accelerating in the dental field and even patients are catching on to the trend. The World Health Organization (WHO) also recognises the importance of AI in medicine and identified the elements of risk such as unethical data collection, cyberattacks and malfunctions.[1]

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1. Ronel Maart: First author – writing, review and editing article (70%)
2. Riaan Mulder: Second author – writing, review and editing article (30%)

AI IN DENTISTRY

A recent study asked 265 patients about AI in dentistry. The patients presented with a feeling and expectation of improved diagnostic confidence (60.8%) and anticipate that AI will be well integrated in the dental workflow within 1-5 years (42.3%) and 6-10 years (46.8%). The patients recognise, however, that cost of treatment may increase (31.7%) and that there could be a decrease in the clinician-patient relationship (36.2%).[2]

There is a form of perceived pressure mounting on practitioners to incorporate modern dental equipment and online services to accelerate treatment time or supplement the diagnosis with visual treatment planning. Many of these applications utilise AI as part of the software to process the inserted data. The use of these products in practices presents various ethical dilemmas, with one at the centre that the clinician would need to mitigate:

- How can practitioners ensure that they are using AI applications and products as a supplemental tool in the armamentarium with ethical guidelines at the centre of patient autonomy?

The adoption of new technologies and their place in dental practice is a constant debate. In most cases, it was a debate about advertising the service and the economic outcomes to the patient coupled with the ethical guiding issues. Practitioners who own or are considering adding applications and equipment that are AI based to their treatment repertoire have an ethical and legal responsibility to ensure the best interest and safety of the patient, above the consideration of improving profit or personal gain.[3] With the incorporation of AI applications into the dental industry it could be debated to become a little more grey and less clear-cut due to the abstract nature of our understanding of what exactly AI is. Already, AI and data processing algorithms are incorporated to various degrees in the software and applications clinicians use in dental practice. So the question is when does the clinician become the student and will the clinician even realise they are not the master of the diagnosis anymore? These two ethical and, some might say, philosophical questions are at the heart of the user training, clinician-patient relationship and potentially other issues described in this communication.

AI-GENERATED DIAGNOSIS

For a new technology such as an instrument or material, it is easier to ask: where is the evidence that it is better than the instrument/material I am currently using? In some cases, it could take years for adoption and the generation of "sufficient evidence" with well-structured academic centred research that excludes case reports. With AI it is more subtle and, in some cases, more obvious. There could already be AI applications in the dental practice where the clinician needs to realise that they are "less in

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control" and must mitigate the potential pitfalls. This is an ethical predicament for the clinician to realise that they are becoming the student and no longer the master that leads to the AI application generated diagnosis. Just because the AI application say so, does not mean it is so.[4] When the clinician considers the possibility, for example, of offering AI-generated services to their patients such as CBCT DICOM volume reports – based on AI applications that "identify" and, to a large extent, then "offer a diagnosis" for various items in the CBCT DICOM volume – the practitioner's skill and diagnostic prelude must be able to identify and critically evaluate the "offered diagnosis" as an adjunct to their diagnosis made previously. The clinician should not be reliant on the AI application to make the diagnosis and generate the radiological report. If the clinician perceives AI as a whole as a tool to progress their diagnostic accuracy and treatment options and not to provide the answer to the diagnostic/treatment plan questions, then the clinician will remain the master.[5] Ethically the clinician should perform a radiographic diagnosis and report before the DICOM volume is uploaded to an AI application for "diagnostic purposes". In medical radiology clinicians are required to first assess the accuracy of the curated data that is provided to the AI application.[6] This continuation of best practice in the dental field will also ensure the clinician remains the master and the AI application becomes an adjunct to the diagnosis, since the clinician always remains responsible legally and clinically for the diagnosis and treatment plan.

PATIENT DATA

Clinicians should be careful to upload their patient DICOM volume to AI applications using the data to additionally perform AI self-training. Some AI applications outsource the diagnosis and treatment plan to a community of application user-clinicians and this already is an ethical dilemma. This is not only happening with radiology applications but also with intra-oral scans serving as digital impressions and DICOM volumes of patients being sent to off-site centres where the diagnosis is made and a provided treatment plan with appliances are manufactured, with the clinician then subsequently providing the treatment. Patient autonomy with the patient's right to self-determination, confidentiality and the clinicians' expertise to provide treatment.[7] Moreover, this practice reduces the dentist-patient communication and shared decision-making that follows the "traditional" diagnosis and treatment plan. Therefore, negative impacts of AI in clinical dentistry include less communication and humanistic care[8] through the clinician being perceived to be more removed from the treatment plan.

The development of AI applications and their improvement rely on computer information, data protection, date extraction quality, reliability of the data and data sharing as methods to ensure continuous development for AI application deep learning. This poses ethical barriers to the clinician and developers as patients' medical and personal protection of information are the main concerns in clinical dentistry[8] and regulated by country laws such as POPIA. Application developers should be guided by skilled clinicians to ensure the training of the AI applications commences only from validated and accurate training data and that continuous "deep learning" does not occur in real time from patient DICOM volumes without validated diagnoses. This can be ensured by using AI applications that subscribe to compliance and protection of patient privacy through initiatives such as the Health Insurance Portability and Accountability Act (HIPAA)-compliant storage systems.[6]

FIRST DO NO HARM

Apart from the fact that the clinician should be firmly rooted in the principle of "primum non nocere" – "first do no harm" – it is imperative the clinician realise their own limitations if the AI application is providing diagnosis and treatment options outside the skillset of the clinician. Additionally, the conundrum of the clinician not recognising the inaccuracies generated by AI applications becomes an ethical issue as well since the clinician would have failed the patient. The potential harm of any diagnosis/treatment must be recognised by the clinician and the patient must be appropriately referred. The practitioner should continue to work within their training of expertise and scope that allow the effective and safe treatment/diagnosis of a patient. AI should not become a tool to venture outside the training and area of expertise, as defined in the Scope of the Professions of Dentistry under the Health Professions Act, 1974.[9] The Health Professions Council of South Africa (HPCSA) guidance is set out in the following Ethical Rule 21, Performance of Professional Acts: "A practitioner shall only perform, except in an emergency, a professional act for which he or she is adequately qualified and sufficiently experienced." In cases where a practitioner is not adequately qualified and sufficiently experienced, the practitioner "shall not fail to communicate and co-operate with appropriately qualified health practitioners in the treatment of a patient." [9] A statement was released by multiple radiology societies regarding AI in radiology and there is "an increasing need to critically evaluate claims for its utility and to differentiate safe product offerings from potentially harmful, or fundamentally unhelpful, ones".[10] Outsourcing diagnosis and treatment plans is already an ethical consideration with the sharing of 3D scans of patient occlusion being sent to off-site centres where the diagnosis is made and appliances manufactured, with the clinician then subsequently providing the treatment. Patient autonomy with the patient's right to self-determination and confidentiality should always be observed by the clinician.[7]

The clinician provides and remains responsible for treatment, irrespective of what outsourcing or AI applications were used to arrive at a diagnosis and treatment plan. The onus falls on the clinician being able to make informed and evidence-based treatment plans. It is the clinician's responsibility to attend accredited continuous professional development (CPD) refresher courses, seek HPCSA-accredited postgraduate courses and to stay abreast of evidence-based dentistry from high quality peer-reviewed scientific research to ensure that the treatment provided is truly evidence-based and constitutes ethical practice.

CONCLUSION

Ultimately, the clinician's treatment recommendations (with and without specialist referral) to the patient are based on holistic consideration of the patient. This will ensure the net benefits of available treatment options and the patient compliance with treatment can result in a successful clinical outcome.[11] Considering the exponential rise of AI applications in clinical dentistry, the following ethical dilemmas were highlighted:

- Protection of the patient's personal data, medical data and the related privacy are at risk.
- Limitation of the decision-making from the dental practitioner using AI to aid diagnosis and treatment

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planning.
- Limitation of dental practitioner and patient shared decision-making process.
- Threat to the "humanness" between the practitioner-patient
- Increased synergistic impact and role of AI application/ equipment manufacturers for clinical practice.

By no means could these ethical dilemmas be exhausted, as the rapid AI innovation and the dynamic nature of technological advances have the potential to raise even more debate. As a fraternity, we need to be vigilant and remain grounded with the basic ethical principles underpinning autonomy, patient confidentiality/privacy and the practitioner-patient relationship. During Covid-19, we were challenged with ethical dilemmas and suggested the moral theory and virtue of ethics that includes characteristics such as integrity and discernment to be considered.[12] In light of the AI ethical challenges and rapid evolution, it is suggested that we consider the moral theory and virtue of ethics to guide clinical practitioners.

Conflict of interest
The authors declare no conflict of interest.

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Should dentists perform independent jaw wiring for weight loss? A principlist analysis

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ABSTRACT

This article presents an ethical analysis for the practice of jaw wiring as an independent weight loss intervention by dentists. The four foundational principles of autonomy, nonmaleficence, beneficence and justice serve as a framework for evaluating the ethical dimensions of the practice, and whether it can be justified. The ethical analysis of this weight loss procedure requires dentists to debate the potential benefits with possible harms, while respecting the autonomy and desires of the patient. While patients possess a fundamental right to autonomous decision-making, conceding to their autonomy is not absolute and dentists need to balance their decisions with considerations of beneficence and nonmaleficence. The ethical analysis concludes that dentists who refuse requests to independently perform jaw wiring for purely weight loss purposes are ethically justified within the principlist framework when the principles of nonmaleficence and beneficence are at stake. The wellbeing and health of the patient, as well as professional obligations, justify their refusal.

INTRODUCTION

The increasing prevalence of obesity[1] coupled with social pressures to conform to an ideal body type is driving individuals to seek alternative and unconventional weight loss strategies, such as jaw wiring. This technique of maxillomandibular fixation has been popularised on social media platforms and is commonly known as "slimming wires". It has gained traction as a method of weight loss that has evolved beyond its original medical indication for treating temporomandibular joint disorders and maxillo-mandibular injuries. More recently, a contentious intra-oral device for jaw immobilisation using orthodontic brackets on molar teeth together with closed-field magnets has been devised, which restricts dietary intake purely for weight loss purposes.[1]

A brief search on Google search engine indicates that a number of dentists in South Africa are advertising the so-called "slimming wires" and offer the service of independent jaw wiring for weight loss. Although it is legal in South Africa for dentists to treat maxillary and/or mandibular fractures with jaw wiring in cases indicated for immobilisation, this trend of patients requesting the procedure for aesthetic reasons presents clinicians with ethical dilemmas, wherein they must consider patients' aesthetic desires versus medical necessity and the potential harm posed by this weight loss procedure. Additionally, dentists must consider whether they can refuse to perform a procedure that may cause more harm than good to the patient or compromise their professional status. This ethical dilemma highlights the complexity of balancing the four principles of biomedical ethics.

Rooted in the works of Beauchamp and Childress,[5] the four principles of biomedical ethics provide a robust ethical framework for scrutinising the appropriateness of clinical interventions, one that resonates with practical significance for jaw wiring as a weight reduction procedure. This analysis aims to offer guidance for dentists facing the ethical dilemma of patient requests for independent jaw wiring as a weight management intervention. Furthermore, this article aims to contribute to the ongoing discourse on clinical ethics and weight management interventions by delineating the ethical boundaries within which dentists must tread in their pursuit of patient wellbeing.

Principlism as a framework

Principlism is an applied ethics approach for the examination of moral dilemmas centering on the application of certain ethical principles.

Tom Beauchamp and James Childress initially proposed the approach in their seminal work, "The Principles of Biomedical Ethics", first published in 1979. Beauchamp and Childress identified four core principles of biomedical ethics – respect for autonomy, beneficence, nonmaleficence and justice – as a guiding framework for ethical decision-making in clinical practice. These principles guide actions, but they are not rules. Principles serve as "general guidelines for the formulation of more specific rules"[5] while rules are "more specific in content and more restricted in scope than principles".[5] The four principles in question are *prima facie* principles, which are considered of equal import ance

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and carry equal weight.[5] Each principle is a serious moral obligation that must be considered along with other duties to resolve ethical dilemmas or conflicts. In other words, these principles are considered binding unless they are superseded by a more compelling claim.[6,7] This means that healthcare professionals must strive to uphold each principle, provided they do not conflict with one another.

Despite its many criticisms, principlism still dominates the bioethics landscape. Principlism's greatest appeal lies in its provision of a simple and accessible approach to thinking about ethical issues in health care.[8] For example, Ranaan Gillon states that principlism "offers a common, basic moral analytical framework and a common, basic moral language"[9] and Beauchamp explains that "the distilled morality of principles gave diversely educated people from many fields a shared and reasonably practical set of norms for the analysis and resolution of moral problems".[10]
In the sections to follow, the four principles are explored in detail and analysed in the context of independent jaw wiring for weight loss.

Autonomy

Autonomy, derived from Kantian philosophy, emphasises the significance of individual self-determination and informed decision-making. To ascertain an individual's autonomy, three fundamental criteria must be fulfilled, namely voluntariness, informed decision-making and capacity.[5]

Firstly, for a person's decision to be considered autonomous, it must be voluntary in nature.[5] In order to decide voluntarily, an individual must make a choice free of any form of coercion or manipulation.[11] Coercion is generally defined as the exercise of power to enforce one's will upon others, often resulting in the infliction of harm or punishment for noncompliance.[12] This can include the use of force or pressure to obtain desired outcomes, such as self-protection.[12] The act of manipulation involves intentionally altering someone's perception of a situation without using persuasion, which in turn influences her or his understanding of the available options.[12] This process of informational manipulation can limit a person's autonomy by making them unaware of important details, ultimately affecting their decision-making.[12] Although the manipulator does not change the person's actual options, their beliefs are influenced, resulting in a modified perception of the situation.[12] Unlike coercion and manipulation, persuasion does not infringe on a patient's autonomy[13] but instead forms part of the informed consent process. Persuasion is the influence of an appeal to reason.[5,12] It is considered akin to shared decision-making, recognising the collaborative nature of decisions in certain contexts.[14]

Informed decision-making is another integral aspect of autonomy. Respect for autonomy necessitates that patients are thoroughly informed about any proposed treatment plan. This involves engaging in extensive discussions with patients about the available treatment options, their associated risks and benefits, costs, prognosis and the consequences of not pursuing treatment.[11] Obtaining a signature on a consent form is not sufficient for respecting autonomy;[11] dentists must ensure the patient comprehends the treatment and its implications. This requires them to actively listen to patient requests and convey information in a way that is easily understandable.[11]

Competency, or capacity, is the third criterion for autonomy. Individuals must possess the ability to make informed decisions, which involves comprehension, logical deliberation and the capacity to make decisions.[13,15] Competent individuals possess the mental faculties necessary to make decisions and are legally authorised to do so. Examples of individuals who lack the mental capacity to make decisions include those who are delusional, dependent on drugs or suffering from mental illness. Additionally, children who are not of legal age to provide consent are legally prohibited from making medical decisions.

These three conditions constitute the basis for obtaining informed consent. Informed consent is both a moral duty and a legal requirement in various countries, including South Africa. Nevertheless, regarding the consent process as a means to evade legal liability rather than as a means to respect autonomy is a departure from the fundamental ethical principle of informed consent. As Beauchamp and Childress point out, "from a moral perspective, informed consent is more concerned with the autonomous choices of patients than with the liability of professionals as agents of disclosure".[5] The primary objective of the informed consent process is to treat the patient as an autonomous individual and to safeguard individuals who lack information about the treatment-related details.[16] If the consent process is viewed as a means to avoid legal liability rather than to assist the patient in comprehending the proposed treatment, it fails to demonstrate respect for autonomy and deviates from the moral obligation of informed consent to one of formality.[16]

Applying the principle of autonomy to independent jaw wiring for weight loss raises critical ethical considerations. Individuals must provide informed consent before undergoing such a procedure, and the nature of this intervention requires careful examination. Jaw wiring significantly impacts an individual's ability to eat and communicate. This restriction has implications not only for the physiological aspects of autonomy but also for the broader concept of self-determination. The decision to undergo jaw wiring must be voluntary and well-informed. However, concerns arise regarding the voluntariness of this decision, especially considering potential societal pressures to conform to certain beauty standards.

The ethical evaluation should scrutinise the quality of informed consent in this context. Are patients adequately informed about the procedure's potential physical, psychological and social consequences? Moreover, does the social context, including societal expectations and body image pressures, influence the voluntariness of their decision?

A patient's request for jaw wiring for weight loss may arise as a consequence of significant societal pressure and stigma associated with their body weight. This external influence raises questions about the authenticity of their decision-making process. Thus, the ethical evaluation, within the autonomy framework, must delve into the complex interplay between individual choice and external pressures.

The findings of a recently published research study using an intraoral device coupled with intraoral magnets for short, medium or long-term usage for weight loss have been heavily criticized by Pausé, *et al*., because the study "is underpinned by anti-fat attitudes and assumptions" and

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"indicative of a culture that consistently promotes harm to fat and other marginalised communities".[17]

Beneficence

Beneficence is highlighted in the Hippocratic Oath as a fundamental principle in clinical ethics. Beneficence refers to any act that fosters goodness.[18] It is rooted in the obligation to promote patients' wellbeing, emphasising positive actions aimed at enhancing the patient's best interests and welfare.[5] Unlike the principle of nonmaleficence, which mandates avoiding harm to others, beneficence affirms positive actions rather than prohibition. In addition to promoting overall health and acting in the patient's best interest, beneficence also entails the ethical duty to prevent harm.[5] This means taking positive steps to promote patient's best interests, rather than merely refraining from harming them. This duty includes the provision of safe, appropriate and beneficial care that aligns with the patient's best interest. For a procedure to be beneficial, it must fulfil three criteria: it must be effective, its effects must be sustainable and there must be no less harmful alternative.[19]

Beneficence is closely linked to informed consent in healthcare. Informed consent is not only a matter of respecting autonomy but also a means of ensuring beneficence. Dentists have an ethical obligation to provide patients with all the relevant information about a proposed procedure, including its potential benefits and risks, which empowers the patient to make an informed decision that is in line with their best interests. Providing comprehensive information about the potential benefits and harms is therefore essential to ensure beneficence. Dentists also have an ethical duty to refer patients to other healthcare professionals when the patient's wellbeing is at stake, and dental procedures may not be the most appropriate or effective means to address a particular issue.[11] This duty to refer aligns with the ethical principle of beneficence as it ensures that the patient receives the most appropriate and beneficial care.

In the context of jaw wiring for weight loss, a thorough ethical evaluation of beneficence requires an assessment of the potential benefits and drawbacks associated with this intervention. Proponents of jaw wiring argue that the procedure can lead to significant weight loss by restricting caloric intake, and in cases of severe obesity where other interventions may have failed, jaw wiring offers a tangible solution. Evaluating the scientific evidence supporting these claims is crucial for a beneficence-based analysis. Although many studies have found that individuals undergoing jaw wiring experienced substantial initial weight loss, the long-term efficacy of this intervention remains a subject of debate.[20] The ethical evaluation should therefore critically examine the balance between the potential short-term benefits and the uncertainty surrounding sustained weight loss. While weight loss is a primary goal, the ethical assessment should also extend beyond physical outcomes to encompass psychological wellbeing. Jaw wiring introduces profound changes to an individual's relationship with food, impacting not only eating habits but also mental and emotional states. Questions arise concerning the potential psychological distress associated with the intervention.

Nonmaleficence

The principle of nonmaleficence imposes a duty to prevent harm to others.[5,13] Harm is generally construed as anything that worsens an individual's condition.[21] The principle of nonmaleficence is a fundamental concept in the field of medicine, and it is encapsulated in the Hippocratic Oath, which states, "first, do no harm". This principle emphasises the importance of avoiding harm to patients during clinical treatment. The principle obligates dentists to prevent harm, minimise risks and refrain from actions that could worsen a patient's condition. In cases where harm cannot be entirely avoided, it is essential to balance the potential benefits against the potential harms and act in the patient's best interests.[22]

The principle of nonmaleficence also obligates dentists to stay informed about latest developments in the field. This continuous education is vital to ensure that healthcare is based on current knowledge and evidence-based practices, thus reducing the risk of harm to patients, and increasing benefits to them.[11] A dentist who neglects to stay abreast of current and relevant knowledge, as well as failing to adhere to contemporary standards of practice, will inevitably fall short of the acceptable standard of practice and may confront professional and legal repercussions as a result.

Nonmaleficence calls for dentists to recognise and acknowledge their own boundaries, and to direct patients to other healthcare professionals when a patient's situation surpasses the scope of their practice or when a specialist from another field could better attend to the patient's needs.[11] By referring patients to professionals with distinct expertise when necessary or when the required treatment is beyond the nonmaleficence scope of practice, dentists can prevent harm to patients and the dental profession.

In the context of jaw wiring for weight loss, a comprehensive ethical evaluation requires the examination of the potential harms and risks associated with this intervention. Jaw wiring introduces inherent physical risks and complications. The wiring of the jaws can lead to several dental problems as well as potential damage to the surrounding perioral tissues. Wiring of the jaws makes oral hygiene maintenance challenging which could, in turn, lead to inflammation of the dento-gingival tissues, enamel decalcification, decay and temporomandibular joint problems.[23] These complications are not only discomforting but also raise concerns about the principle of nonmaleficence. The ethical analysis should scrutinise the extent to which these potential harms align with the principle of nonmaleficence. Additionally, consideration should be given to whether the potential physical complications outweigh the intended benefits of weight loss.

Another area of concern pertains to potential nutritional deficiencies resulting from the restricted diet imposed by jaw wiring. The ethical evaluation must explore the risks of inadequate nutrient intake, considering the long-term implications for overall health. This information prompts ethical inquiries into the balance between achieving weight loss and ensuring the overall wellbeing of individuals, particularly in terms of essential nutrient intake.

Nonmaleficence also extends to psychological wellbeing. The restriction imposed by jaw wiring not only alters eating habits but may also contribute to mental health challenges, including anxiety and depression. The ethical evaluation should address whether the potential psychological harms

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are justifiable in the pursuit of weight loss. The ethical analysis within the nonmaleficence framework should weigh these psychological detriments against the intended benefits and explore alternative interventions that may pose fewer risks.

Justice

In healthcare, the principle of justice plays a crucial role in ensuring that patients receive appropriate care and that dentists adhere to ethical norms. It emphasises the importance of fair, equitable and appropriate treatment of persons.[24] It implies that dentists should respect patients' rights and treat them with fairness and professionalism.[11,13] This means that they should be truthful about available dental services and the risks and benefits of treatment options. It also means that they should not discriminate against any patient, based on factors such as race, religion, culture, occupation and gender. Moreover, that they should allow patients to make free and informed treatment choices and not exploit or take advantage of any patient. "Fairness of the patient assumes a role of primary importance when there are conflicts of interests."[24] Importantly, justice also compels dentists to operate within the boundaries of the legal framework.

Applying the justice principle to the ethical evaluation of jaw wiring for weight loss involves examining issues of accessibility, affordability and cultural sensitivity. An ethical evaluation within the framework of justice requires an examination of whether the opportunity to undergo jaw wiring for weight loss is distributed equitably across different segments of the population. Access to healthcare interventions should not be disproportionately skewed in favour of certain groups, raising concerns about social justice. This prompts ethical inquiries into whether the procedure is accessible to individuals regardless of their financial means, ensuring that the benefits and burdens are distributed justly.

Cultural factors play a significant role in shaping individuals' attitudes towards body image, weight and healthcare interventions. An ethical evaluation within the justice framework necessitates an exploration of the cultural sensitivity of jaw wiring as a weight loss intervention. The ethical analysis should address whether jaw wiring respects diverse cultural perspectives on body image and weight loss, ensuring that the intervention aligns with cultural values and avoids perpetuating unjust disparities.

Justice also encompasses the fair allocation of healthcare resources. The ethical evaluation should scrutinise whether the financial cost of jaw wiring is justifiable in relation to its benefits, considering the broader allocation of healthcare resources in society. This involves weighing the economic burden on individuals against the potential societal benefits, ensuring that the intervention aligns with principles of distributive justice.

Ethical analysis

In the context of utilising jaw wiring for weight loss, despite the initial efficacy observed in weight reduction, the sustainability of this outcome is compromised upon removal of the wiring, necessitating the implementation of requisite lifestyle modifications by the patient.[25,26] Although the procedure may yield effectiveness, the attendant effects lack enduring viability. Moreover, numerous less deleterious alternatives exist for weight loss interventions that are readily accessible and beneficial to patients. These interventions encompass behavioural and lifestyle adjustments, such as adherence to a nutritious, calorically sufficient diet and adherence to a structured exercise regimen. Notably, these interventions are characterised by predictability and engender long-term, sustainable effects.

Contrary to the health-improving claims, jaw wiring for weight loss does not confer any health benefits on the patient. The procedural application of jaw wiring fails to yield sustainable weight loss effects, with alternative, less invasive interventions readily available. Jaw wiring proves unsuitable for weight loss treatment due to its singular limitation to solid food restriction, neglecting other facets integral to weight loss. The ethical principle of beneficence imposes an obligation on dentists to redirect patients seeking jaw wiring for weight loss, as this procedure does not align with the patient's best interests.

Concerning the risk-benefit analysis of jaw wiring for weight loss, the procedure manifests more harm than benefit, a dissonance that holds implications for patients, dentists and society at large. The principle of nonmaleficence mandates that dentists refrain from administering procedures carrying greater risks than benefits. Consequently, independent dental implementation of jaw wiring for weight loss is discouraged. When the objective of jaw wiring pertains to weight loss, the intended purpose diverges from the scope of dental practice. In the case of overweight or obese patients, a comprehensive, multidisciplinary approach is imperative. The etiology of obesity being multifaceted, the caloric restriction induced by jaw wiring is deemed insufficient. Dentists, guided by the principle of nonmaleficence, are directed to partake in a collaborative team effort, refraining from autonomous treatment of weight loss and, instead, providing education and referrals to pertinent professionals.

From a justice standpoint, one might posit that jaw wiring for weight loss constitutes an elective procedure. The allocation of resources to elective procedures raises ethical quandaries concerning distributive justice, as these resources could be redirected to address more urgent healthcare needs. In patients with an ideal Body Mass Index (BMI), jaw wiring for weight loss is deemed an enhancement procedure rather than a therapeutic one. The distinction between treatment and enhancement lies in the former's focus on disease alleviation and health maintenance, while the latter seeks to enhance an individual in the absence of illness. As of present, enhancement procedures remain outside the healthcare purview. Consequently, allocating resources to enhancement procedures is deemed unethical, as these resources could be more judiciously employed within the healthcare domain.

CONCLUSION

In this article, we drew upon the principles of autonomy, nonmaleficence, beneficence and justice to evaluate the ethical permissibility of the practice of independent jaw wiring for weight loss. The ethical analysis of jaw wiring for purely weight loss purposes, using the moral framework of principlism, reveals a complex interplay of ethical principles that guide decision-making in dentistry. The ethical analysis concludes that overriding a patient's autonomous request for independent jaw wiring for weight loss can be justified. While patients possess a fundamental right to autonomous decision-making, this autonomy is not absolute and must

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be balanced with considerations of beneficence and nonmaleficence. The wellbeing and health of the patient, as well as societal and professional obligations, necessitate a nuanced approach that justifies the refusal to perform jaw wiring for weight loss in specific circumstances. The principles of nonmaleficence and beneficence underscore that this procedure is not in the patient's best interest.

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Oral Presentation of Haematological Disease: Part I – Diseases of Bone Marrow Failure

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ABSTRACT

Introduction

The bone marrow is responsible for haemopoiesis, but when it fails, oral mucosal lesions may be seen due to reduced platelets, white blood cells, or red blood cells.

Aims and objectives

This study aims to report on three patients who presented with leukaemia, aplastic anaemia and neutropenia, respectively, with spontaneous bleeding, ulceration and mucosal pallor.

Design/Methods

The oral mucosal features of three patients who presented at the University of Pretoria Oral Health Centre, with varying degrees of bone marrow failure, were recorded. Special investigations were performed to check their bone marrow function. The patients were managed collaboratively with their respective physicians.

Results

These cases demonstrate that dentists should be cognisant of disorders of bone marrow failure so that patients are a) diagnosed timely and appropriately, b) referred back to their treating clinician due to relapse of a known disease, or c) managed in collaboration with their treating clinician to confirm a suspected diagnosis.

Conclusions

Dentists play a pivotal role in diagnosing haematological disease that results from bone marrow failure. Bleeding, ulceration and mucosal pallor are important diagnostic indicators of reduced platelet, neutrophil and red blood cell counts.

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INTRODUCTION

Oral mucosal changes may be the initial sign of systemic disease[1] or the progression of an already known systemic disease process, particularly diseases of haematopoiesis.[2,3] Dentists can play a vital part in detecting and monitoring haematological diseases affecting the oral mucosa.[4] Failure to do so may have disastrous consequences and may even result in the death of a patient.[5]

Diseases impacting the haematopoietic system, with possible effects on platelets, red blood cells, and white blood cells, manifest in the oral cavity through bleeding tendencies, lowered haemoglobin concentration, and susceptibility to opportunistic infections, such as *Candida* and herpes simplex virus infection.[1, 6, 7] Neoplastic white blood cells may also amass within the gingiva and oral mucosa.[8]

This two-part case series will illustrate the impact of haematological disease on oral mucosal health using clinical examples. It will showcase bone marrow malfunction and anaemia. The purpose of this case series is not to provide an all-encompassing overview of the oral presentation of haematological diseases (for a more comprehensive review, please refer to Schlosser 2011, McCord 2017 and Elad 2019).[9-11] Instead, this case series aims to provide useful, practical, examples of clinical scenarios that dentists may encounter. Nonetheless, a fundamental grasp of bone marrow's functioning is vital in understanding the implications of its inadequacy.

The bone marrow is the principal organ for haematopoiesis in adults and children.[12] Haematopoiesis is the process whereby lymphocytes, red blood cells, and platelets are produced.[12] In the bone marrow, multipotent haemopoietic stem cells (HSC) proliferate and differentiate into lymphoid and myeloid precursors, which ultimately give rise to lymphocytes (responsible for adaptive immunity), and granulocytes (responsible for innate immunity), thrombocytes and erythrocytes, respectively.[12-14] Humans are estimated to produce more than 100 billion new hematopoietic cells on any given day.[15]

Suboptimal function of the bone marrow will therefore impact immune defences, the ability to form a blood clot when needed, and oxygen transport. The bone marrow may either be destroyed by the malignant proliferation of immature leukocytes in leukaemia,[16] or due to an autoimmune attack by lymphocytes in aplastic anaemia.[17, 18] Other times, only the production of a single white blood cell is impaired, resulting in neutropenia.[19]

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Timely intervention by a dentist may save a patient's life or support the ongoing medical management of a patient with a known haematological disease.

Permission was obtained from the University of Pretoria, Faculty of Health Sciences, Research Ethics Committee clearance number 485/2023, following informed consent from the participants.

CASE 1 - LEUKAEMIA

The following clinical case demonstrates how timely intervention by a dentist saved a patient's life after earlier opportunities had been missed.

Clinical case presentation

A 22-year-old male patient presented to the University of Pretoria Oral Health Centre (UPOHC), complaining of a painful lower left wisdom tooth (tooth 38), partly impacted and covered by an enlarged operculum. A private dentist had given the patient an appointment to remove the tooth under conscious sedation, but the costs were prohibitive. The attending dentist at the UPOHC noticed anterior marginal gingival bleeding of the maxilla and mandible, and wrongly diagnosed the patient with necrotising gingivitis (Figure 1 and Figure 2). Additional signs, such as purpura of the hard palate (Figure 3), mucosal pallor, skin bruising, and bilateral submandibular lymphadenopathy were noticed, which prompted a consultation by an oral medicine specialist. Further enquiry revealed that the patient recently noticed that his gums bleed easily and his skin bruises easily; he felt tired and was out of breath after walking up the stairs. He presented 2 months earlier to the emergency department of a local hospital with upper respiratory tract infection symptoms. Retrieval of the patient's blood results demonstrates that he already had a reduced red cell count, white cell count, and platelets (See Table I). The patient reported right ear deafness but was otherwise healthy, not using any chronic medication, and had no allergies.

Figure 1: Intra-oral clinical appearance of Case 1 demonstrating spontaneous gingival bleeding and ecchymosis of the maxillary gingiva

Figure 2: Intra-oral clinical appearance of Case 1 demonstrating spontaneous gingival bleeding of the mandibular gingiva

Figure 3: Intra-oral clinical appearance of Case 1 demonstrating purpura of the palate

Special investigations

Considering the oral and systemic signs, which indicated both the presence of anaemia, thrombocytopenia, and possible lymphocytopenia, a full-blood count (FBC), and a peripheral blood smear were ordered. The results revealed pancytopenia, as can be seen in the FBC in Table I, with a corrected white blood cell count (WCC) of 3.07 X 10^9/L, red cell count (RCC) of 2.03 X 10^{12}/L, and platelet count of 6 X 10^9/L. The differential WCC demonstrated significant neutropenia, as seen in Table II. An increased number of large blast cells (45%), with a high nuclear-to-cytoplasmic ratio, folded nuclei with irregular contours, dispersed chromatin and conspicuous nucleoli were seen on the peripheral blood smear. The cytoplasm of the blasts contained fine azurophilic granules and Auer rods. These findings were suggestive of acute promyelocytic leukaemia (APL).

Table I: Full blood count of Case 1

Test	Result	Unit	Reference range
White cell count	3.07	X 10^9/L	3.92 - 10.40
Red cell count	2.03	X 10^{12}/L	4.19 – 5.85
Haemoglobin	7.1	g/dL	13.4 – 17.5
Haematocrit	0.201	L/L	0.390 – 0.510
MCV	99.0	fL	83.1 – 101.6
MCH	35.0	Pg	27.8 – 34.8
MCHC	35.3	g/dL	33.0 – 35.0
Red cell distribution width	15.9	%	12.1 – 16.3
Platelet count	6	X 10^9/L	171 - 388

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Table II: Differential white cell count of Case 1

Test	Result	Unit	Reference range
White cell count (corrected for normoblasts)	3.07	x 10^9/L	3.92 – 10.40
Neutrophils	5.00 % (0.15)	x 10^9/L	1.60 – 6.98
Lymphocytes	47.00 % (1.44)	x 10^9/L	1.40 – 4.20
Monocytes	3.00 % (0.09)	x 10^9/L	0.30 – 0.80
Eosinophils	0.00 % (0.00)	x 10^9/L	0.00 – 0.95
Basophils	0.00 % (0.00)	x 10^9/L	Blast cells 0.00 – 0.10
Blasts	45.00 % (1.38)	x 10^9/L	

Management

Within 24 hours of presentation, the patient was admitted to the hospital under the care of a medical oncologist who immediately administered packed red blood cells and platelets and started induction intravenous chemotherapy with Idarubicin, as well as all-trans-retinoic acid (ATRA). Consolidation therapy included intravenous Mitoxantrone, Idarubicin and ATRA.

The diagnosis of APL was confirmed through a bone marrow biopsy which demonstrated hypoplastic granulopoiesis (70% of cells comprised of abnormal promyelocytes). Cytogenetic testing confirmed the balanced translocation between chromosomes 15 and 17, and both FISH and PCR positively identified the PLM/RARA gene. A CT scan of the chest, abdomen and pelvis showed an enlarged spleen, bilateral pleural effusions, diffuse bone marrow infiltration, pericardial effusion and ascites.

Outcome

The patient achieved complete remission after induction chemotherapy, as confirmed by negative PML/RAR quantitative result on peripheral blood. The patient completed maintenance chemotherapy with Mercaptopurine, Methotrexate and ATRA for another 24 months, and is currently in remission.

DISCUSSION

As in this case, there have been many other patients diagnosed with leukaemia due to oral mucosal features [1, 4, 20-27] yet, in other instances, the signs were originally missed [4, 5] or also misdiagnosed as necrotising gingivitis.[7]

Characteristics of Acute Promyelocytic Leukaemia

Acute leukaemias are generally grouped according to whether they derive from lymphoid or myeloid stem cells. The myeloid leukaemias are further subdivided by whether there is evidence of recurrent genetic abnormalities, as our case demonstrates, a history of therapy for malignancies or a prior history of haematological malignancy.[16]

The confirmation of a diagnosis that was "suspected" on the basis of morphology is by molecular or genetic testing techniques such as FISH or PCR for the PML/RARA gene product. The presence of this genetic aberration is significant as it (apart from making the diagnosis) infers sensitivity to al-trans retinoic acid for therapy. This medication induces maturation of the blast cells into mature neutrophils.[30] APL is cytogenetically characterised by a balanced reciprocal translocation between chromosomes 15 and 17, which results in the fusion between the promyelocytic leukaemia (PML) gene and the retinoic acid receptor (RAR) gene.[16, 31] Acute promyelocytic leukaemia (APL) accounts for 10%–15% of adult acute myeloid leukaemias[32] and is considered the deadliest form of acute leukaemia, due to a coagulopathy associated with the disease, causing a bleeding tendency that can potentially result in death in a matter of hours.[31] Yet, the introduction of all-trans retinoic acid (ATRA) in the treatment of APL, and the further addition of arsenic trioxide (ATO), raised the complete remission rate to 95%, making APL also the most curable type of AML in adults. [31, 33]

Therefore, a small but significant window of opportunity exists for dentists to recognise the oral features of APL, particularly spontaneous bleeding, as the first manifestation of the disease[5] and refer the patient as a haematological emergency for appropriate treatment.[4]

Systemic features of leukaemia

The general features of leukaemia can be explained by the malignant immature white blood cells that increase at the expense of normal bone marrow cells, resulting in pancytopenia. A reduced number of red blood cells result in anaemia accompanied by weakness, fatigue, and pallor, while a bleeding tendency develops due to reduced numbers of platelets. Despite the proliferation of white blood cells, there are insufficient mature granulocytes to protect against infection[7, 9, 11] therefore, opportunistic infections and fever may be seen.[6] Additional systemic features include lymphadenopathy, bone and abdominal pain.[9, 29] Bone marrow failure ultimately results in death due to bleeding or infection[7, 29] and may occur within 6 months or less if left untreated.[29] Therefore, any referral delay may be fatal.[5]

Oral features of leukaemia

The oral features give dentists a unique opportunity and responsibility to diagnose leukaemia, as up to 65% of patients with leukaemia may present with oral manifestations, especially spontaneous gingival bleeding, and submandibular lymphadenopathy, prompting them to visit a dental health care professional.[20, 21]

The oral signs mirror these haematological deficiencies and are characterised by mucosal pallor,[7] gingival bleeding and mucosal bruising,[1, 22] opportunistic infections, and non-specific ulcers due to neutropenia.[7, 27] In addition, direct infiltration of leukemic cells into tissues appears as generalised gingival enlargement, solitary masses, or indurated ulcers.[7, 8, 22, 25, 26, 34]

Extramedullary infiltration ability is a peculiar feature of leukemic cells and is most commonly seen in acute myeloid leukaemia (AML),[27, 35] but has also been reported in chronic myeloid leukaemia (CML).[34] The accumulation of leukemic cells (immature myeloid cells) is called a 'myeloid sarcoma' (MS), but is also known as chloroma, myeloblastoma, or granulocytic sarcoma, and is a rare tumour. [8, 16]

Malignant sarcoma may occur as an isolated (primary) extramedullary tumour (without bone marrow involvement),[2, 36] concurrent with a haematological malignancy, or as the initial manifestation of relapse.[2, 8, 16, 34] Malignant sarcoma most often presents as generalised gingival enlargement

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in AML,[8, 11, 35] or a non-specific gingival mass,[2, 34] and most infrequent as an indurated ulcer (4%).[8] When intra-oral MS is diagnosed before bone-marrow involvement, it allows prompt treatment to prevent disease progression.[36] Myeloid sarcoma heralds a particularly poor prognosis, with only 13.2% of patients surviving overall, and most succumb to the disease within the first year.[2, 34] Leukemic infiltrates may also compress sensory nerves, resulting in pain, paraesthesia or anaesthesia.[11] Chemotherapy and/or radiotherapy, and not local surgery, is indicated for the management of intra-oral MS.[2]

Malignant sarcoma presenting as gingival enlargement typically has a rapid onset, may cover the tooth to the occlusal surface, is often diffuse and extends to affect the entire width of the gingiva,[22-26, 37] may even occur at edentulous sites,[35] or mimic operculitis.[4] The colour may vary from pale pink, to red and purple,[7, 23, 25, 26] and may be accompanied by discomfort, especially when eating.[25] Gingival enlargement hampers proper plaque control, further contributing to bleeding tendencies, and makes the patient again more vulnerable to plaque-induced infection[23] and destructive periodontal disease, which is accelerated by neutropenia.[11] However, gingival enlargement may also be inflammatory reactive only.[35] Given the great likelihood of thrombocytopenia and neutropenia among leukaemia patients, invasive biopsy procedures should[24, 34] be exchanged for fine needle aspiration cytology.[35] Effective chemotherapy successfully resolves gingival enlargement, even in the absence of further periodontal therapy.[23, 24, 26, 37]

In addition, non-specific, aphthous-like ulcerations have also been reported, where the erythematous border has been replaced by a haemorrhagic one.[7] These ulcers can be attributed to lymphopenia particularly neutropenia. Alternatively, neutropenia may also result in opportunistic infections and gingival ulcers due to infection by normal oral flora.[29] Lastly, bilateral submandibular, non-tender, lymphadenopathy and fever may be seen.[7]

Similar to this case, there are multiple case reports of leukaemia diagnoses reached by dentists due to the oral presentation of the disease.[1, 4, 22-26] There are, however, also instances in which the initial signs were missed, resulting in uncontrolled bleeding,[4] and even death.[5] Had this patient's dentist continued with the extraction of tooth 38, or had a scaling and polishing been done to manage the 'necrotising gingivitis', it is very likely that the patient would have experienced significant bleeding.

Management

If the suspicion is raised for leukaemia, the first line of investigation is an FBC with peripheral blood smear,[26] which will demonstrate both the degree of bone marrow failure and abnormal hematopoietic precursor cells circulating in the peripheral blood. These changes will subsequently be confirmed by bone marrow biopsy, and further characterisation can be done with cytochemical staining, immunophenotyping, and cytogenetic analysis of chromosomal abnormalities.[16, 29]

APL is treated as a haematological emergency with immediate ATRA administration and followed only by confirmatory molecular and cytogenetic testing.[30] ATRA induce functional and morphological maturation in APL cells, which causes the treated APL cells to undergo terminal myeloid differentiation and finally apoptosis.[30] The addition of ATO, which has dose-dependent dual effects on APL cells by inducing apoptosis and differentiation at high and low concentrations, has minimised the relapse rate of APL, making it a highly curable disease.[30] The administration of platelets, fresh frozen plasma, and red blood cells corrects the effects of pancytopenia.[4]

CASE 2 - APLASTIC ANAEMIA (AA)

This clinical case emphasises the importance of recognising the role of a known systemic disease, namely aplastic anaemia, and its effect on the oral mucosa, so that the patient's physician can be alerted to the deterioration of the patient's condition.

Clinical case presentation

A 59-year-old male patient presented to the UPOHC complaining of dysphagia, dysphonia, and spontaneous bleeding from his throat, which would wax and wane. The patient reported suffering from aplastic anaemia (AA) and hypertension, for which he uses cyclosporine, folic acid and hydrochlorothiazide, respectively. He has self-administered analgesics (paracetamol, ibuprofen and tramadol) to relieve his discomfort on swallowing. He is a traditional healer, does not smoke and consumes alcohol twice weekly.

Upon clinical examination, a large dark red/brown mass was found on the soft palate, extending to the oropharynx and onto the left buccal mucosa (see Figure 4 and Figure 5). Gingival bleeding was also noted.

Figure 4: Intra-oral clinical appearance of Case 2 demonstrating a dark red/brown mass of the soft palate which is extending to the oropharynx.

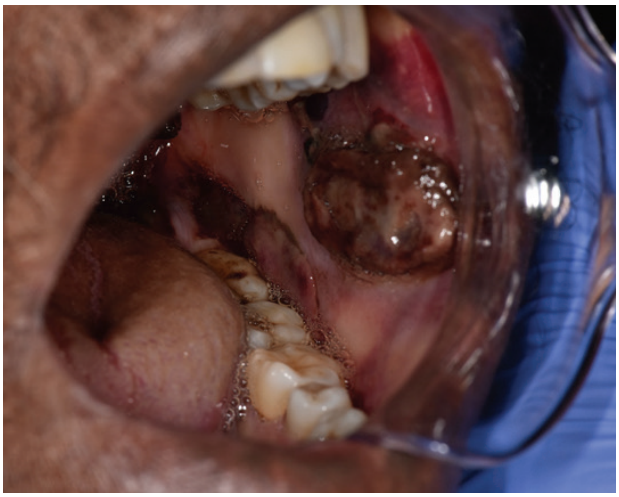

Figure 5: Intra-oral clinical appearance of Case 2 demonstrating a dark red/brown mass of the left buccal mucosa

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Special investigations

The dentist recognised that AA will be associated with a reduced platelet count and resulting bleeding tendencies. However, due to a greater suspicion of Kaposi sarcoma, an incisional biopsy of the left buccal mucosa was performed. The histological report described a fragment of mucosa that consists predominantly of ulceration and thrombi, in keeping with a diagnosis of angina bullosa haemorrhagica (blood filled bullae).

Subsequent retrieval of the patient's earlier blood work revealed a reduced white cell and red cell count, and a platelet count of 22 x 10^9/L (see Table III). An earlier bone marrow biopsy showed a hypocellular specimen, with most of the bone marrow replaced by adipose tissue, interspersed with scattered lymphocytes, mast cells, plasma cells and hemosiderin-laden macrophages. There was no obvious population of blast cells, which was in keeping with a diagnosis of AA.

Table III: Full blood count of Case 2

Test	Result	Unit	Reference range
White cell count	2.53	X 10^9/L	3.92 - 10.40
Neutrophils	1.01 (40.00 %)	X 10^9/L	1.60 – 6.98
Red cell count	2.94	X 10^{12}/L	4.19 – 5.85
Haemoglobin	11.3	g/dL	13.4 – 17.5
Haematocrit	0.336	L/L	0.390 – 0.510
MCV	114.3	fL	83.1 – 101.6
MCH	38.4	Pg	27.8 – 34.8
MCHC	33.6	g/dL	33.0 – 35.0
Red cell distribution width	14.6	%	12.1 – 16.3
Platelet count	22	X 10^9/L	171 - 388

Management

The patient's FBC seen in Table III reflects his blood values while being treated with cyclosporine. His clinical symptoms of thrombocytopenia necessitated additional supportive care with a platelet transfusion.[17, 38]

Outcome

The patient was referred back to his treating physician and continued treatment with cyclosporine, and supportive treatment when necessary.

DISCUSSION

Given the known condition of AA, which may be associated with spontaneous bleeding, a dentist would be wise to report the patient's symptoms to his physician, before attempting an invasive special investigation.

Pathogenesis of aplastic anaemia

In AA, there is a failure of haemopoiesis which is characterised by pancytopenia and bone-marrow aplasia, with the marrow devoid of morphologic precursors to erythrocytes, granulocytes, and platelets.[17, 18] This deficiency may have life-threatening consequences, due to bleeding and infection[17, 18] The disease is normally due to an autoimmune attack by cytotoxic T lymphocytes against haematopoietic stem cells[17, 18] and should be distinguished from inherited bone marrow failure syndromes such as Fanconi's anaemia.[17, 18] Aplastic anaemia is most commonly present between the ages of 15 and 25 years, in individuals with a genetic predisposition, and possible environmental exposures.[17] Yet, the aetiology is seldom established[17, 39] and is only very infrequently attributed to direct damage to the haematopoietic stem or progenitor cells.[40] Our patient was only diagnosed 2 years prior, and, to our knowledge, no eliciting factor was ever identified. Yet, it is unknown if our patient was exposed to any toxins in line with his work as a traditional healer.

Clinical features and diagnosis of aplastic anaemia

Similar to the earlier clinical presentation of leukaemia (case 1), oral and systemic symptoms reflect the peripheral blood values, including the symptoms and signs associated with anaemia, lymphopenia and thrombocytopenia, such as fatigue, opportunistic infections and spontaneous bleeding.[17] These signs are verified by a FBC and bone marrow aspirate and biopsy in which a hypocellular, fatty bone marrow should be found.[17, 18] The bone marrow biopsy was necessary to rule out myelodysplastic syndrome, acute leukaemia or bone marrow metastasis.[41]

Oral features of aplastic anaemia

The oral presentation of aplastic anaemia correlates with the degree of pancytopenia.[42] Similar to this case, spontaneous oral bleeding is the most common and problematic feature of AA.[42-44] This event prompts patients to seek dental care and ultimately enable a diagnosis to be reached.[42] Bleeding becomes especially evident once the platelet count drops below 25 x 10^9 cells/L,[44] as it did in our case (see Table 3). Yet, bleeding events do not directly correspond to the platelet count and are attributed to minor oral trauma, such as coughing and plaque accumulation.[43] Thrombocytopenia may manifest as petechiae, purpura and ecchymoses, or blood-filled bullae.[11]

Contrary to this case, other oral features include opportunistic infections with *Candida* and herpes simplex virus,[43, 44] non-specific oral ulceration (neutropenic ulcer), and oral mucosal pallor[11, 42, 45] while destructive periodontal disease is only seen after prolonged exposure to neutropenia.[43] The initiation of immunosuppressive therapy, especially with cyclosporine, which this patient was taking, frequently results in gingival enlargement and may further contribute to the risk of fungal infections.[43] Yet, these features were not encountered in this patient.

Management

Dental extractions may be complicated by prolonged bleeding and fever in patients with a platelet count of less than 50 x 10^9/L, and an absolute neutrophil count of less than 0,5 x 10^9/L, despite receiving platelet transfusions and prophylactic antibiotics.[43] Invasive procedures would therefore have been risky in this patient.

Treatment of AA is based on the degree of pancytopenia and not marrow cellularity. Accordingly; asymptomatic cytopenias may not require therapy.[17] But when symptoms such as bleeding, fatigue and infections appear, supportive therapy is provided with platelet and red blood cell transfusions and anti-infective agents. In severe AA, treatment is directed at either replacing the bone marrow through allogeneic bone marrow transplantation or preventing the autoimmune attack by immunosuppressive therapy with cyclosporine, anti-thymocyte globulin or high-dose cyclophosphamide.[17, 18]

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CASE 3 – NEUTROPENIA

This clinical case demonstrates the value of eliminating infective aetiologies of a persistent oral ulcer in a patient with suspected neutropenia.

Clinical case presentation

A 57-year-old woman was referred to the UPOHC by her physician to manage a persistent, painful ulcer of her left soft palate. The patient has experienced intermittent episodes of neutropenia, accompanied by oral ulcers, over the past 30 years. These are normally successfully managed with systemic and topical corticosteroids, but the current ulcer had been unresponsive and persisted for four weeks. The ulcer was surrounded by a wide bed of erythema, irregular borders and a granulating base (see Figure 6).

Figure 6: Ulcer of the left soft palate of Case 3

Special investigations

An incisional biopsy was performed to exclude a deep fungal infection, tuberculous ulcer or oral squamous cell carcinoma. However, no infective organism or neoplastic disease process could be identified, and the diagnosis of a 'non-specific ulcer' was made. At the same time, her physician had ordered a blood panel which revealed anaemia and neutropenia of 0.45 x 10^9/L (see Table IV). Therefore, the ulcer could be diagnosed as a neutropenic ulcer.

Table IV: Full blood count of Case 3

Test	Result	Unit	Reference range
White cell count	2.53	X 10^9/L	3.92 – 9.88
Neutrophils %	0.45 (17%)	X 10^9/L	2.0 – 7.5
Red cell count	3.53	X 10^{12}/L	4.13 – 5.67
Haemoglobin	11.6	g/dL	12.1 – 16.3
Haematocrit	0.336	%	37.0 – 49.0
MCV	96	fL	79.9 - 8.91
MCH	32.9	Pg	27.8 – 32.0
MCHC	34.2	g/dL	31.0 – 37.0
Red cell distribution width	13.2	%	10.0 – 17.3
Platelet count	294	X 10^9/L	150 - 450

Management and outcome

The patient was treated with granulocyte colony-stimulating factors (G-CSG), called filgrastim (Neupogen), which quickly restored the neutrophil count to 13.88 x 10^9/L, and led to the complete resolution of the ulcer. A topical corticosteroid was administered as a steroid inhaler (Beclomethasone dipropionate 100µg/actuate, applied 4 times daily) for symptomatic relief.

DISCUSSION

In this case, the history of neutropenia, and accompanying oral ulcers, could have been sufficient to reach a diagnosis. Because the ulcer was chronic, infection or malignancy had to be ruled out first.

Pathogenesis of neutropenia

Neutrophils are part of the innate immune response; they are our first defence against bacteria, fungi and protozoa and are among the primary responders in acute inflammation. The neutrophil is so essential to maintaining health that more than 50% of the bone marrow is dedicated to neutrophil production so that, at times of infection, production can increase 10-fold.[14, 46] Neutropenia is defined as an absolute circulating neutrophil count (ANC) of less than 1.5 X 10^9/l,[19] and our patient's was only 0,45 X 10^9/L.

The aetiopathogenesis of neutropenia can be classified according to why and when it developed. Congenital causes of neutropenia are normally associated with a decreased production or maturation of neutrophils in the bone marrow.[47] These diseases are inherited in an autosomal dominant or recessive manner and include severe congenital neutropenia (Kostmann's syndrome); benign congenital neutropenia; reticular dysgenesis; cyclic neutropenia and Schwachman-Diamond syndrome.[47] Cyclic neutropenia is an autosomal dominant disease, in which neutrophil elastase gene (ELA2) mutation results in intramedullary apoptosis of neutrophils.[48] Our patient was never conclusively diagnosed with these conditions.

Acquired causes of neutropenia are due to increased destruction or reduced production of neutrophils. These deficits may be due to infections, radiation, nutritional deficiencies (vitamin B12 and folate) and drugs that cause myelosuppression. However, non-steroidal anti-inflammatory drugs (NSAIDs) characteristically reduce neutrophil counts.[47]

In HIV infection, neutropenia occurs because of reduced production, increased peripheral elimination of neutrophils, and the myelosuppressive effect of antiretroviral therapy. In this context, neutropenic ulcers should be distinguished from other non-specific ulcers.[49]

Oral features of cyclic neutropenia

Neutrophil dysfunction results in an increased infection rate, commonly presenting intra-orally as destructive periodontal disease and oral ulcers, and may require prophylactic antibiotics to mitigate the risk of infection during dental treatment.[47]

Neutropenic ulcers are similar to major recurrent aphthous stomatitis (RAS) because they are very painful, have regular margins, are covered by a yellow-to-white membrane, and do not have any specific histology, or microbial aetiology.[11,

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[49-51] Nonetheless, contrary to major RAS, neutropenic ulcers do not appear exclusively on non-keratinised mucosa,[49, 50] lack the characteristic erythematous halo due to the absence of the neutrophil inflammatory response,[51] do not scar, heal quicker, and are often multiple.[50] Even though these ulcers recur similarly to RAS, they appear more regularly, at an earlier age, and are associated with fever and periodontal destruction.[11, 49, 50]

Furthermore, the characteristics of the underlying neutropenia will determine the ulcer's behaviour and associated clinical features. In cyclic neutropenia, which becomes evident during infancy or childhood, ulcers are accompanied by fever. Their appearance mirrors the decrease in neutrophils, which occurs every 21 days and lasts 3 to 6 days,[50, 52] but will persist as long as the neutropenia continues.[11, 49] Therefore, our patient likely experienced brief episodes of neutropenia in the past, but persistent neutropenia was responsible for her non-healing ulcer.

The destructive periodontal disease seen in congenital neutropenia occurs early to involve the primary dentition, often resulting in premature exfoliation of teeth.[50] It may be distinguished from aggressive periodontitis by its earlier onset, greater visible signs of gingival inflammation presenting with redness and swelling, and more dental plaque.[50] Oral ulcers may further limit effective plaque control,[48] emphasising the need to resolve the ulcers.

Dental treatment in neutropenia

Persistent oral ulcers require surgical biopsy and histopathological evaluation to rule out oral squamous cell carcinoma, tuberculosis and deep fungal infections. The combined absence of microbial pathogens[11] and demonstration of neutropenia will finally distinguish between a non-specific ulcer (RAS) and a neutropenic ulcer.[49]

If you have a patient with neutropenia, you may rely on chlorhexidine mouth rinses to assist with chemical plaque control[48] and you may continue with non-surgical periodontal treatment once the ANC is restored to > 1,5 x 10^9/L, obviating the need for prophylactic antibiotics.[48]

Depending on the patient's ANC, G-CSF may also be required before other dental treatments to reduce the risk of infectious complications.[47] The greatest risk of infection is with an ANC of less than 0,5 x 10^9/L.[48]

Treatment of neutropenia and neutropenic ulcers

Neutropenic ulcers will only resolve if the neutrophil count is restored.[48-50] Neutrophil recovery is achieved through the administration of G-CSF, which stimulates the proliferation and differentiation of granulocytes.[48] Topical corticosteroids are successfully used in managing RAS and can similarly be employed in the symptomatic management of neutropenic ulcers[53] as in this case. Alternatively, photobiomodulation may be used to provide symptomatic relief and may be combined with antimicrobial agents.[51]

CONCLUSION

These three clinical cases demonstrate how critical it is for dentists to recognise the features of bone marrow failure in the diagnosis and treatment of haematological disease. Bone marrow failure presented here with spontaneous bleeding, mucosal pallor, and ulceration, reflecting the malignant or immune-mediated destruction of the bone marrow, which puts the patient's life at risk if not properly diagnosed. Even though such cases are not commonly encountered in general practice, the significance of spontaneous bleeding or persistent oral ulceration should warn the dentist of the possibility of a serious underlying disease.

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Spindle cell carcinoma of the lower lip: A case report and review of the literature

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ABSTRACT

Background

To document the lip as an unusual site of clinical presentation of spindle cell carcinoma and to conduct a review of the literature.

Methods

A 66-year-old male patient presented with an ulcerated lesion of the lower lip. Morphological examination and immunohistochemical profiling of the lesion were performed.

Results

Histopathological examination showed a high-grade spindle cell neoplasm. Pleomorphic fusiform cells with cytological and nuclear atypia were predominant together with conspicuous perineural infiltration. A small focus of overlying stratified squamous parakeratinising epithelium was identified in a section of the lesion. Co-expression of cytokeratin and mesenchymal markers confirms the epithelial-mesenchymal transition which is inherent to this lesion.

Conclusion

Spindle cell carcinoma (sarcomatoid carcinoma) is a rare variant of squamous cell carcinoma with an infrequent occurrence on the lower lip. The objective in reporting this case is to raise the clinicopathological awareness of this unconventional variant of squamous cell carcinoma to expedite diagnostic and therapeutic intervention.

Statement of clinical relevance

The documentation of a rare form of oral squamous cell carcinoma at an unusual site allows for expeditious diagnostic and therapeutic intervention.

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1. Principal researcher – writing, microscopic analysis (40%)
2. Co-authors – editing, contribution to concept, clinical contribution of patient information (30% each)

Keywords

Spindle cell carcinoma, squamous cell carcinoma, sarcomatoid carcinoma, epithelial-mesenchymal transition

Conflict of interest

No conflict of interest declared

INTRODUCTION

Spindle cell carcinoma (SpCC) represents a rare variant of squamous cell carcinoma (SCC), an epithelial malignancy which has a predominant mesenchymal morphology.[1,2] The diagnosis of SpCC is frequently problematic particularly when there is no microscopic evidence of origin from the overlying epithelium. SpCC thus presents with great diversity within each individual neoplasm as well as variation between neoplasms, which adds to the complexity of diagnosing neoplastic spindle cell lesions at this site.[1]

Spindle cell carcinoma is also variably termed sarcomatoid carcinoma which reflects its true epithelial nature using the term "carcinoma" as well as the fact that both at a morphological and molecular level, the neoplastic cells undergo epithelial-mesenchymal transition (EMT) which provides the sarcomatoid component to its name.[3,4] As a variant of squamous cell carcinoma, it exhibits biological aggressivity and is often associated with an overall poor prognostic outcome.[2,4-9] This is in part a result of the prominent EMT which increases the probability of early/nodal metastases thus increasing the clinical stage at presentation and accounting for the greater incidence of recurrence associated with this form of SCC.[2,7,8,10,11] SpCC is most frequently identified in the head and neck within the larynx, trachea, tongue and maxillary sinuses.[2,5,7,12] Other cases involving the oral cavity are rare with documentation at sites including the lower lip, buccal mucosa and attached gingiva.[2,6,8,13-15] SpCC occurring primarily on the lip presents more often as an ulcerated, endophytic lesion and often has regional lymph node metastases at the time of clinical presentation. This is prognostically significant and confirms the need for increased awareness of SpCC at this site to ensure the accurate diagnosis and implementation of the appropriate management.

CASE REPORT

A 66-year-old male patient presented with a painful ulcer of the lower lip which had been present for nine months. The patient had reported sudden rapid pre-operative growth. Clinical examination showed an area of ulceration with rolled borders measuring 20x40mm in size (Figure 1). In addition, the patient was known to be RVD-reactive with a history of tobacco use and alcohol consumption. There was clinical evidence of bilateral submandibular lymphadenopathy. The clinical impression was that of squamous cell carcinoma. The sections of tissue submitted for histopathological examination confirmed the presence of a malignant predominantly spindled neoplasm which was noted to arise within the overlying oral mucosa of the vermillion border. The patient was unfortunately lost to follow-up which prevented definitive surgical management.

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Figure 1: Clinical presentation of an ulcerated lesion on the lower lip of a 66-year-old male patient which had been present for nine months.

METHODS

The surgical incision specimen was received in a 10% formaldehyde solution followed by macroscopic examination. The tissue was embedded in paraffin, processed and stained routinely with hematoxylin and eosin. Following histomorphological assessment, immunohistochemical staining was performed on four micrometer sections which were first deparaffinised and hydrated followed by antigen retrieval. The antibodies used in this case are listed and summarised in Table I. Positive and negative controls were used for the verification of the staining in each case.

RESULTS

Macroscopic examination

Two separate specimens were submitted as incisional biopsies of the lesional tissue. Specimen 1 comprised two soft tissue fragments, the larger measuring 13x5x5mm and the smaller measuring 11x6x3mm. The first specimen was labelled "left lower lip" and appeared to be surfaced by mucosa. The second specimen was labelled "right lower lip" and comprised a portion of soft tissue measuring 11x6x4mm.

Microscopic examination

Both specimens showed similar histological features and are therefore described together. Sections show portions of soft tissue surfaced on one aspect by stratified squamous non-keratinising epithelium. There is focal evidence of ulceration where an adherent layer of inflammatory crust material is present. Arising within the surface epithelium is a malignant neoplasm. The invasive tumour cells are predominantly fusiform with marked nuclear and cytological atypia and pleomorphism. Occasional scattered foci containing plumper, more epithelioid cells are observed (Figure 2A). Multifocal areas of perineural infiltration are evident.

Expression of the cytokeratin marker AE1/AE3 is positive in both the overlying epithelium as well as within the underlying neoplastic tumour cells (Figure 2B). A second marker of epithelial morphology is p63 which shows diffuse, strong nuclear positivity within the neoplastic cells (Figure 2C). Furthermore, the neoplastic tumour cells show divergent differentiation through the co-expression of Vimentin, a marker of mesenchymal origin (Figure 2D).

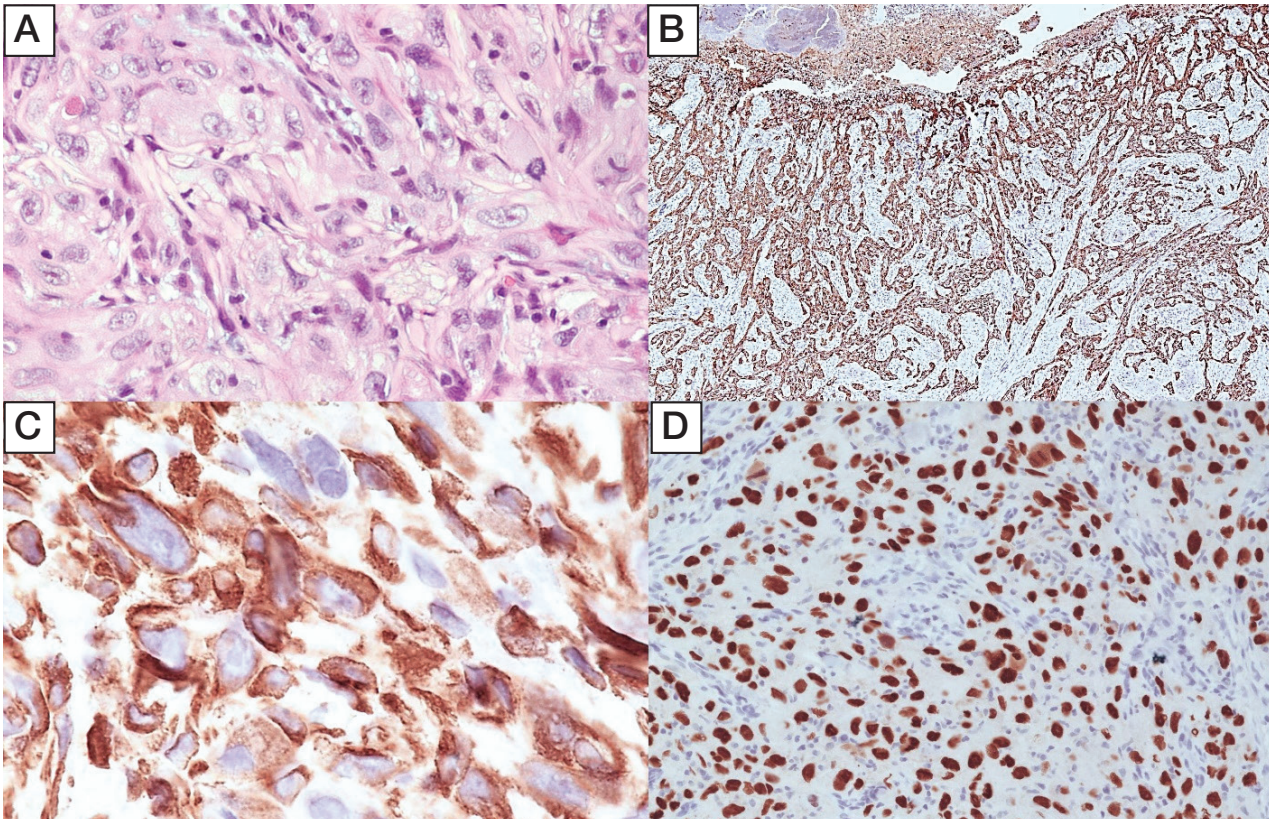

Figure 2A: High-grade epithelioid and fusiform tumour cells with marked cytological pleomorphism and mitotic atypia (Hematoxylin-eosin stain, original magnification x100). **Figure 2B:** Cytokeratin staining of the neoplastic cells is strongly and diffusely positive. The surface ulceration is highlighted here while the stain demonstrates strands, cords and single cell invasion by the tumour cells (Immunohistochemical staining with AE1/AE3, original magnification x200). **Figure 2C:** Co-expression of Vimentin with AE1/AE3 shows divergent lineage of the tumour cells due to epithelial-mesenchymal transition (Immunohistochemical staining for Vimentin, original magnification x200). **Figure 2D:** p63 nuclear positivity is diffusely expressed within the tumour cells (Immunohistochemical staining with p63, original magnification x200).

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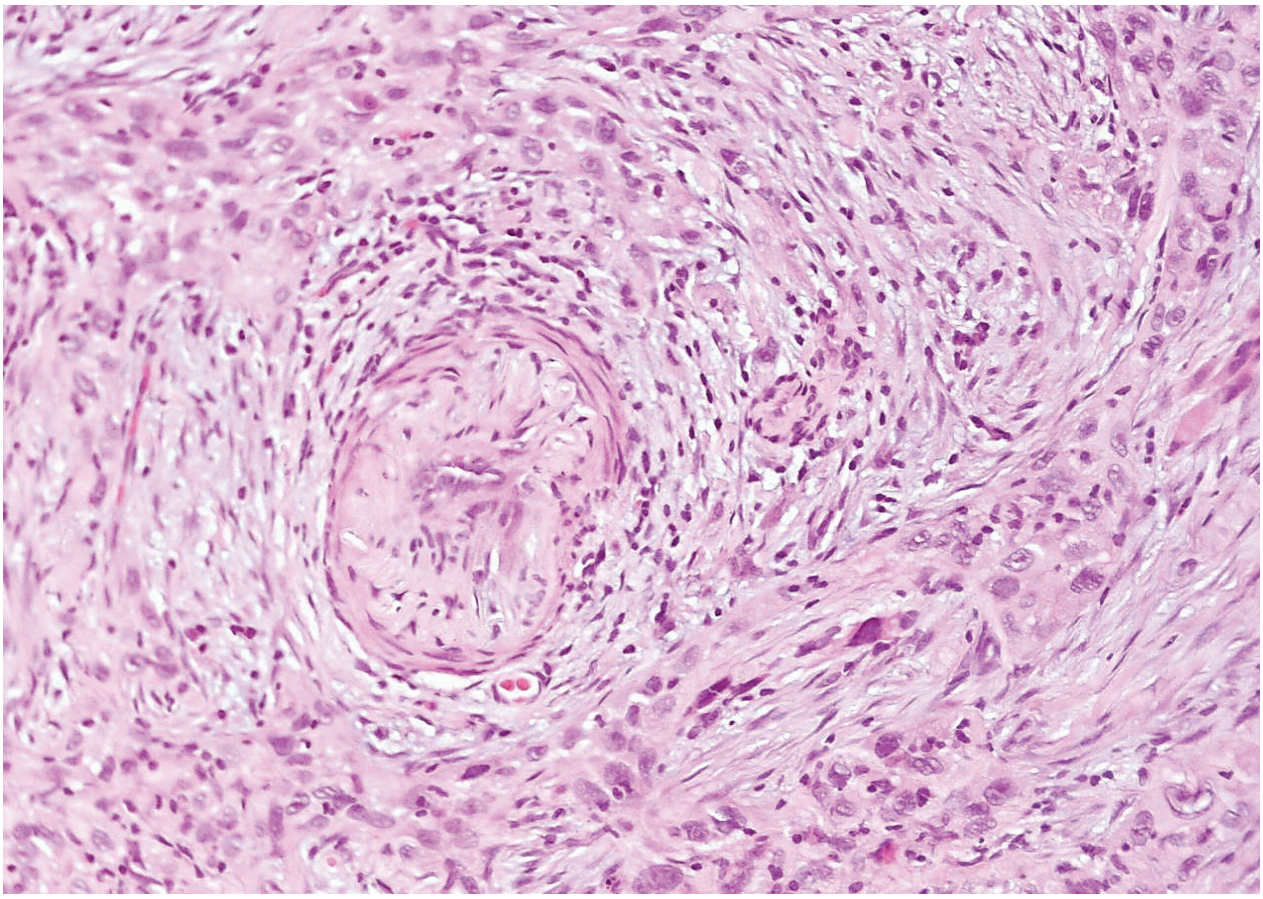

Figure 3: Tumour infiltration around a medium-sized blood vessel highlighting a vague fascicular growth pattern. Fusiform spindled cells are predominant while occasional epithelioid cells with prominent nucleoli are observed (hematoxylin-eosin staining, original magnification x200).

Immunohistochemical staining for S100 is negative within the tumour cells while highlighting extensive areas of perineural infiltration. Immuno-negativity by the neoplastic tumour cells was similarly obtained when stained with SMA; however, upregulated expression by the stromal cells was evident. A vague storiform to fascicular growth pattern is noted as shown in Figure 3.

DISCUSSION

The spindle cell variant of squamous cell carcinoma is a rare high-grade neoplasm synonymously referred to as sarcomatoid carcinoma. The WHO classifies SpCC as a malignant epithelial variant of SCC accounting for approximately 1% of all SCCs. It is biphasic in nature and has a high mortality rate due to its inherent aggressive biological nature and an increased propensity for metastases and recurrence. It is thus imperative for early recognition and treatment to successfully manage this neoplasm.[2] Early polypoid SpCC have a better prognosis than ulcerated or endophytic lesions detected at a later stage. SpCC is seldom if ever associated with high-risk human papillomavirus (HPV) regardless of the subsite of the head and neck involved by such a neoplasm.[9] SpCC of the head and neck is most often located within the larynx, trachea, hypopharynx, oesophagus, maxillary sinuses and orbits. Intra-oral SpCC is similarly rare in comparison to the prevalence of conventional SCC and has been documented to involve the tongue, buccal mucosa, attached gingiva and the lower lip.[1,2] The

Antibody	Clone	Manufacturer	Immunohistochemical staining pattern
AE1/AE3	AE1/AE3	DAKO, Glostrup, Denmark Pre-diluted	Strongly and diffusely positive within the overlying epithelium as well as within the lesional cells
P63	DAK-P63	DAKO, Glostrup, Denmark Pre-diluted	Strong diffuse nuclear signalling detected within tumour cell nuclei.
S100	Polyclonal	DAKO, Glostrup, Denmark Pre-diluted	Negative in lesional cells. Positivity highlights the extensive perineural infiltration.
SMA	HHF35	DAKO, Glostrup, Denmark Pre-diluted	Negative within neoplastic cells. Overexpression is noted by the myofibroblastic cells.

Table 1. Immunohistochemical staining in sections of tissue obtained from spindle cell carcinoma of the lower lip.

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lower lip as a site of involvement by conventional SCC is usually seen in patients with a history of occupational sun exposure.[16] Such an association was not provided in this case. SpCC occurring at mucosal sites are documented to have a higher prevalence in tissues which have undergone therapeutic irradiation and in patients who use tobacco and consume alcohol.[1,2] Furthermore, in addition to tobacco and alcohol use and a previous history of irradiation, poor oral health has been identified as a risk factor for the development of SpCC particularly in genetically susceptible individuals who simultaneously present with a combination of inflammation and injury.[17] SpCC shows a marked demographic difference with a male:female of 11:1 while occurring in the 6th to 7th decades.[2] Oral squamous cell carcinoma (OSCC) in its conventional form has a propensity for demographically presenting in older male patients in the 5th to 7th decades and are etiologically linked to tobacco use and alcohol consumption, representing the seventh most common malignancy globally.[16] The patient in this case report fits very well with the reported demographics of both SpCC and conventional OSCC. It should also be noted that the patient is RVD-reactive, the immunosuppression of which is known to predispose patients to the development of HIV-associated malignancies as well as those which are not defined specifically as HIV-associated. This may be attributed to decreased immune surveillance as well as immune dysfunction.[18] This patient has multiple risk factors which favour the development of OSCC; however, it is most unusual to encounter an SpCC on the lower lip.

Spindle cell carcinoma is one of several variants of SCC which have been described based on their unique histopathological features.[19] These include verrucous carcinoma, basaloid SCC, Papillary SCC, Adenosquamous carcinoma, Adenoid/Acantholytic SCC, carcinoma cuniculatum and spindle cell (sarcomatoid) carcinoma.[19-21] These neoplasms not only have unique microscopic features but are prognostically significant to recognise.[19]

SpCC has a unique clinical presentation in up to 90% of laryngeal or pharyngeal neoplasms in which lesions tend to present as polypoid, exophytic masses which project into the lumen. Lesions occurring within the oral cavity have a more variable morphology with 50 to 60% being exophytic. There is frequently extensive surface ulceration. In up to 80% of cases, at least a focus of conventional SCC is visible at some point within the lesion which may necessitate multiple serial sections of tissue.[1] The spindle cell component, however, most often predominates. The recognisable portion of conventional squamous cell carcinoma may be seen as a focus of epithelial dysplasia, carcinoma-in-situ or frankly invasive SCC which curiously tends to be identified within the stalk of the polyp. The spindle cells tend to be atypical and markedly pleomorphic occurring in association with atypical mitotic figures.[2,3,7,10] Various growth patterns have been identified with some lesions showing a storiform pattern of growth with irregular fascicle formation.[22] Occasional neoplasms have a myxoid appearance, often with extensive surface ulceration and sparsely distributed cells. Lesions in which discohesive tumour cells are identified may be diagnostically challenging as they frequently mimic exuberant granulation tissue. The spindle cell component in SpCC may mimic a true sarcoma although being of epithelial origin. Historical studies have shown that the morphological, immunohistochemical, ultrastructural and molecular features of SpCC show marked genetic similarity between the epithelial and spindled cells as noted in biphasic tumours. This serves to confirm divergent differentiation of the spindled cells from which is otherwise a true carcinoma.[1,19] Lesions with a predominantly monophasic spindled histomorphology tend to hinder accurate diagnosis.[1] The spindle or sarcomatoid component of SpCC occurring in the upper aerodigestive tract may be misdiagnosed as a variety of other spindle cell lesions, particularly malignant lesions, due to the inherent and frankly malignant nature of the neoplasm. However, there may be some morphological overlap with benign lesions in the differential diagnosis. The differential diagnosis for malignant neoplasms includes spindle cell melanoma, angiosarcoma, Kaposi sarcoma, synovial sarcoma and malignant peripheral nerve sheath tumour. Low-grade to benign lesions to be considered in the differential diagnosis include nodular fasciitis, inflammatory myofibroblastic tumour and solitary fibrous tumour.[1,5]

Without evidence of origin from overlying dysplastic surface epithelium or admixed nested epithelial cells, immunohistochemistry is required to confirm the diagnosis. In most cases there will always be at least focal positivity for immunohistochemical staining. AE1/AE3 or pancytokeratins is positive in up to 62% of cases while Epithelial Membrane Antigen (EMA) is positive in up to 47% of cases. P63 is regarded as an additional immunohistochemical marker with positivity being as high as 63%. A rate of 68% immunopostivity is reported when at least one epithelial marker is used but this increases to 79% if a combination of AE1/AE3, EMA and p63 are used. The recent recognition of p40 may improve these statistics; however, there are still many cases which fail to demonstrate positivity with a cytokeratin which perpetuates the diagnostic difficulty.[3] Almost all (100%) cases are positive for Vimentin with a small proportion of cases (up to 33%) showing positivity to either smooth muscle actin (SMA) or muscle specific actin (MSA).[1-3,19]

The unique polypoid clinical presentation at specific subsites, the co-expression of cytokeratins and Vimentin, evidence of origin from overlying epithelium and serial sections showing biphasic areas of squamous differentiation should allow for the diagnosis of SpCC and for distinction from possible malignant differentials. The frankly malignant histopathological features of SpCC generally allows for easy distinction from benign mesenchymal neoplasms. The increased expression of SMA within the stroma, as was noted in this case, is indicative of tumour-stroma crosstalk which occurs when the neoplastic cells secrete angiogenic and growth factors which stimulate the growth of the surrounding fibroblastic stromal cells and vascular cells which allows for the development of a self-sustaining vasculature. In turn, the upregulated stromal cells produce growth factors which further stimulate the neoplastic cells. The presence of such a tumour micro-environment serves to promote tumour growth and metastatic spread.[23] This property alone accounts for a poorer prognosis when present. Furthermore, SpCC inherently displays the properties of divergent differentiation from an epithelial to mesenchymal lineage in a process termed epithelial-mesenchymal transition. This dynamic process causes a change in the cellular morphology of the tissue of origin and suppression of epithelial characteristics, coupled with the acquisition of cell motility, reduced cell death by apoptosis and increased resistance to chemotherapeutic drugs which

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enhances the invasiveness and propensity for metastatic spread of the neoplastic cells.[24] Wide surgical resection remains the treatment of choice for SpCC.[6]

CONCLUSION

Spindle cell carcinoma is a rare variant of squamous cell carcinoma with a small percentage of cases located within the upper aerodigestive tract. The oral cavity is involved far less frequently than are the larynx, hypopharynx, orbits or maxillary sinuses. This case report aims to raise awareness of this unusual variant of SCC when considering the differential diagnosis of malignant spindle cell neoplasms which occur at this site. This requires a high index of suspicion, patience in searching for evidence of origin from overlying epithelium and the use of immunohistochemistry to expedite the diagnosis and initiate the most appropriate treatment.

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What's new for the clinician – summaries of recently published papers (June 2024)

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Edited and compiled by Prof V Yengopal, Faculty of Dentistry, University of the Western Cape

1. BLEACHING EFFICACY OF IN-OFFICE DENTAL BLEACHING WITH DIFFERENT APPLICATION PROTOCOLS: A SINGLE-BLIND RANDOMISED CONTROLLED TRIAL

Most bleaching products used in dentistry are based on the direct use of hydrogen peroxide (H2O2) or its precursor, carbamide peroxide. Tooth whitening is a very complex process that depends on several factors including the pH of the bleaching agent, the method of application and thickness of the bleaching agent to the enamel, the fluctuation of irradiation, length of photoactivation, tooth size, selective absorption of the wavelength of irradiation and so on. Two techniques of tooth whitening have been described – ambulatory (at home) and in-office (by a professional).

In-office bleaching involves using high-concentration hydrogen peroxide gels, typically applied for eight to 50 minutes, with possible renewals two to four times in the same sess ion, after soft tissue protection with a gingival barrier.[1] Uncertainties also persist about the timing and frequency of these applications. Favoreto and colleagues in Brazil (2024)[1] reported on a trial that sought to assess the colour change, adverse effects, self-perception and the impact of oral condition of three different in-office bleaching protocols. The primary research hypothesis tested was whether (1) the use of different in-office dental bleaching protocol with varying application times and frequency are equivalent in terms of colour change. Additionally, as secondary hypotheses, the researchers tested whether interventions will differ in terms of (2) absolute risks and intensities of tooth sensitivity (TS) and gingival irritation (GI) and (3) the self-perception and impact of oral care.

METHODOLOGY

This Brazilian study was designed as an equivalent, parallel, evaluator-blinded randomised controlled trial with an equal allocation ratio. Reporting of the data followed the format of the Consolidated Standards of Reporting Trials (CONSORT).

Participants were recruited via social media platforms such as Instagram®. To be eligible, participants needed to meet the following criteria: good general and oral health, age over 18 years old, absence of periodontal disease, gingival recession or carious lesion in anterior teeth. Additionally, their canines had to have colour A2 or darker based on value-oriented shade guide (Vita classical A1-C4). Exclusion criteria encompassed patients with a history of prior bleaching, dentin hypersensitivity, ongoing use of orthodontic apparatus, dental prosthesis or restoration in anterior teeth, prior endodontic treatment in anterior teeth, severe tooth discoloration (fluorosis or pulpless teeth, stains due to the use of tetracycline), visible cracks in teeth, continuous use of medications such as analgesics and anti-inflammatories, pregnant or lactating women, and patients with habits such as smoking or bruxism.

The sample size calculation included a measure for possible losses, an additional 20% was added, bringing the total required participants to 55 per group or 165 volunteers in total. Randomisation in blocks of 3, 6 and 9 was performed, with an equal allocation ratio. The patients were randomly divided into three groups ($n = 55$) according to the in-office bleaching protocol. In group 1, the bleaching product was applied in two 20-min applications (2 x 20min; manufacturer's recommendation); in group 2, the product was applied in a single 40min application (1 x 40min); and in group 3, the product was applied in a single 30-min application (1 x 30min).

The allocation sequence was determined using opaque, sealed and sequentially numbered envelopes. The individual responsible for randomisation and blinding in this study was not involved in the intervention process. Prior to starting the bleaching procedure, the operator opened the envelopes containing the randomisation details, revealing the participant's assigned group. In this study, only the evaluators were blinded, making it a single-blind clinical trial. Operator and patients knew the groups to which they were allocated due to treatment time or gel renewal during the procedure.

The bleaching procedure was performed by three dentists who had more than five years of clinical experience. The participants were submitted to dental prophylaxis with pumice stone and water with the aid of a Robinson brush on low speed. Operators placed a soft tissue retractor in the patient's mouth and protected the gingival tissue with a light-cured gingival barrier (Total Blanc). The barrier was light cured for 30 seconds every two teeth.

The 35% hydrogen peroxide (Total Blanc Office One-Step), packed in pre-dosed attachable syringes, was employed. The current gel starts with an initial pH 7.3 but isn't stable throughout the entire application period, decreasing to pH 6.3 after 40min of application.

The hydrogen peroxide and thickener syringes were attached by a syringe connector to both syringes. The plungers were pushed six to seven times to ensure a homogeneous activated gel with red colour. The entire mixture was transferred to one of the syringes and disconnected. Then the application tip was attached to the loaded syringe. The bleaching product was applied on the dental surfaces of the participants following the randomisation. Both arches of the participants underwent tooth bleaching, with the teeth from the second premolars to the second premolars being treated. In group 1, after 20min the gel was removed with

an aspirator cannula, and then reapplied for another 20min. In the groups 2 and 3, the gel was kept undisturbed for 40min and 30min respectively. At the end of the bleaching protocol, gel was removed with an aspirator cannula and a moistened gauze. The gingival barrier was removed and the patient's teeth cleaned with an air-water spray. Each patient underwent two bleaching sessions with an interval of seven days between them.

The colour objective and subjective was registered before, after the first and second. bleaching sessions and 30 days after the end of the treatment. Two blind calibrated evaluators with an inter-examiner agreement level of agreement of at least 85% (Kappa statistic) assessed colour outcomes. In case of disagreement during the evaluation, the evaluators needed to reach a consensus before the participant was dismissed. The recordings were made in the same room with the same lighting conditions, with hydrated teeth.

The colour assessment utilised the objective method employing the Vita Easyshade Advance 4.0 spectrophotometer (Vita). This spectrophotometer function is based on the CIELab* system, where L* indicates the lightness value ranging from 0 (black) to 100 (white). Additionally, a* measures colour along the green-red axis and b* measures colour along the blue-yellow axis. The device, calibrated before each measurement, provided these parameters during the assessment. To ensure consistent and standardised measurement of objective colour an impression of the participants' upper arch was made using blue-green condensation silicone to create a guide for the upper anterior teeth. The matrix, created in the vestibular region of the upper right canine's middle third, was perforated to match the active tip of the Vita Easyshade Advance 4.0 spectrophotometer with the aid of a 6mm diameter circular scalpel. The difference between the coordinate registered before, after the first and second bleaching sessions and 30 days after the end of the treatment was calculated. Additionally, the Whiteness Index for Dentistry (WI_D) was calculated. The 50:50% acceptability threshold was considered when the differences in colours observed before and after bleaching exceeded ΔE_{ab}>2.7, ΔE_{00} > 1.8 and WI_D>2.9.

Additionally, only the colour evaluation the upper right canine's middle third was performed using subjective methods using shade guides (Vita classical A1-C4) and Vita Bleachedguide 3D-MASTER. The value-oriented Vita classical A1-C4 colour scale consists of 16 colour shade guides, arranged from the highest (B1) to the lowest (C4) value. Vita Bleachedguide 3D-MASTER scale is a tooth bleaching scale which contains lighter coloured tabs arranged from the highest value (0M1) to the lowest (5M3) value. The colour change of shade guide units (ΔSGU) in the middle third of the vestibular right canine was calculated by subtracting the baseline colour number from the final colour number.

Participants were instructed and asked to assess their tooth sensitivity (TS) and gingival irritation (GI) using a visual analogue scale (VAS) ranging from 0 to 10, where 0 indicated no TS or GI and 10 signified severe TS or GI. The assessed TS is regarded as a brief, acute discomfort that may persist for up to 48h following the bleaching session. The measured GI is described as a stinging or burning sensation experienced by the participant in the soft tissues. The participants should mark a vertical line along the 0-10cm VAS line, the region corresponding to their intensity of TS or GI. Assessments were conducted immediately after, up to 1h, up to 24h and up to 48h following the bleaching sessions. For the dichotomous assessment of TS and GI risk, only those who recorded zero were categorised as without TS or GI; all other recorded values were considered indicative of the presence of TS or GI. To calculate the intensity of TS and GI, the distance from the marked region to the zero end was measured in cm. This procedure was done in both the first and second bleaching sessions and the worst value for statistical analysis was taken.

Aesthetic self-perception was evaluated through the Orofacial Aesthetic Scale in Portuguese (OES-Pt) which contains eight aspects, being: 1. Your facial appearance; 2. Appearance of your facial profile; 3. Your mouth's appearance (smile, lips and visible teeth); 4. Appearance of your rows of teeth; 5. Shape/form of your teeth; 6. Colour of your teeth; 7. Your gums' appearance; 8. Overall, how do you feel about the appearance of your face, your mouth and your teeth.

Patients were instructed to respond by marking with an x how satisfied they were with each of the eight aesthetic aspects on the numerical scale (0-10), where "0" represented very dissatisfied and "10" represented very satisfied. The scale was delivered to be answered before the start of bleaching and after the end of all treatment. Volunteers answered the questionnaire without any intervention and time limit for completion.

The impact of oral condition on quality of life was evaluated through the Brazilian version of the abbreviated form of the Oral Health Impact Profile (OHIP-14), which contains 14 questions. Participants were instructed to respond by marking the questions (0-4) with an x, where "0" = never, "1" = rarely, "2" = sometimes, "3" = repeatedly and "4" = always. The scale was delivered to be answered before the start of bleaching and after the end of all treatment. The participants answered the questionnaire without any intervention from the evaluators and without a time limit for completion.

RESULTS

Three hundred and sixteen participants were examined and 165 were included in the clinical study and randomised to the three study groups (n=55 each).

On average, after one month of bleaching procedure an average of colour change of 10, 7 and 13 units were observed for ΔE_{ab}, ΔE_{00} and WI_D, regardless of the experimental groups evaluated (p>0.48; p>0.38 and p>0.29, respectively). For subjective evaluation, 6 and 7 units were observed with the VITA Classical (p>0.06) and VITA Bleachedguide, respectively (p>0.11) for all experimental groups. According to all colour parameters evaluated, groups did not differ from one another in any of the time assessments (p>0.06).

A significant difference in the risk of tooth sensitivity (TS) was observed between groups (p<0.04). The TS risk of the group 1x30min was the lowest (58%, 95% CI 45-70%) compared to the groups 2x20min (76%, 95% CI 68-85%) and 1x40min (71%, 95% CI 58-81%). Regarding the intensity of TS, no significant difference among groups was observed in any of the two bleaching sessions (p>0.43), as well as in the worst-case scenario when the researchers took the highest value reported by the participants during the

bleaching ($p = 0.31$). The overall value of TS, irrespectively of the group and time assessment, was 0.84 ± 1.45.

No significant difference was observed in the risk of gingival irritation (GI) among groups ($p > 0.44$). The GI risk of the group 1 x 30min was (51%, 95% CI 38-63%), for the group 2 x 20min was (43%, 95% CI 31-57%) and for the group 1 x 40min was (49%, 95% CI 36-62%). Regarding intensity of GI, no significant difference among groups was observed in any of the two bleaching sessions ($p > 0.36$), as well as in the worst-case scenario when the highest value by the participant was used for statistical purposes ($p = 0.78$). The average value of GI intensity, irrespectively of the group and time assessment, was 0.18 ± 0.72.

When each item of aesthetic self-perception (AS) was compared before and after the bleaching treatment, a significant improvement was observed for the three groups ($p < 0.02$) with the largest mean difference 3.6 (95% CI 2.7 to 3.6) in the aspect "Colour of your teeth". Differences among groups were neither observed in the items individually ($p > 0.16$) nor in the overall analysis ($p = 0.12$).

A significant and positive impact of oral condition on quality of life after bleaching was observed for all groups ($p < 0.001$) but they did not differ from one another ($p = 0.320$.

CONCLUSIONS

The results of the present study indicate that high-concentration in-office bleaching can be applied without the need for replacement and for a shorter duration (30min) compared to 40min, as it maintains the whitening effect while reducing the percentage of patients experiencing TS. Additionally, in all groups there was an improvement in aesthetic self-perception and quality of life.

IMPLICATIONS FOR PRACTICE

This trial showed that the 1 x 30min protocol produced equivalent colour change when compared to the other longer bleaching protocols with reduced risk of tooth sensitivity and shorter application time. Also, a more simplified application regimen of a single application of 30min yields effective bleaching and patient satisfaction while minimising undesirable side effects and improving patient satisfaction.

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2. THE HAEMOSTATIC AND COMFORTING EFFECTS OF ORAL ADHESIVE BANDAGES IN TOOTH EXTRACTION: A RANDOMISED CONTROLLED CLINICAL STUDY

Several strategies have been widely used for haemostasis in tooth extraction, including compression, packing and suture. Most commonly used is compression (biting) with cotton balls and gauze for about 30 to 60min, which is economical and convenient. During this period, speaking, chewing and drinking are forbidden to maintain the position of the cotton balls and gauze. Continuous jaw clenching can cause significant discomfort for patients. After removal of the cotton balls, the sockets are exposed to the oral cavity and actions such as spitting, sucking, eating and rinsing can disturb the blood clots within the sockets, leading to potential bleeding. Lacking coverings that prevent irritants from entering the sockets may elevate the risks of dry socket, infection and delayed wound healing.

Oral adhesive bandages are a type of wound dressing material that can adhere to wounded areas and durably shield the wounds from local stimuli in the oral cavity. Several clinical trials have been conducted to explore the characteristics of oral adhesive bandages in various dental practices, including tooth extraction. For extraction sockets, continuous and durable isolation from irritants is critical for haemostasis and the healing of wounds. New types of oral adhesive bandages that can achieve long duration of adhesion, provide excellent haemostatic and pro-healing effects and offer a comfortable experience would provide benefits for patients and deserve to be explored.

Zhou and colleagues from China reported on a trial that sought to test a new type of oral adhesive bandage against the traditional compression materials (cotton balls and gauze) to evaluate whether this wound dressing material could provide durable isolation, ideal haemostasis and protection, and a comfortable experience following tooth extraction.

METHODOLOGY

The was a randomised controlled clinical trial reported in the Consolidated Standards of Reporting Trials (CONSORT) format. There were two groups (experimental and control) of 60 patients each. The trial inclusion criteria were: patients aged 18-65 years who required surgical removal of one single tooth (except upper and lower third molars) at a time. Exclusion criteria were as follows: menstruation, pregnancy or lactation, periodontitis, tobacco usage, coagulation disorders, infection or immune dysfunction, a history of allergy to any drugs, cyst or tumour, and unwillingness to participate in this trial. Blood tests were performed routinely to exclude patients who suffered from coagulation disorders or any serious haematological diseases.

Patients who met the inclusion criteria were randomly divided into the study and control groups by the lottery method. In the study group, oral adhesive bandages were applied to the gingiva and covered the sockets immediately after tooth extraction, remaining in place until they naturally fell off. In the control group, patients bit on cotton balls and gauze for 1h.

The same dentist performed tooth extraction surgeries for all patients following the standard procedure. The surgical area was prepared with 5% povidone iodine solution. All patients were given local anaesthesia. The teeth were removed by using dental elevators or forceps, and curettage of the sockets was performed. Subsequently, different haemostasis materials were placed onto the sockets – oral adhesive bandages for the study group, cotton balls and gauze for the control group.

The oral adhesive bandage was composed of an absorbable adhesive layer and a nonabsorbable shielding layer. The biodegradable adhesive layer was made from hydroxyethyl cellulose, polyvinylpyrrolidone and corrigent. The nonabsorbable shielding layer was made from ethyl cellulose. The oral adhesive bandage is underlaid by a removable polyethylene film. This type of oral adhesive

bandage has two subtypes: type A is designed as a rectangular shape (length: 30mm, width: 15mm, thickness: 0.4mm), while type C is a shorter rectangular shape with a small concave arc on each long side (length: 25mm, width: 15mm, thickness: 0.4mm). Only type A oral adhesive bandages were used in the trial.

When teeth were extracted, blood and saliva on the mucosal surface around the extraction socket were wiped out with cotton balls and saliva suction tubes. The dentist tore the oral adhesive bandages off the polyethylene films and stuck the adhesive side of the bandages to the gingival surface around the sockets. To ensure adhesive strength, continuous pressure on the bandages for more than 15 seconds was required. Then the oral adhesive bandages would stick to the extraction sockets and tightly cover the holes to protect the blood clots.

At postoperative 1h and 24h, the dentist examined the extraction sockets and evaluated and scored the bleeding based on the following standard: 0, severe bleeding, requiring haemostatic measures; 1, moderate bleeding; 2, slight bleeding; 3, no postsurgical bleeding. At postoperative 1h, all patients were given a comfort rating scale which ranged from 0 to 10 (0, severe discomfort; 1-3, slight discomfort; 4-6, normal; 7-9, slight comfort; 10, high comfort), and scored the comfort levels for the method they used. On postoperative day 7, another dentist working under a single-blind principle (unaware of which group patients belonged to) examined all patients and evaluated the healing of wounds following such a standard: 0, moderate to severe tenderness or pain, moderate to severe inflammation reaction in the surgical area; 1, slight to moderate swelling and tenderness, slightly reddened; 2, no swelling and tenderness, normal appearance. Also, the adhesive time of all oral adhesive bandages and any adverse reactions were recorded.

RESULTS

One hundred and twenty patients (49 males and 71 females) were randomised into the study group and the control group. Both groups had similar demographic characteristics. The clinical data revealed that the average adhesion time of oral adhesive bandages was 26.6h. Forty percent of the bandages remained in place on the extraction sockets for an average of 5.7h, while 28% lasted for an average of 21.3h. Additionally, there were 13% and 4% of bandages remaining in place for 30.7h and 45.5h, respectively. Furthermore, 15% of bandages remained at the sites of placement for 83.4h.

At postoperative 1h and 24h, the haemostatic scores of the oral adhesive bandage group, which were 2.88 and 2.97, were significantly higher than those of the cotton balls and gauze group, which were 2.40 and 2.88, respectively. The oral adhesive bandage group also scored significantly higher in terms of comfort compared to the control group. Both groups had similar healing effects and side effects, but the mean score of the oral adhesive bandage group was slightly higher than that of the control group. The adverse event in the oral adhesive bandage group was a case of slight nausea. After the bandage was removed, the nausea obviously subsided.

CONCLUSIONS

The oral adhesive bandages were found to be more effective than the traditional compression method in haemostatic and comforting effects on extraction wounds, and exhibited higher clinical value in extraction wound management.

IMPLICATIONS FOR PRACTICE

For patients with a history of bleeding, oral adhesive bandages seem to offer particular benefit.

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CPD questionnaire on page 282

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

Mastering patient complaints: Effective strategies for dental practices

SADJ JUNE 2024, Vol. 79 No.5 P285-286

By Dr Jacobus Barnard, BChD (UP), MFGDP (UK), PDD (Impl.), PDD (CS) – Dental Mediator at SADA and Dr Tinesha Parbhoo, BChD (UP) – Head: Clinical Support at SADA

Patient complaints are an inevitable aspect of delivering healthcare services, representing critical feedback that can highlight areas needing improvement and opportunities for enhancing patient satisfaction.

Effective handling of these complaints is essential not only for maintaining a positive patient-practitioner relationship but also for ensuring compliance with professional and ethical standards. This article explores the nature of patient complaints within dental practices, emphasising the importance of proactive and empathetic communication, and outlines best practices for resolving issues efficiently and constructively.

By implementing a structured and responsive complaints management procedure, healthcare providers can address patient concerns promptly, prevent escalation to third-party involvement, and ultimately improve the quality of care provided.

Since introducing an independent complaints resolution service in 2012, SADA has successfully resolved more than 5500 disputes between patients and dentists, offering an alternative to the HPCSA for patients seeking redress for their dental care concerns. This series aims to share the valuable experience gained over the past 12 years, assisting our members in preventing patient complaints.

I have received a patient complaint – what now?

As with any professional service, there may be times when outcomes do not meet expectations, leading to patient complaints. Patients dissatisfied with their dental treatment or its cost often initially communicate their concerns and expectations to the dentist or practice staff, either verbally or in writing. It is only when the practice is unable or unwilling to address these concerns that patients may involve a third party, such as the South African Dental Association (SADA) or the Health Professions Council of South Africa (HPCSA). Many complaints received by SADA or HPCSA could have been resolved internally through an effective practice complaint procedure. Patients who direct their complaints to the HPCSA may sometimes be disappointed by the lengthy process and lack of a satisfactory resolution, which often involves simply receiving an explanation or an apology. In a dental setting, the most effective way to address a patient's concerns is for the dentist to invite the patient to discuss their issues at the earliest possible stage. If the dentist is unaware of the patient's dissatisfaction, resolving the issue is impossible. To encourage patients to voice any problems, they need confidence that their concerns will be listened to and addressed promptly and effectively.

Do's and don'ts when you receive a complaint

Do not: Tell the patient they are wrong, unreasonable or that no one else has ever complained.

Do: Acknowledge the patient's unhappiness and take them seriously. Listen to their experience, concerns and expectations without interrupting. If the practice does not listen, the patient will seek a willing ear, such as SADA, the HPCSA or a lawyer.

Do: Give the patient the time and recognition to explore their complaint as thoroughly or superficially as they wish. Ensure they do not feel their complaint is being ignored or dismissed.

An effective complaints procedure can prevent unnecessary third-party involvement and provide a basis for the dentist and patient to rebuild their relationship. However, an in-house complaints procedure is not intended to resolve issues of liability, negligence, financial or other compensation, or regulatory complaints. In these instances, dentists must contact their indemnifier urgently for advice and assistance.

Complaints are an unfortunate reality for anyone delivering professional services. As healthcare professionals, we have an ethical and professional duty to respond to criticism and complaints promptly and constructively (HPCSA Booklet 1– General Ethical Guidelines – 5.1.10 Duties to Patients). On the other hand, our patients have the right to complain about healthcare services received, to have such complaints investigated, and to receive a full response (Patients Right Charter – Booklet 3 – 2.12 Complaints about health services).

The importance of implementing a "practice complaints procedure" at the practice for patients who want to complain about their treatment or experience cannot be overestimated. Most complaints received by the HPCSA or SADA could have been resolved in-house through a practice complaints procedure. It is only because unhappy patients are ignored or dismissed at the practice that the decision to involve a third party is made.

Principles of a practice complaints procedure

Every staff member must be trained in what to do when a patient expresses dissatisfaction and each plays a vital role in reducing the likelihood of a patient becoming dissatisfied. An effective complaints procedure can prevent unnecessary third-party involvement and provide a basis for a dentist and patient to rebuild their relationship.

Written procedure: An agreed written procedure for handling complaints ensures every staff member knows what to do.

Designated individual: A named senior individual with good communication skills and experience should be responsible for operating the practice's in-house complaints procedures. Patients should be advised of this person's

name, job title and how to contact them, and assured of a friendly, approachable and prompt response.

Acknowledgment and logging: Every complaint must be listened to, acknowledged and logged in a register, even if the dentist or staff member thinks the complaint has no merit. Often, the first time a dentist becomes aware of a complaint is when the letter from the HPCSA arrives because staff did not inform the dentist of the patient's complaint as soon as it was received.

Patient choices: Give the patient options – would they prefer to meet at the practice or discuss their concerns over the telephone?

Communication: Always keep the patient informed of what is happening. A person who feels their complaint is ignored is more likely to involve a third party such as SADA or the HPCSA. Confirming each stage of the complaints procedure in writing is a good policy. If the patient involves the HPCSA or a lawyer, it is invaluable to be able to demonstrate that you did everything you could to resolve the problem at an early stage.

Efficient resolution: Customer satisfaction decreases in proportion to the number of times the complainant has to contact the organisation to effect resolution. Make each contact count.

Training: Good communicators usually make good complaints handlers. Most dental team members have no formal communication or complaint-handling training, so it is worthwhile to train them in these skills

Learning from international best practices

UK: The General Dental Council (GDC) in the UK emphasises the importance of clear communication and a structured complaints process. The GDC recommends having a designated complaints manager, offering patients multiple ways to submit their complaints, and ensuring timely and transparent responses.

US: The American Dental Association (ADA) suggests that practices adopt a patient-centric approach to complaints, involving patients in the resolution process and using feedback to drive continuous improvement. They also recommend regular training for staff on handling difficult conversations and conflict resolution.

Australia: The Australian Dental Association (ADA) highlights the importance of cultural competence in handling complaints, recognising that communication styles and expectations can vary significantly among different patient demographics. They advocate for personalised communication strategies to effectively address concerns.

Canada: The Canadian Dental Association (CDA) supports the use of mediation and alternative dispute resolution techniques to handle complaints. This approach aims to resolve issues without escalating to regulatory bodies, maintaining a focus on restoring patient relationships and trust.

Maintaining ethical standards: Duties and rights

Healthcare professionals have a duty to respond to complaints constructively, while patients have the right to have their concerns investigated and addressed. Adhering to ethical guidelines and implementing effective complaints procedures can help balance these duties and rights, ensuring a positive outcome for both parties.

Conclusion

Patient complaints, while challenging, provide an opportunity for improvement in dental practices. By adopting proactive communication strategies, implementing a robust complaints procedure and continuously training staff, dental practices can effectively address patient concerns, prevent escalation to third-party involvement and enhance the overall quality of care. Embracing these strategies not only improves patient satisfaction but also strengthens the patient-practitioner relationship, contributing to the long-term success of the practice.

NB: The following edition of this article will focus on how to respond to a patient complaint as well as useful communication skills to employ when dealing with a patient.

CPD questionnaire on page 282

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

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Beneath the surface: Unusual radiological findings in a peripheral ossifying fibroma

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S Rajbaran-Singh[1], N Nzima Chiloane[2], L Masilo[3]

A 26-year-old asymptomatic and otherwise healthy female patient presented with a pedunculated, non-tender tumour of rubbery firm consistency measuring 66x70x59mm on the anterior region of the maxilla impairing normal mastication and speech. The patient reported the tumour to be of long duration.

Diagnostic imaging demonstrated an expansile soft tissue shadow associated with and displacing the right central and lateral incisors (Figure 2). Cone-beam computed tomography revealed mild maxillary superficial cortical erosion in the anterior maxilla with solid, linear and scattered foci of radiopacity evident intralesionally. Histopathological examination of the excised tumour, supported by radiological interpretation, confirmed microscopic features of a giant peripheral ossifying fibroma with a myxoid component.

Fig.1

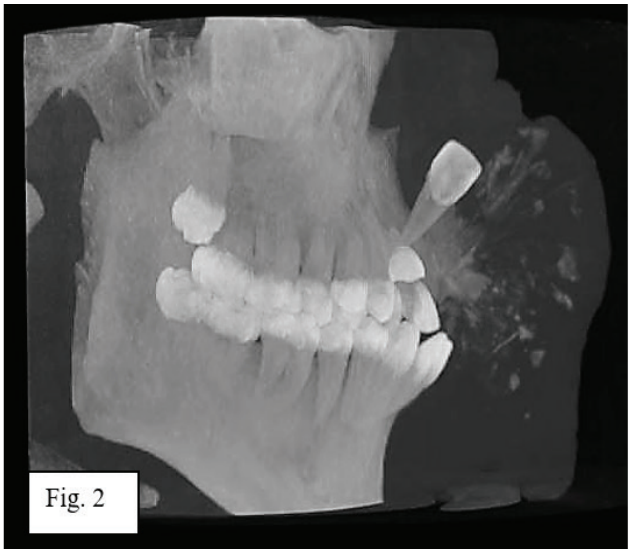
Fig. 2

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Peripheral ossifying fibroma, calcification, bone, cone-beam computed tomography

Peripheral ossifying fibromas are benign reactive lesions arising from mesenchymal gingival tissue in response to diverse inflammatory conditions that include, but are not limited to, plaque, calculus, orthodontic appliances, ill-fitting prosthesis and restorations.[1] Dystrophic calcification, cementum-like material and the presence of immature and mature bone within connective tissue histologically characterise the lesion.[2] The lesion most commonly occurs in female patients and demonstrates a predilection for the anterior maxillary gingiva in association with the interdental papillae of the incisor and canine teeth.[2] The age range for presentation appears to be wider than that of the first two decades of life as classically reported, with cases being documented in newborns and patients in the seventh decade of life.[1,2,3] Lesions most often demonstrate a nodular, pedunculated or sessile appearance that justifies clinical differential diagnoses of other gingival nodular lesions such as pyogenic granuloma and peripheral giant cell granuloma. Diagnostic imaging may aid in refining the diagnosis by demonstrating the presence of focal or diffuse radiopacity within the soft-tissue lesion.

While peripheral ossifying fibromas are not uncommon, this case demonstrates several less frequently evidenced features. Firstly, the dimensions of this lesion exceed those most frequently reported in the literature and make this case additive to the limited proportion of peripheral ossifying fibromas described as large, atypical or gigantiform.[1,2,4,5] Secondly, cone-beam computed tomography demonstrated localised superficial erosion of the proximal maxillary alveolar bone with the displacement of the right central and lateral incisors. Intralesional soft tissue shadows demonstrated significant amounts of radiopaque material arranged in a solid mass with band-like extensions and scattered foci. There is marked displacement of the maxillary right incisors. Bilaterally the maxillary canines demonstrate widened periodontal ligament spaces. Radiographic findings within peripheral ossifying fibromas are infrequent and have been cited to occur in less than 10% of lesions.[2] The significant amount and appearance of mineralisation evident radiographically, in this case, may be attributed to the maturation of the lesion and correlates to a history of long duration. This case highlights for the clinician the exuberant mineralisation that may uncommonly be evident radiographically in peripheral ossifying fibromas.

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CPD questionnaire

Radiographic methods - The way forward in age estimation in the Western Cape, South Africa

1. **Select the CORRECT option. The following were excluded from the study:**
   - A. Carious teeth
   - B. Restored teeth
   - C. Teeth with one root
   - D. All of the above are correct
   - E. Only (a) and (b) are correct

The educators and caregivers' oral health knowledge, attitudes, and practices in special education schools in the eThekwini District, KwaZulu-Natal

2. **Choose the CORRECT answer. How many participants were recruited in the study?**
   - A. 20
   - B. 312
   - C. 22
   - D. 25

3. **Which answer is CORRECT. The aim of this study was to ascertain educators' and caregivers'**
   - A. Oral health status
   - B. Dental carries status
   - C. Oral health knowledge attitudes, and practices
   - D. Oral health care programmes
   - E. Oral health education

4. **Select the CORRECT option to complete the statement. The results of the present study showed some ……?**
   - A. Consistencies
   - B. Accuracy
   - C. Positivity
   - D. Inaccuracy
   - E. Inconsistencies

5. **Choose the CORRECT option to fill in the missing word. On regression analysis, ……of the variables (age, gender and location) were statistically significant.**
   - A. all
   - B. one
   - C. a number
   - D. none
   - E. three

6. **Which percentage is CORRECT to make the statement true. Only……of participants believed that sugar consumption contributes to tooth decay due to bacteria turning sugar into acid.**
   - A. 51.6%
   - B. 2.24%
   - C. 46.8%
   - D. 70.90%

Evaluation of different baseplate materials on casts with various palatal vault depths

7. **Choose the CORRECT answer. Retention in complete maxillary dentures**
   - A. may be influenced by the palatal form
   - B. is generally best in deep "V shaped" palatal vaults
   - C. may be affected by the mobility of the soft palate
   - D. all of the above are correct
   - E. only a) and c) above are correct

8. **Select the CORRECT option. With regards to self-cured acrylic resins used in dentistry, which statement is incorrect?**
   - A. lack of flavour or odour
   - B. versatility
   - C. acceptable bonding to artificial teeth
   - D. greater resistance to fracture than heat-cured acrylic resins
   - E. reduced processing time

9. **Which answer is INCORRECT. With regards to light-cured acrylic resin denture materials, which statement is incorrect?**
   - A. are available in different forms
   - B. have more residual methyl methacrylate monomer than heat cured acrylic resins
   - C. are less dimensionally stable than self-cured acrylic resins
   - D. have greater tensile strength than heat-cured acrylic resins

10. **Select the CORRECT option. 3D-printed denture bases:**
    - A. are cost-efficient with regards material and time
    - B. have greater flexural strength than heat-cured acrylic resins
    - C. result in much wasted raw materials
    - D. have low colour stability than heat-cured acrylic resins

11. **Choose the CORRECT option. Based on the results of the current study:**
    - A. for all three palatal depths, the material with the closest adaptation mid-palatally was the heat-cured acrylic resin
    - B. for all three palatal depths, the material with the closest adaptation in the post-dam area was the self-cured acrylic resin
    - C. for all three palatal depths, the material with the closest adaptation in the incisive papilla was the wax
    - D. for all three palatal depths, the material with the closest adaptation generally was the light-cured acrylic resin
    - E. for all three palatal depths, the material with the closest adaptation generally was the 3-D printed materials

Oral Presentation of Haematological Disease: Part I – Diseases of Bone Marrow Failure

12. **Select the CORRECT answer. The diagnosis of leukaemia is made upon evaluation of the:**
    - A. Full blood count
    - B. Peripheral blood smear
    - C. Bone marrow biopsy
    - D. All of the above

13. **Which of the following is CORRECT. The oral features of leukaemia may be misdiagnosed as necrotizing gingivitis because both diseases are characterized by:**
    A. Gingival necrosis
    B. Spontaneous gingival bleeding
    C. Gingival enlargement that extends beyond the gingival margin
    D. Fatigue

14. **Choose the INCORRECT option. In both leukaemia and aplastic anaemia, bone marrow failure results in pancytopenia. Identify the incorrect statement:**
    A. In APL, abnormal promyelocytes crowd out the normal bone marrow.
    B. In leukaemia, the abnormal cells that crowd out the normal bone marrow, may be of myeloid or lymphoid origin.
    C. In aplastic anaemia, the bone marrow is replaced by fibro-fatty tissue.
    D. In aplastic anaemia, the hematopoietic stem cells are destroyed by cytotoxic T cells.

15. **Select the CORRECT answer. Oral ulcers seen in cyclic neutropenia, appear similar to recurrent aphthous ulcers, except for the following distinction:**
    A. Absence of pain
    B. Absence of red halo
    C. Absence of fibrinopurulent membrane
    D. Absence of systemic symptoms

16. **Select the INCORRECT option. Patients with aplastic anaemia are treated with all of the following measures, except:**
    A. Topical glucocorticosteroids
    B. Cyclophosphamide
    C. Cyclosporine
    D. Blood transfusions

Radiology corner: Beneath the surface: Unusual radiological findings in a Peripheral Ossifying Fibroma

17. **Select the CORRECT answer. Peripheral ossifying fibromas commonly radiographically demonstrate:**
    A. Scattered radiopaque foci
    B. Cortical erosion
    C. Tooth displacement
    D. Cortical perforation

18. **Which option is CORRECT. Peripheral ossifying fibromas occur most commonly in:**
    A. between the 7th and 8th decades of life
    B. between the 2nd and 4th decades of life
    C. newborns
    D. adolescents

Evidence-based dentistry: What's new for the dentist

19. **Which answer is CORRECT. In the Bleaching trial, colour change was measured using:**
    A. Subjective methods using Vita Easyshade Advance 4.0 spectrophotometer, Vita classical A1-C4 and Vita Bleached guide 3D-MASTER
    B. Objective methods using Vita Easyshade Advance 4.0 spectrophotometer, Vita classical A1-C4 and Vita Bleached guide 3D-MASTER
    C. Subjective method using Vita Easyshade Advance 4.0 spectrophotometer; objective methods using Vita classical A1-C4 and Vita Bleached guide 3D-MASTER
    D. Objective method using Vita Easyshade Advance 4.0 spectrophotometer; subjective methods using Vita classical A1-C4 and Vita Bleached guide 3D-MASTER

20. **In the bleaching trial, the risk of Gingival irritation (GI) was lowest in which of the following bleaching protocol groups**
    A. 1 × 30 min
    B. 2 × 20 min
    C. 1 × 40 min
    D. All groups were equivalent

Ethics

21. **Select the CORRECT answer. What is the primary purpose of implementing a "Practice Complaints Procedure" in a dental practice?**
    A. To reduce the workload of the dentist.
    B. To ensure all complaints are ignored.
    C. To prevent unnecessary third-party involvement and rebuild the dentist-patient relationship.
    D. To delay the resolution of complaints.

22. **Which of the following is INCORRECT. Which of the following is NOT a recommended approach when handling a patient complaint?**
    A. Telling the patient they are wrong or unreasonable.
    B. Acknowledging the patient's unhappiness and taking them seriously.
    C. Listening to the patient's concerns without interrupting.
    D. Giving the patient the time to explore their complaint as thoroughly as they wish.

23. **Choose the CORRECT option. According to the article, what is the most effective way to address a patient's concerns in a dental setting?**
    A. Ignoring the patient's complaint.
    B. Inviting the patient to discuss their concerns at the earliest possible stage.
    C. Referring the patient immediately to the HPCSA.
    D. Providing a pre-written apology letter to all complaining patients.

24. **Select the CORRECT option. What should be done with every complaint received, even if it seems to have no merit?**
    A. It should be ignored to save time.
    B. It should be acknowledged and logged in a register.
    C. It should be dismissed without consideration.
    D. It should be referred to a third-party immediately.

25. **Which of the following is CORRECT. Why is it important for dental staff to receive training in communication and complaint-handling skills?**
    A. To make them feel more important.
    B. Because good communicators usually make good complaints handlers.
    C. To ensure they can argue effectively with patients.
    D. So they can avoid dealing with complaints altogether.

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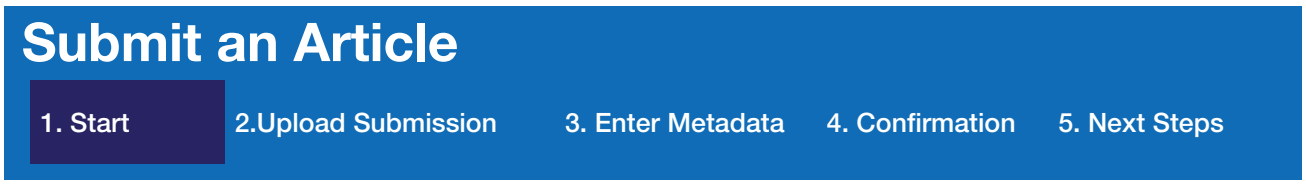

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