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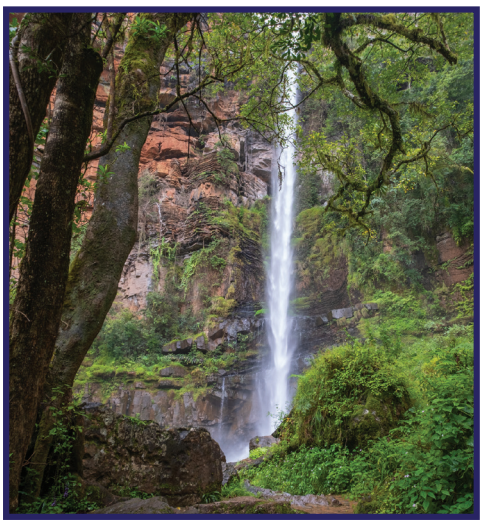

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Professionalism in South African Dental Practice

SADJ September 2023, Vol. 78 No.8 p383-384

Prof NH Wood - ***BChD, DipOdont(MFP), MDent(OMP), FCD(SA), PhD***

As we navigate the complex landscape of oral healthcare in South Africa, we find ourselves at a critical juncture where our collective wisdom and ethical commitment are challenged. This editorial is a call to action—a reminder of our paramount responsibility to our patients and to the field of dentistry itself. We must address a pressing issue that has, at times, remained hidden beneath the surface: the dangers of neglect in the treatment of our patients' dental conditions.

Within the context of our busy practices and the intricacies of patient care, it is all too common for the early signs and symptoms of dental conditions to be inadvertently overlooked. It's essential to recognize that even seemingly minor dental issues can evolve into major complications if not addressed promptly. The silent menace of delayed treatment has to potential to escalate unintended consequences to the oral health of the patient. From an ethical perspective, our commitment to the well-being of our patients should drive us to take a proactive stance on early identification and intervention. The principle of non-maleficence, the obligation to "do no harm," holds significant weight in dentistry. Delayed treatment can lead to exacerbated pain and suffering, as well as increased risks of complications, which might have been prevented if addressed promptly.

One concerning practice that has crept into our profession is the overprescription of antibiotics that seemingly serves to defer treatment to a date more suitable to the practitioner. While antibiotics have their place in dental care, they should never be seen as a panacea for deferring necessary dental procedures. This trend raises a multitude of ethical concerns, particularly regarding the principle of justice, which entails fair and equitable access to healthcare.

When patients are sent home with antibiotics, they may face additional costs, potential complications, and in some cases even worsening conditions. The ethical alarm bells reverberate most intensely in the domain of justice. Justice in healthcare demands the impartial allocation of resources and equitable access to quality care for all individuals. By overprescribing antibiotics and postponing essential dental treatments, practitioners inadvertently introduce disparities into the healthcare equation. Patients who are administered antibiotics and sent home without prompt dental intervention may unwittingly face a multitude of adverse consequences.

Financial burdens represent one facet of the injustice. The additional costs incurred by patients for prescriptions and follow-up visits due to deferred treatments can be substantial. In many cases, individuals with limited financial resources are disproportionately affected, potentially deterring them from seeking the care they desperately need. This financial strain not only undermines the principles of affordability and accessibility in healthcare but also exacerbates existing healthcare disparities. Beyond the financial implications, there is the risk of complications. Dental conditions, when left unaddressed, tend to deteriorate. The temporary relief provided by antibiotics for example, is fleeting, and the underlying dental issues continue to worsen. Consequently, patients who endure postponed dental treatments run an increased risk of experiencing exacerbated symptoms, which might have been otherwise preventable.

In the most severe scenarios, delayed treatments can lead to the unanticipated worsening of conditions, exemplifying a stark violation of the ethical principle of non-maleficence. In the pursuit of mitigating immediate inconveniences or streamlining appointment schedules, practitioners inadvertently expose their patients to the threat of worsening oral health issues. By overprescribing antibiotics and deferring the requisite dental procedures, a well-intentioned albeit misguided endeavor to alleviate short-term discomfort paradoxically places the patients at an increased risk of enduring more harm.

To address the dangers of neglect in the treatment of patients' dental conditions, we must recommit ourselves to the principles that underpin our profession. Some of the points to consider in this regard will include:

A. Early Detection and Education

- Embrace continuing education to stay abreast of the latest diagnostic tools and techniques.
- Advocate for regular dental check-ups to promote early detection of diseases and abnormalities.
- Prioritize patient education to enhance awareness of the importance of prompt treatment.

B. Ethical Practice

- Uphold the principles of non-maleficence and beneficence by prioritizing patients' well-being over convenience.
- Strive for equitable access to care, ensuring that financial factors do not hinder the timely receipt of treatment.

C. Collaboration and Guidance

- Foster a culture of collaboration among dental professionals, encouraging open dialogue and shared expertise.
- Seek guidance from ethical committees and professional bodies to address potential gray areas in treatment decisions.

D. Advocacy and Awareness

- Engage in public outreach and advocacy to increase awareness about the dangers of neglect in dental treatment.
- Collaborate with patient advocacy groups to strengthen the call for timely and appropriate care.

As professionals dedicated to the health and well-being of our patients, we must rise above the pressures of time and economics to fulfil our ethical obligations. The dangers of neglect in dental treatment are real, and they demand our collective attention.

By embracing early detection, practicing ethically, collaborating, and advocating for awareness, we can chart a path forward that ensures that the smiles of our patients reflect not only their health but also our unwavering commitment to their welfare. Let us as dental practitioners in South Africa stand united in our mission to provide the best possible care to our patients, never forgetting the ethical principles that guide our profession.

Building Smiles and Loyalty: The Power of Customer Loyalty Programs in Dental Practices

SADJ September 2023, Vol. 78 No.8 p385

Mr KC Makhubele – CEO, South African Dental Association

In the highly competitive world of dental practices, winning the loyalty of your patients is a critical factor for success. Happy, loyal patients not only return for their regular check-ups but also become your brand advocates, referring friends and family to your practice. One effective way to nurture this loyalty is by implementing a customer loyalty programme. In this blog, we'll explore how loyalty programmes can benefit your dental practice and offer some insights into creating one.

The importance of customer loyalty in dentistry

Before we delve into the specifics of loyalty programmes, let's understand why loyalty matters in the dental field:

Long-term relationships: Dental care is an ongoing need. Establishing a loyal patient base means securing long-term relationships that can span decades.
Referral potential: Satisfied patients are more likely to refer friends and family, leading to organic growth for your practice.
Revenue stability: Loyal patients contribute to a steady stream of revenue, reducing the need for aggressive marketing to attract new clients constantly.

Why implement a customer loyalty programme?

A well-designed customer loyalty programme can amplify these benefits. Here's why you should consider one for your dental practice:

Increased retention: Loyalty programmes encourage patients to stick with your practice. Special offers or discounts for returning patients can be enticing.
Word-of-mouth marketing: Happy patients who receive rewards for referring others can become enthusiastic advocates for your practice.
Data insights: Loyalty programmes often come with data collection tools. This data can help you understand patient preferences and tailor your services accordingly.

Creating an effective customer loyalty programme for your dental practice

Now that we understand the importance of loyalty programmes, let's explore how to create one for your dental practice:

Define your goals: Start by determining what you want to achieve with your loyalty programme. Is it increased retention, more referrals or better patient engagement?
Choose the right incentives: Consider what would be most appealing to your patients. This could include discounts on cleanings, free whitening treatments or even small gifts such as dental care products.
Simple enrolment: Make it easy for patients to join your programme. This could be as straightforward as filling out a form or signing up online.
Communication is key: Regularly communicate with your loyalty programme members. This could be through email newsletters, personalised messages or even a dedicated app.
Track and analyse data: Use the data collected from your programme to gain insights into patient behaviour and preferences. This can help you fine-tune your offerings and marketing strategies.
Reward referrals: Encourage patients to refer others by offering rewards for successful referrals. A discount or a free service for both the referrer and the new patient can work wonders.
Personalise rewards: Tailor rewards to individual patient needs. For example, offer a free fluoride treatment for a child's birthday or a discount on teeth whitening for someone interested in cosmetic dentistry.
Feedback mechanism: Include a feedback mechanism within your programme. This shows you value patients' opinions and these can help you improve your services.
Promote your programme: Ensure your patients are aware of your loyalty programme through your website, social media and in-office signage.
Evaluate and adjust: Continuously assess the effectiveness of your loyalty programme. If certain incentives or communication methods aren't working, be prepared to adapt and evolve.

A well-executed customer loyalty programme can significantly enhance patient retention, encourage referrals and solidify your dental practice's reputation. By focusing on patient satisfaction and engagement, you can create a win-win situation where your patients get the care they need and your practice thrives through their loyalty. So, start building those smiles and loyalty today!

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19 September 2023
Dear Prof Wood

I write this letter as a retired prosthodontist with many years of experience. As I look back on my career, I often say: "I wish had been told this when I started on the path of my career in dentistry."

We live in an exciting era where knowledge is available at our fingertips. I never had the benefit of Google, YouTube, ChatGPT and others. Today, anything you want to know is available at the press of a button.

The only constant in life is change but, as with any ocean current, it is how you set the sails. It is how we deal with the challenges we face that is important. Problems are a sign of life. The reality is that we really don't know what we don't know and that is where tapping into the experience of someone else becomes invaluable.

Artificial intelligence is becoming the norm in this day and age – and so I turned to ChatGPT to ask the question: "Why does a dentist need coaching?"

I got a fascinating answer from ChatGPT which I will share with you here.

Dentists, like professionals in many other fields, may seek coaching for several reasons:

Improving clinical skills: Dentistry is a constantly evolving field with new techniques and technologies. Dentists may seek coaching to stay up to date with the latest advancements and improve their clinical skills.

Patient communication: Effective communication is crucial in dentistry. Dentists may receive coaching to enhance their skills, especially when discussing treatment plans, explaining procedures and addressing patient concerns.

Practice management: Running a dental practice involves various aspects including financial management, team leadership and patient scheduling. Coaching can help dentists streamline their practice management processes for better efficiency and profitability.

Patient satisfaction: Happy patients are more likely to return and refer others. Dentists may seek coaching to enhance patient satisfaction by providing a positive experience, reducing anxiety and ensuring quality care.

Career growth: Dentists may aspire to grow their careers by taking on new challenges such as opening multiple practices or specialising in a particular field of dentistry. Coaching can provide guidance on career development strategies.

Work-life balance: Balancing a demanding dental practice with one's personal life can be challenging. Coaches can help dentists find ways to manage stress, delegate tasks and achieve a better work-life balance.

Goal achievement: Like anyone else, dentists have personal and professional goals. Coaches can assist dentists in setting and, ultimately, achieving these goals, whether they relate to clinical skills, income targets or personal development.

In summary, coaching can benefit dentists by helping them improve their clinical skills, manage their practices more effectively, enhance patient relationships and achieve their career and personal goals. It's a way to invest in continuous improvement and professional development.

I end off by saying that "If you do what you always did, you will get what you always got!" Something has to change. The change begins with us. We have to be brave to embrace change and enjoy the benefits.

I encourage my colleagues to take this recommendation of coaching and mentoring seriously.

Yours sincerely,
Dr Gerald Kaplan
gkaplan@prosthodontist.co.za

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Knowledge and attitude of adolescents regarding e-cigarettes: A scoping review

SADJ September 2023, Vol. 78 No.8 P383-393

R Kudenga[1], M Vorster[2], J Yang[3]

ABSTRACT

Introduction

The World Health Organization Framework Convention on Tobacco Control has informed countries to ban or regulate electronic cigarettes (e-cigarettes) because of their health adverse effects. Although e-cigarettes are regulated, their popularity has increased among teens.

Objective

To review published articles on the knowledge and attitude of adolescents regarding e-cigarettes and whether their knowledge and attitude influence their use of e-cigarettes.

Methods

Literature published from January 2012-11 March 2022 in the PubMed, Web of Science and PsycINFO databases were systematically reviewed using the SPIDER search strategy. We screened the full texts of 100 qualitative and quantitative studies that met the inclusion criteria. Of these, 68 studies were not eligible for review, leaving 32 articles: 21 quantitative studies and 11 qualitative studies.

Results

Most adolescents believed that e-cigarettes were less harmful than traditional cigarettes. Adolescents used e-cigarettes out of curiosity and the different flavours. Their source of information came from friends, family and social media. Some adolescents believed that e-cigarettes were perfectly safe, and adolescents were influenced by tobacco companies' marketing campaigns.

Conclusion

Findings indicate that adolescents are aware of e-cigarettes; however, their perceptions of them differ. Some adolescents believe that e-cigarettes are safe, while others believe them to be harmful to health or remain unsure of their effects. Findings also revealed that adolescents' use of e-cigarettes is linked to their perceptions of them.

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Authors' contributions

1. Dr Rutendo Kudenga (primary researcher)	70%
2. Prof Martin Vorster (scientific writing)	20%
3. Justin Yang (scientific writing)	10%

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INTRODUCTION

Electronic cigarettes (e-cigarettes) are battery-operated devices that contain a liquid that emits a vaporised solution when heated. They are sometimes referred to as "vapes", "e-cigs", "vape pens", "e-hookahs" and "electronic nicotine delivery systems". The e-liquid comprises nicotine and flavouring chemicals within a solvent, usually propylene glycol and/or glycerine.[1] E-cigarettes entered the global market in 2004 and were often advertised by tobacco companies as a smoking cessation tool. Since their introduction e-cigarettes have undergone a rapid transformation. E-cigarette products come in the form of disposables, where the device is disposed of after the liquid is finished; open reusable systems that can be refilled with any e-liquid of choice; and closed reusable systems that have removable cartridges that can be replaced when the e-liquid is finished.[2]

Over the past decade, the popularity of e-cigarettes among teenagers has soared. Globally, the uptake of e-cigarettes among adolescents has increased steadily, especially in high-income countries.[3] E-cigarettes are the most commonly used tobacco product among the youth with 19.6% of high school students in the United States of America (US) using these devices.[4] Data from the 2020 National Youth Tobacco Survey in the US revealed that 550,000 middle school students and 3.02 million high school students have reported using e-cigarettes.[4] The increased e-cigarette use among the youth over the past decade caused the Food and Drug Administration (FDA) and the US Surgeon General to declare it as an epidemic in 2018.[5,6] In the United Kingdom (UK), the regular use of e-cigarettes by adolescents is low, with only 11.2% of 11- to 17-year-olds having tried an e-cigarette in 2021.[7] In Australia, 14% of adolescents between the ages of 12 and 17 years old have experimented with e-cigarettes.[8] Although these studies report a low prevalence of use, they may be subject to self-report bias. Morean et al.[9] found that teens indicated "no" when asked if they had ever used an e-cigarette but would then report "yes" when asked about a specific electronic cigarette brand. This research suggests that the prevalence of e-cigarette use among the youth may be understated.

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Table 1. SPIDER framework used to structure the review question

S	PI	D	E	R
Sample	Phenomenon of Interest	Design	Evaluation	Research Type
12- to 17-year-old adolescents in high income countries	E-cigarette use	All study designs	Knowledge, beliefs, attitude	Qualitative, quantitative or mixed-method studies

Although studies have shown that e-cigarettes may be an effective smoking cessation tool, they have caused more harm than good, especially among adolescents.[4] The appeal of e-cigarettes has attracted more teenagers, who would never have started smoking, to start vaping.[10] E-cigarettes have also led to more teenagers who currently smoke traditional cigarettes compared to the number of teenagers who would have smoked in the absence of e-cigarettes.[10, 11] The Theory of Planned Behaviour (TPB) has been linked to e-cigarette use. The TPB proposes that a person's subjective norms, attitudes and perceived behavioural control towards a specific behaviour are connected to their intention to carry out the behaviour.[12] For example, Hershberger et al.[13] revealed that people who have a positive attitude toward e-cigarettes were more likely to use them. The TPB can be used to explain the rising popularity of e-cigarettes among teenagers.

Adolescents are exposed to e-cigarette advertising through social media platforms such as Tik Tok, Instagram and Facebook. Wang et al.[14] concluded that adolescents who were exposed to low-impact e-cigarette advertising were more susceptible to e-cigarette use; even those who had never used cigarettes or e-cigarettes. E-cigarette advertising and promotion increases awareness and knowledge and might be a potential factor facilitating the use of e-cigarettes. In 2019, the World Health Organization Framework Convention on Tobacco Control issued a policy recommending the ban or regulation of e-cigarettes.[15] These regulations should aim to prevent adolescents from using e-cigarettes.

To date, there is little data on the long-term health effects of e-cigarette use, and research investigating the adverse effects e-cigarettes is ongoing. The National Academies of Science, Engineering and Medicine released a report reviewing more than 800 studies on the health consequences of e-cigarettes.[16] The report concluded that e-cigarettes have their own health risks, and although the level of known toxicants is lower than combustible cigarettes, the toxicants still cause adverse health effects.[16] E-cigarette toxicants have acute effects on the immune system, the cardiovascular system and the pulmonary system.[17] As of February 2020, there have been 2,807 cases of e-cigarette or vaping product use-associated lung injury (EVALI) hospitalisations and 68 deaths.[18] There are many unknowns regarding e-cigarette use, but there is substantial evidence showing that e-cigarettes are potentially detrimental to your health. The purpose of this scope is to examine existing literature on adolescents' knowledge and belief of e-cigarettes and whether their perceptions are associated with the use of e-cigarettes.

METHODS

Search strategy

From 2-7 March 2022, a search was conducted on the PubMed, Web of Science and PsycINFO electronic databases. The SPIDER search strategy was used to conduct the systemic review[19] (Table 1). The sample included adolescents aged 12-17 years in high-income countries. The phenomenon of interest was e-cigarette use. The knowledge and attitude of adolescents were evaluated, and the research type included qualitative, quantitative and mixed study designs. Literature reviews, systematic reviews, meta-analyses and editorials were excluded. The search strategy used was (E-cigarettes or e-cigarettes or vaping or electronic nicotine delivery system (ENDS)) AND (adolescent or youth or teenager) AND (knowledge or perception or beliefs or attitude or opinion). The term "high-income country" was not used in the search strategy because it gave limited results. The research focused on articles published between January 2012 and 11 March 2022. The search strategy results are presented in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram[22] (Figure 1).

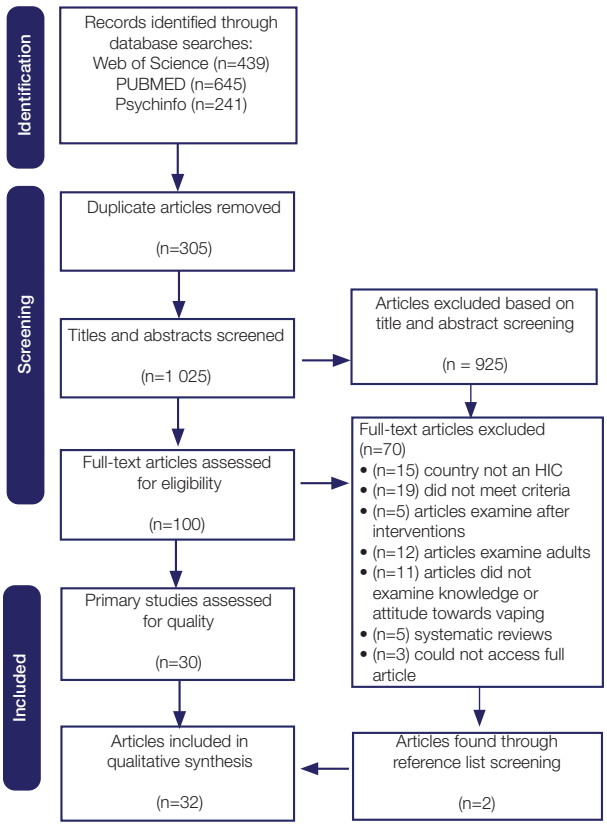

Figure 1. PRISMA flow chart to show the study selection process. Flowchart adapted from the PRISMA template.[20] HIC: high-income countries

Eligibility criteria and study selection

Eligible articles included peer reviewed primary research studies (quantitative, qualitative and mixed studies) published between January 2012 and March 2022. The World Bank defines high-income economies as those with a gross national income per capita of $12,696 or more.[21] Only primary research from the countries listed by the World

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Bank as countries with high-income economies was eligible. We included studies that included participants who ranged in age from 12 to 17 years. These studies were included only if they reported results in an age stratified manner. Most countries legally view 18-year-olds as adults, and 18-year-old people can legally purchase e-cigarettes which biases their perceptions. Articles that reported on the knowledge and attitude of adolescents towards the use of e-cigarettes after interventions were excluded.

Data extraction

Data from the 32 articles were extracted and captured in a table in an Excel (Microsoft USA) spreadsheet. Information on the year of study, authors, country of study, type of research, study design, participants, sample size, sampling methods, recruitment, response rate, results and limitations were extracted from the articles.

Study selection and results

Thirty articles were included in the study. Two additional articles were identified from bibliographies.[22, 23] Studies were conducted in the US (n=20), UK (n=5), Finland (n=2), Hong Kong (n=1), Germany (n=1), France (n=1), Canada (n=1) and Ireland (n=1) (Table 2). Of the 32 studies, 19 were cross-sectional,[22, 24-41] 10 were qualitative studies,[23, 42-50] two were randomised control studies[51, 52] and three were longitudinal studies.[32, 43, 53]

Table 2. List of published articles included in this review (n=32)

Author	Year	Country	Title
Alexander et al[42]	2018	USA	Youth who use e-cigarettes regularly: A qualitative study of behaviour, attitudes, and familial norms
Ambrose et al[24]	2014	USA	Perceptions of the relative harm of cigarettes and e-cigarettes among US youth
Amrock et al[25]	2015	USA	Perception of e-cigarette harm and its correlation with use among US adolescents
Bernat et al[26]	2018	USA	Electronic cigarette harm and benefit perceptions and use among youth
Bold et al[43]	2016	USA	Reasons for trying e-cigarettes and risk of continued use
Brossier et al[50]	2020	France	Are French adolescents ready to adopt the electronic cigarette? A qualitative study of their knowledge and representations
Chaffee at al[53]	2018	USA	Tobacco product initiation is correlated with cross-product changes in tobacco harm perception and susceptibility: Longitudinal analysis of the Population Assessment of Tobacco and Health youth cohort
de Andrade et al[44]	2015	UK	Teenage perceptions of E-cigarettes in Scottish tobacco-education school interventions: co-production and innovative engagement through a pop-up radio project
East et al[27]	2018	UK	Harm perceptions of E-cigarettes and nicotine: A nationally representative cross-sectional survey of young people in Great Britain
Ebrahimi et al[28]	2020	USA	The road to vaping: E-cigarette susceptibility and curiosity among US adolescents susceptible and non-susceptible to cigarette smoking
El-Amin et al[41]	2022	Finland	Adolescents' perceptions of harmfulness of tobacco and tobacco-like products in Finland
Fairman et al[45]	2021	USA	"You have to vape to make it through": E-cigarette outcome expectancies among youth and parents
Farrelly et al[51]	2015	USA	A randomized trial of the effect of e-cigarette TV advertisements on intentions to use e-cigarettes
Ford et al[29]	2016	UK	Adolescents' responses to the promotion and flavouring of e-cigarettes
Giovacchini et al[30]	2017	USA	Use and perceived risk of e-cigarettes among North Carolina middle and high school students
Gorukanti et al[31]	2017	USA	Adolescents' attitudes towards e-cigarette ingredients, safety, addictive properties, social norms, and regulation
Hammal et al[46]	2016	Canada	Exploring attitudes of children 12-17 years of age toward e-cigarettes
Hansen et al[38]	2018	Germany	Electronic cigarette marketing and smoking behaviour in adolescence: a cross-sectional study
Hanafin et al[32]	2021	Ireland	Friends and family matter most: a trend analysis of increasing e-cigarette use among Irish teenagers and socio-demographic, personal, peer and familial associations
Hilton et al[47]	2016	UK	E-cigarettes, a safer alternative for teenagers? A UK focus group study of teenagers' views
Jiang et al[39]	2016	Hong Kong	Electronic cigarette use among adolescents: a cross-sectional study in Hong Kong
Johnson et al[48]	2017	USA	A qualitative study of adolescent perceptions of e-cigarettes and their marketing: Implications for prevention and policy
Kinnuen et al[40]	2015	Finland	Awareness and determinants of electronic cigarette use among Finnish adolescents in 2013: a population-based study

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Kwon et al[33]	2018	USA	Predictors of youth e-cigarette use susceptibility in a US nationally representative sample
Less et al[49]	2021	USA	"If someone has it, I'm gonna hit it": Lessons learned from Minnesota teens about vaping
Padon et al[52]	2018	USA	A randomized trial of the effect of youth appealing e-cigarette advertising on susceptibility to use e-cigarettes among youth
Park et al[23]	2019	USA	Listening to adolescents: Their perceptions and information sources about e-cigarettes
Pepper et al[34]	2018	USA	Adolescents' understanding and use of nicotine in e-cigarettes
Pepper et al[22]	2016	USA	Adolescents' interest in trying flavored e-cigarettes
Rohde et al[35]	2018	USA	The role of knowledge and risk beliefs in adolescent e-cigarette use: A pilot study
Tackett et al[36]	2021	USA	Adolescent susceptibility to e-cigarettes: An update from the 2018 National Youth Tobacco Survey
Weishaar et al[37]	2016	UK	'Maybe they should regulate them quite strictly until they know the true dangers': a focus group study exploring UK adolescents' views on e-cigarette regulation

A thematical analysis was carried out to identify patterns in the research articles. Five themes emerged from the articles (Figure 2):

1. Source of e-cigarette information
2. Perceived harmfulness of e-cigarettes versus traditional cigarettes
3. E-cigarette initiation
4. Determinants of e-cigarette use
5. E-cigarette knowledge and beliefs

Source of information

Five studies discussed the source of e-cigarette information.[27, 39, 40, 42, 44] The studies reported that adolescents got their information from family and/or friends. The information either resulted in a positive or negative attitude toward e-cigarettes. The studies also reported that social media applications such as Facebook, YouTube and Twitter influenced their perception. Some adolescents reported seeing music videos with rappers doing vape tricks and it was appealing.[50] Other sources of information included e-cigarette advertisement billboards, posters and television.

Determinants of e-cigarette use

The environment surrounding adolescents determines whether they are susceptible to e-cigarette use. Adolescents who were surrounded by friends who vape have a higher chance of joining than adolescents who were not surrounded by people who vape. When participants were asked what would help them to stop using e-cigarettes, they responded that they would stop vaping if they were "not being around friends who use them".[42] Second-hand smoke exposure, even in public spaces, is also associated with increased susceptibility to e-cigarette use.[33] In the US, 8 million adolescents were exposed to e-cigarette use in 2018. In another study participants reported that they used e-cigarettes because they were cheaper and easier to hide from their parents.[43] Similarly, Scottish adolescents also reported that e-cigarettes were more accessible and cheaper than traditional cigarettes.[44] Participants

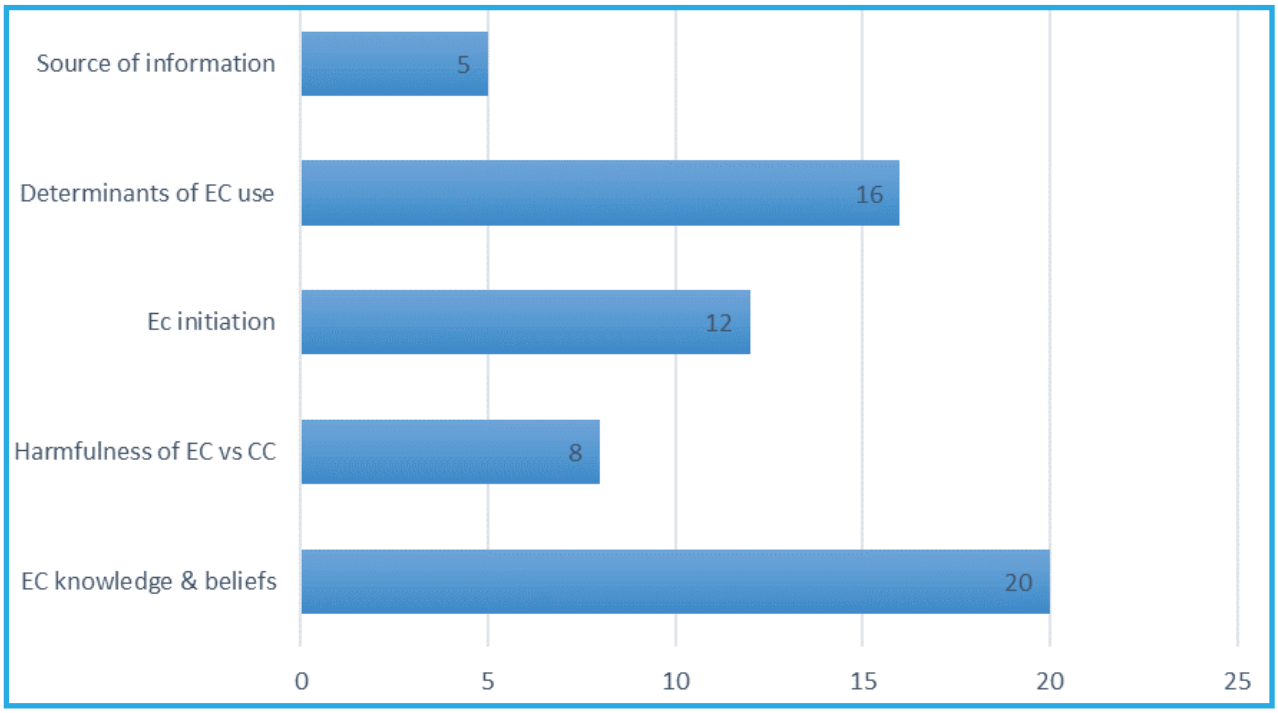

Figure 2. Number of articles that reported on the different themes. EC, e-cigarette; CC, conventional cigarette

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in a qualitative study reported that advertisements conveyed that e-cigarettes were "cool" and gave the impression that e-cigarettes were "safer" or "better" than combustible cigarettes.[48] A randomised trial reported that e-cigarette advertising was persuasive and engaged adolescents effectively.[51] The experiment showed that being exposed to four e-cigarette advertisements changed non-user adolescents' attitudes to be more positive and more favourable, and resulted in intentions to try them in the future. In a qualitative study conducted in France, one participant reported that advertising specifically targeted young people and motivated them to start using e-cigarettes.[50]

E-cigarette initiation

Twelve studies explored the reason for initiating e-cigarettes.[22, 23, 28, 29, 32, 34, 42-45, 50, 53] Adolescents initiated e-cigarettes because they were curious, and there is a vast array of flavours. They viewed the device as something cool and fun to use because of its sleek design. The different flavours and colours of the e-liquid were appealing to adolescents. Adolescents were more interested in trying fruity, sweet flavours such as bubble gum and menthol compared to flavours such as alcohol and tobacco. Adolescents also believed that candy flavoured or fruit-flavoured e-liquid were less harmful than tobacco or alcohol flavours.[22] Therefore, they were more likely to initiate e-cigarette use due to the perceived harmlessness of the fruity flavours. Friends and family have a big influence on whether adolescents initiate e-cigarette use. When family members or friends use e-cigarettes, adolescents tend to have a more positive attitude. Some participants said that they would try e-cigarettes if a friend gave it to them.[39] Adolescents, especially high school students, also took up vaping because they could perform tricks using e-cigarettes.[42]

Perceived harmfulness of e-cigarettes versus traditional cigarettes
Eight studies reported that adolescents believed e-cigarettes were less harmful compared to traditional cigarettes.[23-26, 46-48, 51] Some 30% to 80% of adolescents believed that e-cigarettes were less harmful. In the UK, participants believed that e-cigarettes were less toxic because they contained no tar or chemicals, and they associated the smoke with water vapour.[44] However, in three quantitative studies from the US, between 15% and 22% of participants believed that e-cigarettes were as harmful as traditional cigarettes.[24-26] A minority (2%-5%) of participants believed that e-cigarettes were more harmful. Between 10% and 50% did not know or were unsure of the harmful extent of e-cigarettes. E-cigarette users (71.8%) were more likely to report that e-cigarettes were less dangerous than traditional cigarettes while 31% of non-users were less likely to report that e-cigarettes were less dangerous.[25]

E-cigarette knowledge and beliefs

Twenty studies[22-26, 30-35, 37, 39-42, 44-47, 49,50] which reported on adolescents' knowledge of e-cigarettes was high (70%-85%) in all countries except for Canada. Most of the participants from Canada showed very little or no knowledge of e-cigarettes.[46] The studies revealed an increasing awareness with age, therefore more participants in high school were e-cigarette users. Adolescents believed that e-cigarettes were either perfectly safe, harmful to health or not harmful at all. Risk beliefs seemed to determine e-cigarette use. Susceptible e-cigarette users, adolescents who had tried e-cigarettes (ever users) and electronic regular users believed that e-cigarettes were not harmful. Few adolescents believed that the smoke produced by the e-cigarette was water vapour. In one study, some participants (23%) believed that e-cigarettes were not tobacco products.[31]

Nine studies reported on whether participants were aware of the nicotine content in e-cigarettes,[22, 27,34, 39, 40-42, 44, 46] with only one in five adolescents being unsure or not believing that e-cigarettes contained nicotine.[22] Adolescents who were unsure of the nicotine level in their devices had been given a device by a family member or a peer. Some participants associated nicotine content with the colour of the e-cigarette liquid believing that the darker the liquid the higher the nicotine content. Other participants associated nicotine content with the physical effects, strong taste and a feeling of light-headedness. Most participants had a misperception about the nicotine in e-cigarettes.[22] In one study, half of e-cigarette users who vaped with nicotine and more than half of users who usually vaped without nicotine believed that the nicotine in their devices was artificial or "chemically engineered".[34, 42] Some participants believed that nicotine caused little harm.[27, 44]

Fourteen studies reported on the perceived benefits of e-cigarettes.[22,26, 31, 36, 37, 42-50] Some participants said that e-cigarettes could be used as a smoking cessation tool, helping teens who struggle to quit smoking. Other participants described e-cigarettes as a coping mechanism to help reduce anxiety.[26, 45, 49] One study reported that 31% of adolescents, mostly e-cigarettes users, believed that e-cigarettes reduce stress.[26] Participants in two studies believed that second-hand smoke from e-cigarettes was harmless to the public.[36, 46]

DISCUSSION

It is evident from the reviewed articles that various factors influence e-cigarette use among adolescents. The belief that e-cigarettes are less harmful than traditional cigarettes was associated with e-cigarette use. E-cigarette users are more likely to self-report a positive perspective of e-cigarettes than non-users, this was shown in the studies conducted in the US.[25, 26, 27]. E-cigarette use was associated with a favourable social environment. Adolescents with friends and/or family members who use e-cigarettes were more likely to use them. Their exposure to the devices and e-cigarette advertisements gave them a positive perception towards them and increased their likelihood to use them.[38]

This review shows that adolescents aged 12-17 in high-income countries have mixed perceptions regarding e-cigarettes. Most adolescents reported that e-cigarettes are less harmful than traditional cigarettes, and some adolescents believed e-cigarettes were not harmful. Adolescents also believed e-cigarettes contained artificial nicotine and were therefore less addictive and safer than traditional cigarettes.[34, 42] However, one device being less harmful than the other does not mean that it is harmless. The long-term effects of e-cigarettes are not yet fully understood and there is a lack of clear evidence on their health impact.

Currently, public health has not reached consensus about whether e-cigarettes are less harmful than traditional cigarettes. Literature suggests that adolescents are not sure of how harmful e-cigarettes are, which might be due to this lack of public health consensus. More evidence suggests that e-cigarette use is linked to smoking addiction, especially in adolescents.[54] Supporters of e-cigarettes believe that their devices replace high-risk behaviour, such as smoking traditional cigarettes, with a far less harmful one. In contrast, the opponents of e-cigarettes focus on the risks to adolescents.[55] There is no conclusive evidence that proves e-cigarettes can be used as a smoking cessation tool.[56] Despite the lack of evidence, e-cigarettes have been promoted as a smoking cessation tool in England's Public Health campaign.[57] In contrast, the FDA has not approved e-cigarettes as a smoking cessation tool due to the lack of concrete evidence.[58] Further, e-cigarette companies do not encourage smoking cessation; they encourage a long-term swap.[59,60] The risk profile of e-cigarettes is still evolving

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and it is a work in progress, but countries must consider that e-cigarettes pose a health risk and adolescents need to be informed about these health risks.

E-cigarette advertising conveys misinformation surrounding the safety of e-cigarettes to the public. Advertising companies design appealing content by portraying their devices as being fashionable and "cool" by using celebrities. Although companies state that they do not intend to advertise to the youth, their advertisements are appealing to the youth and impact their perception of devices.[51] The effect of e-cigarette marketing on adolescents shows that there are few regulations, which are not strongly enforced. Adolescents report seeing e-cigarettes on social media although there are restrictions.[50] E-cigarette company JUUL Labs' marketing campaign was investigated for two years by 33 states in the US. They discovered that JUUL marketed its e-cigarettes to teens through social media posts and launch parties. JUUL settled lawsuits by paying more than $440m. JUUL Labs has lawsuits against it from teens who say they have become addicted to its e-cigarette product.[61] E-cigarette advertising plays a major role in the teen vaping epidemic, and they have the potential to "renormalise" smoking in the form of vaping and reverse decades of work that public health campaigns have achieved towards tobacco denormalisation.[62]

The TPB explains why adolescents use e-cigarettes (Figure 3). According to the TBP, perceptions play an important role on whether adolescents initiate e-cigarette use. Adolescents have a more favourable attitude towards e-cigarettes because of the vast array of flavours, especially sweet flavours. E-cigarettes also have a sleek design and colourful packaging, which influences adolescents' perceptions. E-cigarettes are easily accessible and are used as a coping method to help teens manage their stress and anxiety. Adolescents who have an unfavourable attitude believe that e-cigarettes are addictive and harmful or that e-cigarettes are a gateway to other risky behaviours. Adolescents are further pressured to start vaping if they are exposed to second-hand smoke and having their family and peers vape around them. E-cigarette marketing, including celebrities using e-cigarettes and doing tricks, also creates social pressure. Most adolescents who have family members or peers informing them of harmful effects do not initiate vaping. Non-motivational factors such as availability of resources and favourable opportunities to perform the behaviour represent the individual's control over the behaviour. Adolescents like that they can conceal e-cigarettes from their parents, unlike traditional cigarettes. Adolescents can use e-cigarettes indoors and outdoors. All these factors are determinants that either increase or decrease the intention to use an e-cigarette.

LIMITATIONS

The studies included in this review were conducted in France, Germany, the UK, Finland, Canada, Ireland and Hong Kong. Studies in other high-income countries such as Australia or New Zealand could not be identified. Studies from the US made up two-thirds of the total number of studies. The lack of studies from other countries limits our understanding of adolescents' knowledge and attitude toward e-cigarettes globally. Global information could help countries to develop interventions to stop e-cigarette use among adolescents. The scope was conducted by a single reviewer. Ideally, studies should be reviewed by two or more reviewers to reduce the risk of bias. Very few studies reported on the source of e-cigarette information. Future studies need to include questions on sources of information.

CONCLUSION

Findings indicate that adolescents are aware of e-cigarettes; however, their perceptions of them differ. Some adolescents believe that e-cigarettes are safe, while others believe them to be harmful to health or remain unsure of their effects. The study reveals that there is an association between adolescents' perceptions and e-cigarette use. Besides this association the exposure to e-cigarette advertising is significantly associated to e-cigarette use. Governments need to rethink regulations on e-cigarette advertising campaigns to reduce the number of adolescents initiating e-cigarette use. More research is needed to investigate the sources of e-cigarette information. This information will give public health officials an understanding of adolescent e-cigarette use so that misperceptions can be addressed to reduce the prevalence of e-cigarette use.

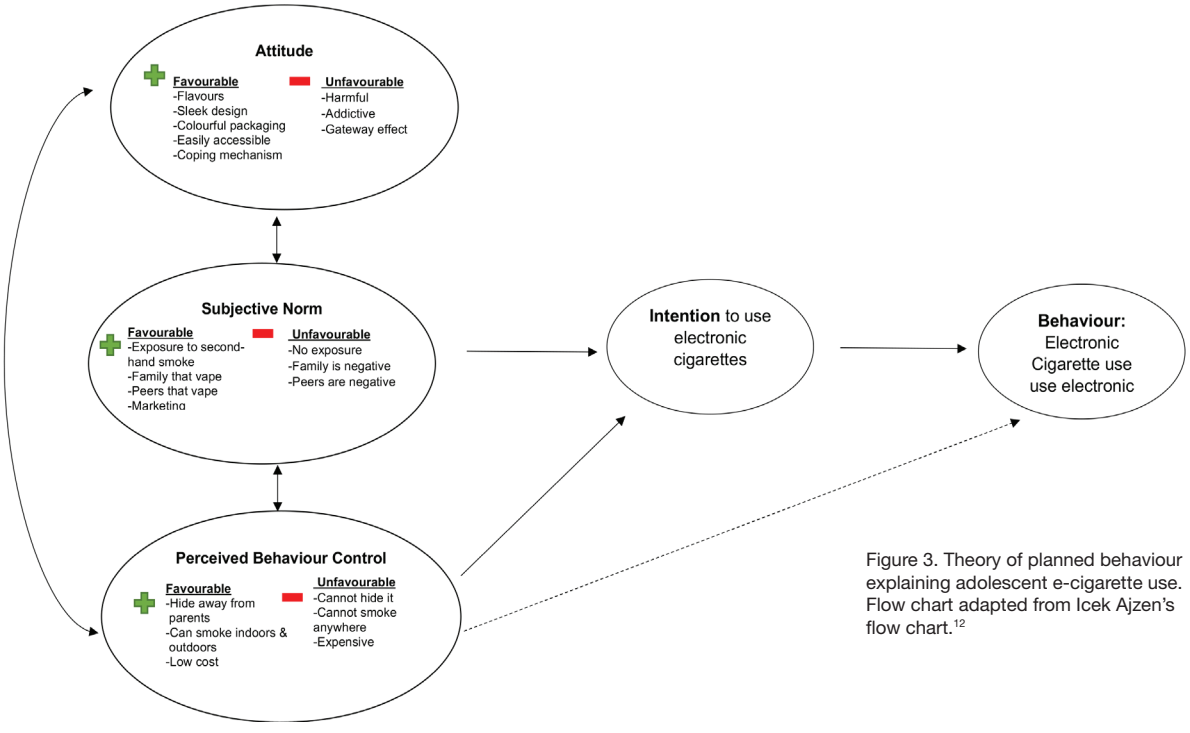

Figure 3. Theory of planned behaviour explaining adolescent e-cigarette use. Flow chart adapted from Icek Ajzen's flow chart.[12]

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REFERENCES

1. National Center for Chronic Disease P, Health Promotion Office on S, Health. Publications and Reports of the Surgeon General. E-Cigarette Use Among Youth and Young Adults: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2016
2. Levy DT, Lindblom EN, Sweanor DT, et al. An economic analysis of the pre-deeming US market for nicotine vaping products. Tob Regul Sci. 2019;5(2):169-181. https://doi.org/10.18001/TRS.5.2.8
3. Becker TD, Rice TR. Youth vaping: a review and update on global epidemiology, physical and behavioral health risks, and clinical considerations. Eur J Pediatr. 2022;181(2):453-462. https://doi.org/10.1007/s00431-021-04220-x
4. Wang TW, Neff LJ, Park-Lee E, et al. E-cigarette use among middle and high school students - United States, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(37):1310-1312. https://doi.org/10.15585/mmwr.mm6937e1
5. US Department of Health and Human Services. Surgeon General's advisory on e-cigarette use among youth. Centres for Disease Control and Prevention; 2018. https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-ecigarette-use-among-youth-2018.pdf. (accessed 22 February)
6. Food and Drug Administration. Statement from FDA Commissioner Scott Gottlieb, MD, on new steps to address epidemic of youth e-cigarette use. USA: Food and Drug Administration; 2018. https://www.fda.gov/news-events/press-announcements/statement-fda-commissioner-scott-gottlieb-md-new-steps-address-epidemic-youth-e-cigarette-use (accessed March 2 2023)
7. Action on Smoking and Health. Use of e-cigarettes among young people in Great Britain. 2021. https://ash.org.uk/wp-content/uploads/2021/07/Use-of-e-cigarettes-among-young-people-in-Great-Britain-2021.pdf (accessed 4 April)
8. Guerin N, White V. ASSAD 2017 Statistics & Trends: Australian secondary students' use of tobacco, alcohol, over-the-counter drugs, and illicit substances. 2020
9. Morean ME, Camenga DR, Bold KW, et al. Querying about the use of specific e-cigarette devices may enhance accurate measurement of e-cigarette prevalence rates among high school students. Nicotine Tob Res. 2020;22(5):833-837. https://doi.org/10.1093/ntr/nty240
10. Soneji S, Barrington-Trimis JL, Wills TA, et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. JAMA Pediatr. 2017;171(8):788-797. https://doi.org/10.1001/jamapediatrics.2017.1488
11. Blaha M. 5 Vaping facts you need to know. Johns Hopkins Medicine; 2021. https://www.hopkinsmedicine.org/health/wellness-and-prevention/5-truths-you-need-to-know-about-vaping (accessed 4 April)
12. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991;50(2):179-211. https://doi.org/10.1016/0749-5978(91)90020-T
13. Hershberger A, Connors M, Um M, Cyders MA. The theory of planned behavior and E-cig use: Impulsive personality, E-cig attitudes, and E-cig use. Int J Ment Health Addict. 2018;16(2):366-376. https://doi.org/10.1007/s11469-017-9783-6
14. Wang L, Chen J, Ho SY, et al. Exposure to e-cigarette advertising, attitudes, and use susceptibility in adolescents who had never used e-cigarettes or cigarettes. BMC Public Health. 2020;20(1):1349. https://doi.org/10.1186/s12889-020-09422-w
15. World Health Organization. The Convention Secretariat. Information note on classification of novel and emerging tobacco products 2019. https://untobaccocontrol.org/impldb/wp-content/uploads/Info-Note_Novel-Classification_EN.pdf (accessed 15/11/2022)
16. National Academies of Sciences Engineering and Medicine. Public health consequences of e-cigarettes. Washington, DC: National Academies Press; 2018
17. Eltorai AE, Choi AR, Eltorai AS. Impact of electronic cigarettes on various organ systems. Respir Care. 2019;64(3):328-336. https://doi.org/10.4187/respcare.06300
18. Centers for Disease Control and Prevention. Outbreak of lung injury associated with the use of e-cigarette, or vaping, products. 2021. https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html#epi-chart (accessed 02/04/2022)
19. Murdoch University. Systematic reviews-Research guide. 2022. https://libguides.murdoch.edu.au/systemati (accessed 1 April)
20. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71
21. World Bank. World Bank country and lending groups. 2022. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed 14 March)
22. Pepper JK, Ribisl KM, Brewer NT. Adolescents' interest in trying flavoured e-cigarettes. Tob Control. 2016;25(Suppl 2):ii62-ii66. https://doi.org/10.1136/tobaccocontrol-2016-053174
23. Park E, Kwon M, Gaughan MR, Livingston JA, Chang YP. Listening to adolescents: Their perceptions and information sources about e-cigarettes. J Pediatr Nurs. 2019;48:82-91. https://doi.org/10.1016/j.pedn.2019.07.010
24. Ambrose BK, Rostron BL, Johnson SE, et al. Perceptions of the relative harm of cigarettes and e-cigarettes among US youth. Am J Prev Med. 2014;47(2):S53-S60. https://doi.org/10.1016/j.amepre.2014.04.016
25. Amrock SM, Zakhar J, Zhou S, Weitzman M. Perception of e-cigarette harm and its correlation with use among US adolescents. Nicotine Tob Res. 2015;17(3):330-336. https://doi.org/10.1093/ntr/ntu156
26. Bernat D, Gasquet N, Wilson KOD, Porter L, Choi K. Electronic cigarette harm and benefit perceptions and use among youth. Am J Prev Med. 2018;55(3):361-367. https://doi.org/10.1016/j.amepre.2018.04.043
27. East K, Brose LS, McNeill A, et al. Harm perceptions of electronic cigarettes and nicotine: A nationally representative cross-sectional survey of young people in Great Britain. Drug Alcohol Depend. 2018;192:257-263. https://doi.org/10.1016/j.drugalcdep.2018.08.016
28. Ebrahimi Kalan M, McKelvey K, Ibrahimou B, Trucco EM, Ben Taleb Z. The road to vaping: e-cigarette susceptibility and curiosity among US adolescents susceptible and nonsusceptible to cigarette smoking. Health Educ Behav. 2020;47(5):696-705. https://doi.org/10.1177/1090198120943166
29. Ford A, MacKintosh AM, Bauld L, Moodie C, Hastings G. Adolescents' responses to the promotion and flavouring of e-cigarettes. Int J Pub Health. 2016;61(2):215-224. https://doi.org/10.1007/s00038-015-0769-5
30. Giovacchini CX, Pacek L, McClernon FJ, Que LG. Use and perceived risk of electronic cigarettes among North Carolina middle and high school students. NC Med J. 2017;78(1):7-13. https://doi.org/10.18043/ncm.78.1.7
31. Gorukanti A, Delucchi K, Ling P, Fisher-Travis R, Halpern-Felsher B. Adolescents' attitudes towards e-cigarette ingredients, safety, addictive properties, social norms, and regulation. Prev Med. 2017;94:65-71. https://doi.org/10.1016/j.ypmed.2016.10.019
32. Hanafin J, Sunday S, Clancy L. Friends and family matter most: a trend analysis of increasing e-cigarette use among Irish teenagers and socio-demographic, personal, peer and familial associations. BMC Public Health. 2021;21(1):1988. https://doi.org/10.1186/s12889-021-12113-9
33. Kwon E, Seo DC, Lin HC, Chen Z. Predictors of youth e-cigarette use susceptibility in a US nationally representative sample. Addict Behav. 2018;82:79-85. https://doi.org/10.1016/j.addbeh.2018.02.026
34. Pepper JK, Farrelly MC, Watson KA. Adolescents' understanding and use of nicotine in e-cigarettes. Addict Behav. 2018;82:109-113. https://doi.org/10.1016/j.addbeh.2018.02.015
35. Rohde JA, Noar SM, Horvitz C, et al. The role of knowledge and risk beliefs in adolescent e-cigarette use: A pilot study. Int J Environ Res Public Health. 2018;15(4):830. https://doi.org/10.3390/ijerph15040830
36. Tackett AP, Keller-Hamilton B, Hébert ET, et al. Adolescent susceptibility to e-cigarettes: An update from the 2018 National Youth Tobacco Survey. Am J Health Promot. 2021;35(4):551-558. https://doi.org/10.1177/0890117120971121
37. Weishaar H, Trevisan F, Hilton S. 'Maybe they should regulate them quite strictly until they know the true dangers': a focus group study exploring UK adolescents' views on e-cigarette regulation. Addiction. 2016;111(9):1637-1645. https://doi.org/10.1111/add.13377
38. Hansen J, Hanewinkel R, Morgenstern M. Electronic cigarette marketing and smoking behaviour in adolescence: a cross-sectional study. ERJ Open Res. 2018;4(4):00155-02018. https://doi.org/10.1183/23120541.00155-2018
39. Jiang N, Wang MP, Ho SY, Leung LT, Lam TH. Electronic cigarette use among adolescents: a cross-sectional study in Hong Kong. BMC Public Health. 2016;16(1):202. https://doi.org/10.1186/s12889-016-2719-4
40. Kinnunen JM, Ollila H, El-Amin SE-T, et al. Awareness and determinants of electronic cigarette use among Finnish adolescents in 2013: a population-based study. Tob Control. 2015;24(e4):e264-e270. https://doi.org/10.1136/tobaccocontrol-2013-051512
41. El-Amin S, Kinnunen JM, Rimpelä A. Adolescents' perceptions of harmfulness of tobacco and tobacco-like products in Finland. Int J Environ Res Public Health. 2022;19(3):1485. https://doi.org/10.3390/ijerph19031485
42. Alexander JP, Williams P, Lee YO. Youth who use e-cigarettes regularly: A qualitative study of behavior, attitudes, and familial norms. Prev Med Rep. 2018;13:93-97. https://doi.org/10.1016/j.pmedr.2018.11.011
43. Bold KW, Kong G, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for trying e-cigarettes and risk of continued use. Pediatrics. 2016;138(3):e20160895. https://doi.org/10.1542/peds.2016-0895
44. de Andrade M, Angus K, Hastings G. Teenage perceptions of electronic cigarettes in Scottish tobacco-education school interventions: co-production and innovative engagement through a pop-up radio project. Perspect Public Health. 2016;136(5):288-293. https://doi.org/10.1177/1757913915612109
45. Fairman RT, Weaver SR, Akani BC, Dixon K, Popova L. "You have to vape to make it through": E-cigarette outcome expectancies among youth and parents. Am J Health Behav. 2021;45(5):933-946. https://doi.org/10.5993/ajhb.45.5.13
46. Hammal F, Finegan BA. Exploring attitudes of children 12-17 years of age toward electronic cigarettes. J Community Health. 2016;41(5):962-968. https://doi.org/10.1007/s10900-016-0178-6
47. Hilton S, Weishaar H, Sweeting H, Trevisan F, Katikireddi SV. E-cigarettes, a safer alternative for teenagers? A UK focus group study of teenagers' views. BMJ Open. 2016;6(11):e013271. https://doi.org/10.1136/bmjopen-2016-013271
48. Johnson AC, Mays D, Hawkins KB, Denzel M, Tercyak KP. A qualitative study of adolescent perceptions of electronic cigarettes and their marketing: Implications for prevention and policy. Child Health Care. 2017;46(4):379-392. https://doi.org/10.1080/02739615.2016.1227937
49. Less EL, Mady M, Beckman KJ, Kingsbury JH. "If someone has it, I'm gonna hit it": Lessons learned from Minnesota teens about vaping. Health Promot Pract. 2021:15248399211045353. https://doi.org/10.1177/15248399211045353
50. Brossier M, Querre M, Regnier Denois V. Are French adolescents ready to adopt the electronic cigarette? A qualitative study of their knowledge and representations. J Public Health. 2022;30:573-582. https://doi.org/10.1007/s10389-020-01326-8
51. Farrelly MC, Duke JC, Crankshaw EC, et al. A randomized trial of the effect of e-cigarette TV advertisements on intentions to use e-cigarettes. Am J Prev Med. 2015;49(5):686-693. https://doi.org/10.1016/j.amepre.2015.05.010
52. Padon AA, Lochbuehler K, Maloney EK, Cappella JN. A randomized trial of the effect of youth appealing to e-cigarette advertising on susceptibility to use e-cigarettes among youth. Nicotine Tob Res. 2018;20(8):954-961. https://doi.org/10.1093/ntr/ntx155
53. Chaffee BW, Cheng J. Tobacco product initiation is correlated with cross-product changes in tobacco harm perception and susceptibility: Longitudinal analysis of the Population Assessment of Tobacco and Health youth cohort. Prev Med. 2018;114:72-78. https://doi.org/10.1016/j.ypmed.2018.06.008
54. Al-Hamdani M, Manly E. Smoking cessation or initiation: The paradox of vaping. Prev Med Rep. 2021;22:101363. https://doi.org/10.1016/j.pmedr.2021.101363
55. Balfour DJK, Benowitz NL, Colby SM, et al. Balancing consideration of the risks and benefits of e-cigarettes. Am J Public Health. 2021;111(9):1661-1672. https://doi.org/10.2105/ajph.2021.306416
56. Villanti AC, Feirman SP, Niaura RS, et al. How do we determine the impact of e-cigarettes on cigarette smoking cessation or reduction? Review and recommendations for answering the research question with scientific rigor. Addiction. 2018;113(3):391-404. https://doi.org/10.1111/add.14020
57. Boseley S. Public Health England maintains vaping is 95% less harmful than smoking. The Guardian. 2018 28 December 2018
58. Centers for Disease Control and Prevention. Adult smoking cessation - The use of e-cigarettes. 2020. https://www.cdc.gov/tobacco/data_statistics/sgr/2020-smoking-cessation/fact-sheets/adult-smoking-cessation-e-cigarettes-use/index.html (accessed 31 March)
59. Flint SW, Jones AW. The irresponsible promotion of e-cigarettes and Swaptober. Lancet Respir Med. 2018;6(1):e3-e4. https://doi.org/10.1016/s2213-2600(17)30473-3
60. Tactics T. E-cigarettes: Marketing. University of Bath; 2021. https://tobaccotactics.org/wiki/e-cigarettes-marketing/ (accessed 31 March)
61. Perrone M, Collins D. Juul to pay nearly $440M to settle states' probe into marketing of vaping products for teens. USA Today. 2022
62. Fairchild AL, Bayer R, Colgrove J. The renormalization of smoking? E-cigarettes and the tobacco "Endgame". N Eng J Med. 2013;370(4):293-295. https://doi.org/10.1056/NEJMp1313940

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The prevalence of food insecurity in South African dental schools: A cross-sectional study

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ABSTRACT

Background

Food security is an important factor which can promote academic outcomes and general health and wellbeing of dental students. The aim of this study was to determine the extent of food insecurity among dental students across all dental schools in South Africa.

Methodology

An online cross-sectional survey was adapted and modified from the United States Department of Agriculture Community Food Security Assessment toolkit and disseminated to the four dental schools/faculties in South Africa. Food insecurity was determined using a pre-specified questionnaire on food insecurity. The sample size was determined based on a previous study. Categorical variables were displayed as frequencies and percentages and associations were determined using a Chi-squared test and a Fishers' Exact test. A simple and multiple logistic regression was run to determine the strength and direction of associations with food insecurity with other variables of interest using backward elimination and a likelihood ratio test.

Results

The study consisted of 210 participants. The median age was 21 [IQR:21-22] years. Most of the students were from UWC (53.5%, n=113). There were more females than males in the study. Almost 90% (89.1%, n=187) of dental students felt food insecure in some form or other.

Discussion

Food insecurity is prevalent among oral healthcare students and requires intervention from stakeholders such as the universities, government and various role players to aid in the eradication thereof.

Conclusion

Food insecurity among dental students in South Africa is at an all-time high. This paper provides evidence that can inform stakeholders of the necessity to improve student access to food at dental schools in South Africa.

Keywords

Food insecurity, dental students, higher education, South Africa, undergraduate dental

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Ameera Yusuf Essa	40%
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BACKGROUND

Food insecurity plays a major role in affecting populations across the globe in both lower middle-income and high-income countries.[1,2] Food security, as defined by the United Nations Committee on World Food Security, means that all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their food preferences and dietary needs for an active and healthy life.[3] In 2020, between 720 and 811 million people faced hunger.[4] According to Sustainable Development Goal (SDG) 2 [Zero Hunger], it is envisioned by the United Nations to alleviate hunger, achieve food security, improve nutrition and promote sustainable agriculture completely by 2030.[5] According to the United Nations: World Food Programme, from 2017-2019 between 15% and 24.9% of South Africans were subjected to chronic hunger, which is indicative that the SDG goals will not be achieved by 2030. The prevalence of severe food insecurity in the total South African population was 18% from 2014-2016, which was much higher than other upper to middle-income countries such as Serbia, Russia and Romania – 1.2%, 0.7% and 1.1% – but lower than Namibia and Botswana.[6]

The prevalence of food insecurity among university students ranges from 21% to 82%, globally.[7] Studies conducted with regard to food insecurity in the context of university students in South Africa are few. Numerous studies have been conducted regarding school children in South Africa and the effect of food insecurity on cognitive function. Due to the bias that higher education only caters for the elite and financially stable, food insecurity at higher institutes is often a disregarded subject matter, but this has changed with the #feesmustfall movement since 2015.[8] As a result of not being in full-time employment, having to rely on alternate sources of income to fund themselves while studying, living for the first time on their own[9], preparing food for themselves for the first time, and studying in an unfamiliar environment[9] have all led to the challenges of food insecurity among students that should not be overlooked.[4] These challenges have posed an impact of an imbalanced diet which can have dire medical, physical and educational consequences for students.[10-14]

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Food insecurity does not affect all students equally. In South Africa, students who are persons of colour, first-generation students and students from foster care systems are more likely to experience food insecurity. Food insecurity has been studied among different populations at universities across South Africa[15,16]. This will be the first time food insecurity will have been reported in oral healthcare students across South Africa. This study aimed (1) To determine the prevalence of food insecurity among oral healthcare students across South Africa; and (2) To develop a multivariate model to identify possible association between food insecurity and potential risk indicators in undergraduate dental students across South Africa. The information obtained from this study will highlight the need for university stakeholders to provide food pantries and nutrition education programmes.

METHODS

A cross-sectional descriptive quantitative online survey was utilised (self-administered online survey – SurveyMonkey®) across the four dental schools in South Africa – University of the Western Cape (UWC), University of Pretoria (UP), University of the Witwatersrand (Wits) and Sefako Makgatho Health Sciences University (SMU). Participants were enrolled undergraduate dental, oral hygiene and dental therapy students at the four dental schools in South Africa. The inclusion criteria consisted of all undergraduate dental, oral hygiene and dental therapy students in South Africa. The online survey was adapted and modified to suit the needs of the research in a local and specific circumstance from the United States Department of Agriculture Community.

Continuous data such as "age" was displayed as median and interquartile range, since age was not normally distributed. All categorical data was displayed as frequencies and percentages. Bivariate comparisons were made using Chi-squared or its nonparametric equivalent (Fishers Exact test – used if the cell counts were less than five). Food insecurity was dichotomised where responses with "once a week", "few times a week" and "daily" to the question "How often do you skip a meal?" were considered as food insecure. Gender referred to biological sex. The residences of the students were based on whether the students stayed while they were studying, "At home", "Private residential boarding" or at "University residence".

Perceptions, behaviour, nutritional values, impact of food insecurity and experiences of hunger

Students were asked to describe whether they thought that their meals were nutritious or not and they were also asked to report whether they brought a packed lunch to school ("No", "Yes/Sometimes"). Perceived nutritional value of purchased food was also assessed by asking the question whether the participant considered the food that they purchased to be "nutritious" or "unhealthy". Categories such as "more often" referred more than once, ever. Participants were also required to answer whether they worried about not having enough food to eat ("Daily/More often", "Never"), and whether they felt hungry when going to sleep because they did not have enough food to eat ("Yes", "No").

Accessibility and affordability

Questions around financial accessibility to food were asked, including whether the participant had money to buy food if they did not carry a packed lunch to school ("No", "Yes/Sometimes"). Affordability of food was determined by assessing whether the food purchased by students on campus was affordable ("Affordable", "Expensive") and how often they purchased fast food because it was cheaper ("Daily/More often", "Never"). And whether the food purchased on campus, and its availability, was also assessed ("Yes", "No").

Food scarcity and coping strategies for food scarcity

"How often have you had no food to eat because of lack of resources" ("Daily/More often", "Never"), and behaviour of watering down food to stretch it further was also assessed ("Yes", "No").

Strategies used to acquire food

Strategies such as selling assets, sacrificing health or education, buying instruments, buying scrubs, WiFi and textbooks were assessed ("Yes"/"No"). Financial coping strategies such as borrowing money from friends were also assessed ("Yes", No").

Table 1: Baseline demographics

		n (%)	Food Insecure 187 (89.1) n (%)	Food Insecure 23 (10.9) n (%)	p-value
Name of institution	SMU	45 (21.4)	43 (95.6)	2 (4.4)	0.199
	UP	21 (10)	17 (80.9)	4 (19.1)	
	UWC	113 (53.8)	98 (86.7)	15 (13.3)	
	WITS	31 (14.8)	29 (93.6)	2 (6.5)	
Discipline of study	Dental Therapy	7 (3.3)	6 (85.7)	1 (14.3)	0.718
	Dentistry	168 (80)	149 (88.7)	19 (11.3)	
	Oral Hygiene	35 (16.7)	32 (91.4)	3 (8.6)	
Gender	Male	57 (27.1)	49 (86.0)	8 (14.0)	0.456
	Female	152 (72.9)	138 (90.2)	15 (9.8)	
Residence	Home with family	66 (31.4)	59 (89.4)	7 (10.6)	0,152
	Private boarding	41 (19.5)	33 (80.5)	8 (19.5)	
	University residence	103 (49)	95 (92.2)	8 (7.8)	

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Table 2: Perceptions, behaviour, nutritional values, impact of food insecurity and experiences of hunger

		n (%)	Food Insecure 187 (89.1) n (%)	Food Insecure 23 (10.9) n (%)	p-value
Do you consider your meals to be nutritious or unhealthy?	Nutritious	153 (72.9)	131 (85,6)	22 (14.4)	0.006*
	Unhealthy	57 (27.1)	56 (98.3)	1 (1,7)	
Do you bring a packed lunch to campus?	No	65 (31.0)	63 (96,9)	2 (3.1)	<0.015*
	Yes/Sometimes	145 (69.1)	124 (85.5)	21 (14.5)	
Do you consider the food you purchase to be nutritious?	Nutritious	153 (72.9)	131 (85.6)	22 (14,4)	0.005*
	Unhealthy	57 (27.1)	56 (98.3)	1 (1.7)	
How often did you worry that you are not eating enough food?	Daily/More Often	111 (52.9)	108 (97.3)	3 (2.7)	<0.001*
	Never	99 (47.1)	79 (79.8)	20 (20.2)	
Did you ever go to sleep hungry because you don't have enough food?	Yes	47 (22.4)	46 (97.9)	1 (2.1)	0.032*
	No	163 (77.6)	141 (86.5)	22 (13.5)	

A simple unadjusted and multiple adjusted logistic regression model was run to determine associations between food insecurity and different risk factors. Variables included in the final multiple regression model were determined based on a likelihood ratio test using backward elimination. All statistical analysis was performed in StataCorp 2021. Stata Statistical Software (Release 17). College Station, TX: StataCorp LLC. All tests noted as statistically significant at p<0.05.

RESULTS

This study consisted of 210 participants. The median age of the participants was 21 [Interquartile range (21;22)]. Of the 210 participants, 89.1% (n=187) classified themselves as being food insecure. The majority, 53.8% (n=113), of the participants were students from UWC. Students from UWC were more likely to report being food insecure, 15% (n=15). Dentistry students made up 80% (n=168) of the participants and were more likely to report food insecurity (Table 1).

Perceptions, behaviour, nutritional values, impact of food insecurity and experiences of hunger

The majority, 69.1% (n=145), of the participants considered their meals to be unhealthy. In addition, 85.5% (n=124) of these participants felt food insecure. However, the majority of the participants considered the food that they purchased to be nutritious (72.9%, n=153). There was a statistically significant association between food insecurity and bringing a packed lunch to campus (p<0.015*) (Table 2).

Accessibility and affordability of food

Just over 31% (n=65) of the sample did not bring a packed lunch to school and, of those, 96.9% (n=56) were food insecure. Just over 52% (n=111) were worried that they did not have enough food to eat, and 22.4% (n=47) went to bed feeling hungry (Table 3). The majority of the students reported that they always had money to buy food (68.1%,

Table 3: Accessibility and affordability of food

			Food Insecure 187(89.1) n (%)	Food Secure 23 (10.9) n (%)	p-value
If you don't carry a packed lunch, do you always have money to buy food?	No	67 (31.48)	64 (95.5)	3 (4.5)	
	Yes/Sometimes	143 (68.1)	123 (86.0)	20 (14.0)	0.056*
If you have to buy food on campus, is it readily available?	No	43 (20.5)	40 (93.0)	3 (7.0)	0.425
	Yes	167 (79.5)	147 (88.0)	20 (12.0)	
How affordable is the food you purchase on campus?	Affordable	91 (43.3)	38 (41.8)	53 (58.2)	0.084
	Expensive	119 (56.7)	36 (30.3)	83 (69.8)	
How often do you purchase fast food because it is cheaper?	Daily/More Often	130 (61.9)	34 (26.2)	96 (73.9)	0.001*
	Never	80 (38.1)	40 (50 .)	40 (50 .)	

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Table 4: Food scarcity

		n (%)	Food Insecure 187(89.1) n (%)	Food Secure 23 (10.9) n (%)	p-value
How often have you had no food to eat because of a lack of resources?	Daily/More Often	89 (42.4)	86 (96.6)	3 (3.4)	0.003*
	Never	121 (57.6)	101 (83.5)	20 (16.5)	
Have you ever watered down/stretched your meals to make them last longer?	Yes	94 (44.7)	89 (94.7)	5 (5.3)	0.019*
	No	116 (55.2)	98 (84.5)	18 (15.5)	

n=67), of which 12% (n=64) of these students were food secure.

Food scarcity

Sixty-seven (31.9%) of the participants reported to skip a meal daily. Almost 43% (n=89) reported to not eat food due to lack of resources. There was a statistically significant association between food insecurity and lack of resources to buy food (p=0.003). There was also a significant association between students stretching or watering down their food to make it last longer and food insecurity (p=0.019) (Table 4).

Strategies to acquire food

Economic strategies such as selling assets, sacrificing health, not buying instruments, not buying scrubs, not buying Wi-Fi or textbooks to buy food were reported. There was a statistically significant association between choosing between buying textbooks or paying for notes and food insecurity (p=0.003) (Table 5).

Participants who worried that they were not eating enough food were 7.639 (2.08 to 28.02) times more likely to report food insecurity compared to participants who did not worry that they were not eating enough food. Overall, the different disciples in dentistry, different types of dental students or different institutions did not differ in food insecurity perception.

Table 5: Strategies to acquire food

		n (%)	Food Insecure n (%)	Food secure n (%)	p-value
Did you ever have to sell assets or items to buy food?	Yes	16 (7.6)	15 (93.8)	1 (6.2)	1
	No	194 (92.4)	172 (88.7)	22 (11.3)	
Did you ever have to sacrifice health or education costs to buy food?	No	160 (76.2)	138 (86.3)	22 (13.7)	0.019*
	Yes	50 (23.8)	49 (98.0)	1 (2.0)	
Did you ever have to choose between buying instruments and buying food?	No	162 (77.1)	139 (85.8)	23 (14.2)	0.003*
	Yes	48 (22.9)	48 (100.0)	0 (0.0)	
Did you ever have to choose between buying clothes/scrubs and buying food?	No	134 (63.8)	114 (85.1)	20 (14.9)	0.014*
	Yes	76 (36.2)	73 (96.1)	3 (3.9)	
Did you ever have to choose between buying Wi-Fi and buying food?	No	179 (85.2)	157 (87.7)	22 (12.3)	0.234
	Yes	31 (14.7)	30 (96.8)	1 (3,2)	
Did you ever have to choose between buying textbooks or paying for notes and buying scrubs?	No	149 (71.0)	127 (85.2)	22 (14.7)	0.003*
	Yes	61 (29.1)	60 (98 .4)	1 (1.6)	
Have you ever had to borrow money for food from friends?	Yes	82 (39.1)	16 (19.5)	4 (4.9)	<0.025*
	Never	128 (61.0)	109 (85.2)	19 (14.8)	

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Table 6: Adjusted and unadjusted logistic regression

Food insecure		95% Confidence Interval	p-value	95% Confidence Interval	p-value
Name of institution	SMU				
	UP	0.198 (.033 to 1.181)	0.076		
	UWC	0.304 (0.067 to 1.387)	0.124		
	WITS	0.674 (0.09 to 5.062)	0.702		
Discipline of study	Dental Therapy				
	Dentistry	1.307 (0.149 to 11.449)	0.809		
	Oral Hygiene	1.778 (0.157 to 20.1)	0.642		
Gender	Female				
	Male	0.666 (.266 to 1.667)	0.385		
Residence	Home with family				
	Private boarding	0.489 (0.163 to 1.471)	0.203		
	University residence	1.409 (0.486 to 4.088)	0.528		
Do you consider your meals to be nutritious or unhealthy?	Nutritious				
	Unhealthy	9.405 (1.237 to 71.486)	0.03*		
Do you bring a packed lunch to campus?	No				
	Yes/Sometimes	0.187 (0.043 to 0.825)	0.027*		
Do you consider the food you purchase to be nutritious?	Nutritious				
	Unhealthy	2.44 (1.014 to 5.869)	0.046*		
How often did you worry that you are not eating enough food?	Daily/More Often				
	Never	0.11 (0.032 to 0.382)	0.001*	7.639 (2.08 to 28.02)	0.002*
Did you ever go to sleep hungry because you don't have enough food?	Daily/More Often				
	Never	0.139 (0.018 to 1.062)	0.057*		
If you don't carry a packed lunch, do you always have money to buy food?	No				
	Yes/Sometimes	0.288 (0.083 to 1.007)	0.051		
If you have to buy food on campus, is it readily available?	No				
	Yes	0.551 (0.156 to 1.949)	0.355		
How affordable is the food you purchase on campus?	Affordable				
	Expensive	2.222 (.916 to 5.393)	0.078		
How often do you purchase fast food because it is cheaper?	Daily/More Often				
	Never	0.284 (0.114 to 0.705)	0.007*		
How often have you had no food to eat because of a lack of resources?	Daily/More Often				
	Never	0.176 (0.051 to 0.613)	0.006*		

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Food insecure	SMU	95% Confidence Interval	p-value	95% Confidence Interval	p-value
Have you ever watered down/ stretched your meals to make them last longer?	Daily/More Often				
	Never	0.306 (0.109 to 0.858)	0.024*		
Did you ever have to sell assets or items to buy food?	Daily/More Often				
	Never	0.521 (0.066 to 4.14)	0.538*		
Did you ever have to sacrifice health or education costs to buy food?	No				
	Yes	7.812 (1.026 to 59.499)	0.047*		
Did you ever choose between buying clothes/scrubs and buying food?	No				
	Yes	4.269 (1.225 to 14.879)	0.023*		
Did you ever have to choose between buying Wi-Fi and buying food?	No				
	Yes	4.204 (0.546 to 32.385)	0.168		
Did you ever have to choose between buying textbooks or paying for notes and buying scrubs?	No				
	Yes	10.394 (1.369 to 78.933)	0.024*		
Have you ever had to borrow money for food from friends?	No				
	Yes	0.294 (0.096 to 0.899)	0.032*	1.686 (.51 to 5.57)	0.392

DISCUSSION

Some 89.1% of oral healthcare students in South Africa reported food insecurity, which is a statistic not to be taken lightly. This result was higher than previous studies from other universities in the country that reported 65% of students were deemed food insecure.[1] In contrast to the Free State study, where males felt more food insecure than females, the majority (75%, n=102) were females in this study.[15]

Almost 31.9% of students skipped a meal daily. While a vast array of factors could contribute to students skipping a meal, this still indicates that skipping a meal can be directly linked to being food insecure. In an ever-changing world, some students are still required to manage their hunger by using techniques such as watering down their food. More than 16% of students worried about not having enough food to eat at least once a week, the majority of whom were food insecure. Some 44.76% of the students felt that they had no food to eat because of a lack of resources; more than 94% were food insecure.

Some 22.4% of students have had at least one night a week where they have gone to bed on an empty stomach. While, again, reasons for this may vary, it is still unacceptable that students are meant to focus and concentrate on studying, not sleeping on an empty stomach. Marshall et al. (2021) have also shown that food-insecure students are more likely to report having experienced food- or hunger-related stress, sleep, study or academic performance than their food-secure counterparts.[18]

While it must be noted that economic factors alone are not responsible for food insecurity, with most of the students finding the food available on campus to be nutritious, it must also be observed that 61.9% of students still purchased food on campus because it is cheaper. Students at Wits and in the Free State shared the same concerns about food availability on campus and the lower nutritional content thereof, as noted in the 2013 study.[15]

Some coping strategies noted were borrowing money from friends (39.1%) and selling assets (7.6%). These methods of coping are unstable and only valid for the short term. Long-term solutions need to be suggested for these students.

Hunger can impede students from functioning optimally. In an ideal world, all people should be well taken care of, healthy and food secure; however, that is not the case, especially among dental students in South Africa. Due to the great variety of factors that need to be considered when dealing with food insecurity, it is not a unilateral issue that can be resolved individually. We need intervention from the local government and parliament to aid in the eradication of food insecurity.

Food insecurity is a complex issue and requires multiple collaborative strategies to reduce the growing risk of individuals becoming food insecure. Implementing policies and interventions to ensure that nutritious food is affordable and readily available conveniently is imperative.[19] Some recommendations would be to formulate a universal model to determine food insecurity, a restructuring procedure to reallocate funds for needy students by providing food instead of cash and food vouchers from specific retailers, and universities to provide more cost-effective, nutritious and healthy food options on their campuses.

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At a governmental level, the possibility of having food banks and alternative methods of food procurement must be discussed, as hunger is the leading cause of theft and crime in South Africa and has negative impacts on all aspects of life. Food insecurity practices should focus on increasing food access and affordability, building community food solutions, regional development, supporting food social enterprise, and planning for local food systems.[20] It is also important for further research to be conducted to ascertain the actual effects of food insecurity on the education and performance of students.

CONCLUSION

Food insecurity is rife in South African dental institutions. Food insecurity may impact on the success of dental students' academic performance and the students' health in general. There is a need to address food insecurity at university level.

Abbreviations

SDG – sustainable development goals
UWC – University of the Western Cape
UP – University of Pretoria
Wits – University of the Witwatersrand
SMU – Sefako Makgatho Health Sciences University

Limitations

This was a cross-sectional study and causal relationships cannot be speculated. The data from this study was self-reported and open to reporting bias and attempts to reduce this bias were ensured via the anonymity of the survey. There could have been selection bias, as students who dropped out or de-registered from studies were not included in this study.

DECLARATIONS

Ethics approval and consent to participate

Ethical approval was received from UWC Humanities and Social Science Research Ethics Committee: Reference Number: HS17/8/28. All research was performed in accordance with the Declaration of Helsinki and informed consent was obtained from all the participants. There were no minors involved in this study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

The authors declare they have no conflict of interest.

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Authors' contributions

Ameera Yusuf Essa, Shoayeb Shaik, Faheema Kimmie-Dhansay: Substantial contributions to the conception, design of the study, data acquisition, interpretation of the data, drafting the manuscript, critically revising the manuscript and final approval of the version to be published. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors read and approved the final manuscript.

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REFERENCES

1. Farrell P, Thow AM, Abimbola S, Faruqui N, Negin J. How food insecurity could lead to obesity in LMICs: when not enough is too much: a realist review of how food insecurity could lead to obesity in low- and middle-income countries. Health promotion international. 2018 Oct 1;33(5):812-26
2. Pollard CM, Booth S. Food insecurity and hunger in rich countries – it is time for action against inequality. International journal of environmental research and public health. 2019 Jan;16(10):1804
3. Food and agriculture organization of the United Nations. Chapter 2. Food security: concepts and measurement[21] [Internet]. www.fao.org. 2021 [cited 01 October 2021]. Available from: https://www.fao.org/3/y4671e/y4671e06.htm
4. Food and agriculture organization of the United Nations. The State of Food Security and Nutrition in the World 2021 [Internet]. www.fao.org. 2021 [cited 01 October 2021]. Available from: https://www.fao.org/state-of-food-security-nutrition/en/
5. United Nations World Food Programme. [Internet] https://www. wfp. org/zerohunger. [cited 01 October 2021]. Available from: https://www.wfp.org/zero-hunger?utm_source=google&utm_medium=cpc&utm_campaign=12117193092&utm_content=116548231597&gclid=CjwKCAjw49qKBhAoEiwAHQVTo2dKGmZZc7-9126NSfWcjc6t7yeoyspgTsjiO9azDG12hG8hTJuJbRoCQ0cQAvD_BwE&gclsrc=aw.ds
6. FAO, IFAD, UNICEF, WFP and WHO. The State of Food Security and Nutrition in the World 2020. Transforming food systems for affordable healthy diets. Rome, FAO. https://doi.org/10.4060/ca9692en
7. Shi Y, Davies A, Allman-Farinelli M. The association between food insecurity and dietary outcomes in university students: A systematic review. Journal of the Academy of Nutrition and Dietetics. 2021 Dec 1;121(12):2475-500
8. Dullah Omar Institute. The challenges of hunger among students in higher education in South Africa. 2021 [Internet] [cited 01 October 2021]. Available from: https://dullahomarinstitute.org.za/news/nsfas-at-the-helm-of-student-hunger-at-universities
9. Leung CW, Wolfson JA, Lahne J, Barry MR, Kasper N, Cohen AJ. Associations between food security status and diet-related outcomes among students at a large, public midwestern university. Journal of the Academy of Nutrition and Dietetics. 2019 Oct 1;119(10):1623-31
10. Gao X, Scott T, Falcon LM, Wilde PE, Tucker KL. Food insecurity and cognitive function in Puerto Rican adults. The American journal of clinical nutrition. 2009 Apr 1;89(4):1197-203. PMID: 19225117; PMCID: PMC2667463
11. Gundersen C, Ziliak JP. Food insecurity and health outcomes. Health affairs. 2015 Nov 1;34(11):1830-9. doi: 10.1377/hlthaff.2015.0645. PMID: 26526240
12. Silva MR, Kleinert WL, Sheppard AV, Cantrell KA, Freeman-Coppadge DJ, Tsoy E, Roberts T, Pearrow M. The relationship between food security, housing stability, and school performance among college students in an urban university. Journal of College Student Retention: Research, Theory & Practice. 2017 Nov;19(3):284-99
13. Payne-Sturges DC, Tjaden A, Caldeira KM, Vincent KB, Arria AM. Student hunger on campus: Food insecurity among college students and implications for academic institutions. American Journal of Health Promotion. 2018 Feb;32(2):349-54
14. Theodoridis X, Grammatikopoulou MG, Gkiouras K, Papadopoulou SE, Agorastou T, Gkika I, Maraki MI, Dardavessis T, Chourdakis M. Food insecurity and Mediterranean diet adherence among Greek university students. Nutrition, Metabolism and Cardiovascular Diseases. 2018 May 1;28(5):477-85. doi: 10.1016/j.numecd.2018.02.007. Epub 2018 Feb 21. PMID: 29655531
15. Van den Berg L, Raubenheimer J. Food insecurity among students at the University of the Free State, South Africa. South African Journal of Clinical Nutrition. 2015 Jan 1;28(4):160-9
16. Sabi SC, Kolanisi U, Siwela M, Naidoo D. Students' vulnerability and perceptions of food insecurity at the University of KwaZulu-Natal. South African Journal of Clinical Nutrition. 2020 Oct 1;33(4):144-51
17 Cohen BE, Solutions IQ. Community food security assessment toolkit. Washington, DC: US Department of Agriculture, Economic Research Service; 2002 Jul. Available from: https://www.ers.usda.gov/webdocs/publications/43164/15824_efan02013_1_.pdf?v=1773.6
18. Marshall TA, Zheng R, Anderson CL, Handoo N, Qian F. Is food insecurity a barrier to dental student success? Journal of Dental Education. 2021 Sep;85(9):1518-24
19 Battersby-Lennard J, Fincham R, Frayne B, Haysom G. Urban food security in South Africa: case study of Cape Town, Msunduzi and Johannesburg. Development Planning Division Working Paper Series. 2009;15
20. Everatt D, Dube N, Ntsime M. Integrated Sustainable Rural Development Program Phase I evaluation: Nodal Review Researched and written for the Independent Development Trust

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Radiographic assessment of developing maxillary canine ectopia and its association with dental anomalies in the mixed dentition

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ABSTRACT

Introduction

Reciprocal associations have been found to exist between various dental anomalies.[1-14] Maxillary canine ectopia may, however, occur in dentitions without any anomalies.

Aims and objectives

The aim of the study was to establish the prevalence of dental anomalies in a sample of panoramic radiographs. The objective was to establish whether associations exist between canine ectopia and the presence of one or more of a range of selected developmental dental anomalies. A cross-sectional study was carried out on 574 mixed dentition panoramic radiographs in patients with a dental age ranging from 8 to 12 years.

Results

Signs of potentially ectopic maxillary canines were evident in 85% of the radiographs and of these, 80.7% showed no evidence of the selected dental anomalies which were studied. The most prevalent association of potential canine ectopia and the anomalies studied was found with supernumerary teeth (6.5%), followed by infraocclusion of primary molars (4.5%). Peg-shaped lateral incisors showed a statistically significant association (p=0.043) with mesial overlap of the cusp tip of the maxillary canine and the root of the lateral incisor. Taurodontism was significantly associated with increased angulation of the developing canine (p=0.0049) and dilaceration showed a statistically significant association (p=0.03) with non- resorption of canines.

Conclusion

In cases where dental anomalies are present, the developing canines should be carefully monitored both clinically and radiographically.

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Dr A Hudson: Writing article	20%
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Prof N Mohamed: Writing article, editing	20%

Conflict of interest
None

Introduction

Pre-eruptive canine ectopia refers to erupting canines that show signs of moving in the wrong direction.[1] When assessing the developing canines during the mixed dentition stage, important factors need to be taken into consideration.

- These have been identified by Hudson *et al*.[1] as
- The presence of the canine bulges
- The presence of dental anomalies
- The late development of the dentition
- The size, position or absence of the lateral incisors
- The amount of space available in the arch and
- The mobility of the primary canines.

The early diagnosis of one or more developmental anomalies during the mixed dentition stage should be viewed as a potential early warning sign of possible

Table I: Dental age vs. the prevalence of potentially ectopic maxillary canines

Dental Age	n (%)	Total n (%)
8	40 (8.1)	89 (18.1)
9	49 (9.9)	
10	211 (42.8)	404 (81.9)
11	133 (27)	
12	60 (12.2)	
Total		493

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Table II: Prevalence of each radiographic marker indicating canine ectopia at various dental ages.

		n (%)					
Dental Age	Total n	Rotated Maxillary Lateral Incisors	Non-resorption of primary canines	Overlap	Angulated maxillary canines	Mx. Enlarged	Mnd. Enlarged
8	40	39 (97.5)	N	N	2 (5)	6 (15)	5 (12.5)
9	49	47 (95.9)	N	N	2 (4.1)	6 (12.2)	3 (6.1)
10	211	159 (75.3)	176 (83.4)	56 (26.5)	9 (4.3)	28 (13.2)	20 (9.5)
11	133	103 (77.4)	72 (54.1)	33 (24.8)	8 (6)	18 (13.5)	16 (12)
12	60	57 (95)	10 (16.7)	14 (23.3)	2 (3.3)	6 (10)	6 (10)
Total	493	405	258	103	23	64	50

*N= Normal observation at this age.

canine ectopia.[1] These include ectopic eruption of the first permanent molars, taurodontism, invaginations[2, 3, 4] and size and shape of the maxillary lateral incisor.[5-12] The lateral incisors are thought to guide the canines into position, therefore, in cases where the root of the lateral incisor is smaller than normal or the lateral incisor is congenitally missing, ectopia may result. [13, 14]

Significant reciprocal associations have been demonstrated between palatally displaced canines, small maxillary lateral incisors, infraocclusion of primary molars, missing second premolars and enamel hypoplasia.[15] Several authors have suggested that infraocclusion of primary molars may cause ectopic eruption of the maxillary canines, because of the effect it has on the transeptal fibres.[3,15, 16, 17] Late developing dentitions and in particular, late developing lateral incisors, may be more disruptive for canine eruption than missing lateral incisors.[18, 19, 20] Studies have shown that aplasia of the second premolars may cause ectopic eruption of the permanent maxillary canines.[3,15] However, since these premolars show a high variability in the initiation of calcification,[21, 22, 23, 24] they should only be considered congenitally missing after the dental age of 7 years in order to avoid a false positive diagnosis.[25] Some may erupt as late as a year after the eruption of the contralateral premolar.[21] Aplasia of premolars could possibly create arch-length discrepancies, making it difficult for the maxillary canine to erupt into its normal position.[26]

Not much research has focused on the relationship between supernumerary teeth and ectopic maxillary canines. Baccetti[15] found that supernumerary teeth did not have any association with palatally displaced maxillary canines. The presence of supernumerary teeth within the dental arch may cause delayed eruption of teeth, space issues, displacement of adjacent teeth and ectopic eruption of teeth.[27,28] A mesiodens, for example, may prevent or delay eruption of the permanent maxillary central incisors which may cause ectopic eruption of a central incisor with a potential effect on the space remaining to accommodate canine eruption.[29] Less frequently, a mesiodens may cause dilaceration or resorption of the permanent central incisor root, which may have an effect on the positioning of the canine.[30, 31, 32]

Bjerklin *et al*.[3] suggested that there is a statistically significant association between ectopic first molars and ectopic maxillary canines. However, Baccetti[15] found no association between ectopic molars and palatally displaced canines. Becktor *et al.*,[2] showed that 23.3% of the 30 patients examined presented with ectopic eruption of the permanent first maxillary molar and root resorption of the second primary molar. This takes place prior to root resorption of the maxillary primary canines which is caused by ectopic maxillary permanent canines. Hence, the ectopic first molars could possibly be used as an early risk factor for the prediction of maxillary canine ectopia.

Methodology

The rationale for the study was to show whether or not there is a correlation between dental anomalies and canine ectopia in a South African context. An analytical, descriptive, cross-sectional, retrospective study was carried out to attempt to establish any relationship/ association between potential maxillary canine ectopia and the presence of a variety of selected developmental dental anomalies. Sequential, good quality mixed dentition panoramic radiographs (n = 574) from the UWC Paediatric Dentistry department at the Tygerberg Oral Health Centre were used. These radiographs were taken between 2011 and 2014 on patients with a dental age ranging from 8 to12 years. Patients with syndromes, cleft lip and palate, a history of previous extractions and those who received prior orthodontic treatment, were excluded.

The radiographic markers used for prediction of canine ectopia were:

- Rotated lateral incisors
- Non-resorption of primary canine roots

Table III: Prevalence of developmental anomalies in potentially ectopic maxillary canines (n=493).

Developmental Anomalies	Cases n (%)
No Developmental Anomalies present	398 (80.7)
Congenitally Missing lateral incisors	6 (1.2)
Aplasia of Premolars	12 (2.4)
Peg-Shaped Maxillary Lateral Incisors	7 (1.4)
Infraocclusion of Primary Molars	22 (4.5)
Supernumerary Teeth	32 (6.5)
Taurodontism	7 (1.4)
Dilaceration	17 (3.4)
Ectopic Molars	0

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- Overlap between the developing permanent canine and the root of the lateral incisor
- Angulation of the developing canine greater than 30^0 to the mid-sagittal plane
- Enlarged developing maxillary canines
- Enlarged developing mandibular canines

Each of the radiographs exhibiting signs of potentially ectopic canines, were examined in order to determine the presence and/ or absence of the following developmental anomalies:
- Congenitally missing lateral incisors
- Aplasia of premolars
- Peg-shaped permanent maxillary lateral incisors (where the incisal width was less than the cervical width)
- Infraocclusion of primary molars (diagnosed by a "step" in the occlusal plane)
- Supernumerary teeth
- Taurodontism
- Dilaceration of roots greater than 90^0
- Ectopic eruption of permanent first molars

The results obtained were coded accordingly and transferred to a Microsoft Excel spreadsheet.

Data processing and analysis

Pearson's correlation coefficient was used to determine the degree to which two variables were associated. For a correlation coefficient to be statistically significant, its absolute value must exceed 0.0834. This indicates an association. The Chi-square test of independence and Fisher exact test were also used to determine whether two categorical variables were dependent or independent. A p-value of <0.05 indicates that the variables have an association.

Results

Of the 574 radiographs studied, 493 displayed potentially ectopic maxillary canines (Table I).

The anomalies detected are displayed in Table III. Roughly 80% of the cases presented with ectopia with no evidence of anomalies.

Of the 493 panoramic radiographs, 95 had anomalies present, 8 of which presented with more than 1 anomaly:
- 1 case presented with a congenitally missing lateral incisor, a peg-shaped lateral incisor and a supernumerary tooth.
- 2 cases presented with a congenitally missing incisor and a supernumerary tooth.
- 2 cases presented with infraocclusion and aplasia of a premolar.
- 1 case presented with infraocclusion and dilaceration.
- 1 case presented with infraocclusion and a supernumerary tooth.
- 1 case presented with a peg-shaped lateral incisor and a supernumerary tooth.

DISCUSSION

The findings of this study confirm the conclusion of Sorenson *et al*.[4] that maxillary canine ectopia can occur in dentitions without any other dental deviations (Tables I, II and III). Other studies however suggest that the presence of one anomaly could predict another in the same case.[15,33] The reciprocal associations found by Baccetti[15] were not seen in this study. The low prevalence of developmental anomalies in this study (Table III) may be due to the genetic factors governing these various anomalies i.e. ethnicity/ hereditary factors.

Table IV: The presence of developmental anomalies and their association with the selected radiographic markers predicting potential canine ectopia.

	n (%)					
Developmental Anomalies	**Rotated Laterals (n=405)**	**Non-resorption of primary canines (n=258)**	**Overlap (n=103)**	**Angulation (n=23)**	**Mx. Enlarged (n=64)**	**Mnd. Enlarged (n=50)**
No Developmental Anomalies	333 (82.2)	209 (81)	80 (77.7)	18 (78.3)	51 (79.7)	43 (86)
Congenitally Missing Lateral incisors	2 (0.5)	5 (1.9)	0	1 (4.3)	0	0
Aplasia of Premolars	10 (2.5)	7 (2.7)	2 (1.9)	0	2 (3.1)	0
Peg-Shaped Maxillary Lateral Incisors	3 (0.7)*	5 (1.9)	2 (1.9)**	0	2 (3.1)	1(2)
Infraocclusion of primary molars	17 (4.2)	14 (5.4)	3 (2.9)	1 (4.3)	3 (4.7)	1(2)
Supernumerary Teeth	24 (5.9)	16 (6.2)	9 (8.7)	2 (8.7)	5 (7.8)	3 (6)
Taurodontism	6 (1.5)	3 (1.2)	2 (1.9)	2 (8.7)	0	1(2)
Dilaceration	14 (3.5)	5 (1.9)****	4 (3.9)	2 (8.7)***	1 (1.6)	1(2)
Ectopic Molars	0	0	0	0	0	0

* p = 0.01
** p = 0.043
*** p = 0.0049
**** p = 0.03

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No statistically significant associations ($p > 0.05$) were found to exist between congenitally missing lateral incisors and each of the radiographic markers when assessed separately (Table IV). This concurs with the findings of a study by Peck *et al*.[10] which found no statistical significance in the relationship between missing maxillary lateral incisors and palatally displaced maxillary canines. Some studies have found that roughly 5% of congenitally missing maxillary lateral incisors occur with palatally displaced maxillary canines[7,9], whilst others noted the frequent presence of palatally displaced canines.[11,12] Nanda[8] suggested that non-resorption of primary canines was likely to occur in cases with congenitally missing lateral incisors. These authors emphasized Broadbent's original 1941 observation, where the absence of a maxillary lateral incisor deprives the erupting permanent maxillary canine of the normal guidance provided by the root of the maxillary lateral incisor. This in turn leads to the high occurrence of palatally displaced canines. In the present study, the low number of cases with a congenitally missing maxillary lateral incisor may have accounted for the difference in the findings. Further investigations of congenitally missing maxillary lateral incisors using a bigger sample size may reveal a different association with maxillary canine ectopia.

The Chi-square independence test revealed no statistically significant associations between any of the potential markers of canine ectopia and aplasia of premolars (Table IV). The present study did not confirm the significant inverse relationship that Baccetti[34] found between the maxillary lateral incisor rotation and aplasia of premolars. The difference in findings may be due to the low prevalence of aplasia of premolars within the selected sample.

A statistically significant association was found between peg-shaped maxillary lateral incisors (Table IV) and mesial overlap of the maxillary canine cusp tip over the root of the maxillary lateral incisor ($p= 0.043$).

The statistically significant association with mesial overlap supports the work of several authors who have reported the high incidence of peg-shaped maxillary lateral incisors in children with ectopic maxillary canines.[6,9,10,15,35] All other radiographic markers showed no statistically significant association with peg-shaped maxillary lateral incisors. The significance of the mesial overlap may be understated because of the age limit on the study sample. Other studies have also demonstrated weak or no association between peg-shaped maxillary lateral incisors and the failure of eruption of the maxillary canine.[36,37]

A statistically significant association was found between peg-shaped maxillary lateral incisors (Table IV) and rotated maxillary lateral incisors ($p= 0.01$). The probability test showed that:

- There was a 0.74% chance for peg-shaped maxillary lateral incisors to occur when a rotated maxillary lateral incisor existed.
- There was a 33% chance for a rotated maxillary lateral incisor to occur in the presence of a peg-shaped maxillary lateral incisor.

Radiographically, the normal maxillary lateral incisor appears with the incisal edge of the crown parallel to the occlusal plane. The mesial and distal ridges are present and the V-shaped lingual fossa is visible. In the case of a rotation, only one of the ridges would be visible. The curvature of the cervical line is distinct in the direction of the incisal edge when the maxillary lateral incisor is rotated.[38] The peg-shaped lateral presents with cervical margin broader than the crown tip with no ridges visible. Thus, radiographically, rotated maxillary lateral incisors could appear peg-shaped (depending on the severity of the rotation). This highlights a limitation of the present study in that it was a radiographic study without a clinical examination.

No statistically significant associations were found between infraocclusion of primary molars and the radiographic markers assessed. However, other studies showed significant associations between infraocclusion of primary molars and displaced maxillary canines.[3,15,17] The difference in the results could possibly be due to the low prevalence of infraoccluded primary molars within the study sample.

No statistically significant association was found between supernumerary teeth and any of the radiographic markers. This study concurs with Baccetti's[15] study, which found that the group with supernumerary teeth did not show any significant associations with palatally displaced maxillary canines. Gomes *et al.*[39] also found that supernumerary teeth were common in his study of patients aged 9 to 10 years and noted that non-resorption of the primary maxillary canines occurred simultaneously.

Taurodontism showed no statistically significant association with potentially ectopic maxillary canines as determined by all the considered radiographic markers in Table II ($p= 0.48$). Nagpal *et al.*[40] found a statistically significant relationship between maxillary canine ectopia and taurodontism. In the present study, however, taurodontism showed a statistically significant association (Table IV) with the angulation of the canine ($p= 0.0049$). When the angulation of the maxillary canine was greater than 30^0, the probability test found that:

- There was a 22% chance of taurodontism occurring.
- There was only a 9% chance of angulation of the maxillary canine being greater than 30^0 when taurodontism existed.

Dilaceration (Table IV) showed a statistically significant association with non-resorption of primary maxillary canines ($p= 0.03$). When non-resorbed primary maxillary canines existed, the probability test showed that:

- There was a 29% chance of dilaceration occurring.
- There was only a 2% chance for non-resorption of the primary maxillary canines to occur when dilaceration existed.

A total of three premolars and fourteen molars presented with dilacerations, whereas only four central incisors and two lateral incisors displayed dilaceration. This is consistent with studies conducted by Malcic *et al*.[41] which recorded a 1.43% prevalence of dilaceration (90^0 or greater) of lateral incisors on panoramic radiographs. The question remains as to whether a dilaceration of 45^o is normal or abnormal. No literature has specified the normal anatomical angle for dilaceration, which is why researchers use various criteria. This study found no statistically significant association between dilaceration and potentially ectopic maxillary canines as determined by the six radiographic markers ($p= 0.24$) (Table III).

In a sample size of 480 cases, Chohayeb[42] reported that

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disto-labial dilaceration occurred in 52% of the maxillary lateral incisors. He disregarded angles less than 20^0 when recording dilaceration. Maxillary lateral incisors have a normal anatomical distal curvature[43] for which, the exact degree of angulation is unknown. This result is therefore still questionable, because the normal anatomical curvature could have been 30^0 or more and these cases may have been included as an anomaly when Chohayeb[42] was recording the prevalence of dilaceration, thus, bringing about the high prevalence of dilaceration of the maxillary lateral incisors in their study. The data reported by Chohayeb[42] is not consistent with Malcic *et al*.'s[41] results, where the prevalence of dilaceration for the lateral incisors was 1.43% in a sample size of 488 panoramic radiographs and 7% on periapical radiographs. Malcic *et al*.[41] only recorded root dilacerations greater than or equal to 90^0, which is a strict criterion compared to Chohayeb's[42] criteria. Hamasha *et al.*[44] reported a prevalence of 1.2% for dilaceration in the maxillary lateral incisors in a sample size of 812 periapical radiographs. They also recorded all dilacerations of 90^0 and above. However, compared to Malcic *et al*.'s[41] study, they found a lower prevalence for dilaceration using periapical radiographs. The present study used panoramic radiographs to identify the presence of root dilacerations. Hence, Hamasha *et al.*'s[44] prevalence could not be compared with the present study.

The diagnosis of an ectopic first molar may be made clinically upon the eruption between a dental age of 5 to 7 years. Since the current study only used panoramic radiographs from dental age 8 years and above, the only way to determine if a first molar had ectopically erupted, was to identify the presence of resorption in the disto-buccal root of the second primary molar.[2, 45] This study did not find any statistically significant associations with the various radiographic markers, thus supporting the findings of Baccetti's study.[15] However, Bjerklin *et al.*[3] found a statistically significant association between ectopic maxillary canines and ectopic molars.

CONCLUSION

When clinicians identify taurodontism prior to dental age 10, they should be aware of the possibility of angulation of the maxillary canines of greater than 30^0. This enables them to take interceptive measures (like the timeous extraction of the primary canines[1]) by monitoring the movement of the maxillary canine.

In the case of peg-shaped lateral incisors which can be clinically diagnosed on eruption at a dental age of 8 years, the overlap between the developing canines and lateral incisors should be monitored for signs of ectopia. The same holds true for supernumerary and infraoccluded teeth which demonstrated the strongest association with canine ectopia.

Should any root dilacerations of the lateral incisors or canines be identified prior to the dental age of 10 years, the resorption of the primary canine roots should be monitored for ectopia.

REFERENCES

1. Hudson APG, Harris AMP, Mohamed N. Maxillary canine management in the pre-adolescent: A guideline for general practitioners. SADJ. 2010; 65 (8): 366-370.
2. Bektor KB, Steiniche K, Kjaer I. Association between ectopic eruption ectopic eruption of maxillary canines and first molars. Eur J Orthod. 2005; 27 (2): 186-189.
3. Bjerklin K, Kurol J, Valentin J. Ectopic eruption of maxillary first permanent molars and association with other tooth and developmental disturbances. Eur J Orthod. 1992; 14 (5): 369-375.
4. Sorenson BB, Artmann L, Larsen HJ, Kjaer I. Radiographic assessment of dental anomalies in patients with ectopic maxillary canines. Int J Paed Dent. 2009; 19 (2): 108- 114.
5. Shapira Y, Kuftinec MM. Early diagnosis and interception of potential maxillary canine impaction. JADA. 1998; 129 (10): 1450-1454.
6. Becker A. Palatally impacted canines: In: Orthodontic treatment of impacted teeth. Martin Dunitz Ltd. 1998; Chapter 6, Pages 85-101.
7. Becker A, Smith P, Behar R. The incidence of anomalous maxillary lateral incisors in relation to palatally displaced cuspids. Angle Orthod. 1981; 51 (1): 24-29.
8. Nanda SK. The developmental basis of occlusion and malocclusion. Events in the life cycle of each permanent tooth. Quintessence Publishing Company, Chicago 1983; Pages 81-158.
9. Brin I, Becker A, Shalhav M. Position of the maxillary permanent canine in relation to anomalous or missing lateral incisors: a population study. Eur J Orthod. 1986; 8 (1):12-16.
10. Peck S, Peck L, Kataja M. Site specificity of tooth maxillary agenesis in subjects with canines malpositions. Angle Orthod. 1996; 66 (6): 473-476.
11. Miller BH. The influence of congenitally missing teeth on the eruption of the upper canine. Dent Pract Dent Rec. 1963; 13: 497-504.
12. Bass TB. Observations on the misplaced upper canine tooth. The Dental Practitioner and Dental Pract Dent Rec. 1967; 18: 25-33.
13. Bektor KB, Steiniche K, Kjaer I. Association between ectopic eruption ectopic eruption of maxillary canines and first molars. Eur J Orthod. 2005; 27 (2): 186-189.
14. Jacoby H. The etiology of maxillary canine impactions. Am J Orthod. 1983; 84 (2): 125-132.
15. Baccetti T. A controlled study of associated dental anomalies. Angle Orthod. 1998; 68 (3): 267-274.
16. Becker A. The effects of infraocclusion: Part 3. Dental arch length and the midline. Am J Orthod Dentofac Orthop. 1992; 102 (5): 427-433.
17. Shalish M, Peck S, Wasserstein A, Peck L. Increased occurrence of dental anomalies associated with infraocclusion of deciduous molars. Angle Orthod. 2010; 80 (3): 440-5.
18. Peck S, Peck L, Kataja M. The palatally displaced canine as a dental anomaly of genetic origin. Angle Orthod. 1994; 64 (4): 249-256.
19. Becker A, Chaushu S. Dental age in maxillary canine ectopia. Am J Orthod Dentofac Orthop. 2000; 117 (6): 657-662.
20. Leifert S and Jonas I. Dental anomalies as a micro symptom of palatal canine displacement. J Orofac Orthop. 2003; 64 (2): 108-120.
21. White SC, Pharaoh MJ. Oral radiology: Principles and interpretation. 6th edition. Mosby Elsevier 2010; Pages 295-304.
22. Wisth PJ, Thunold K, Böe OE. Frequency of hypodontia in relation to tooth size and dental arch width. Acta Odontol Scand. 1974; 32 (3): 201-206.
23. Nik-Hussein NN. Hypodontia in the permanent dentition: A study of its prevalence in Malaysian children. Aust Orthod J. 1989; 11 (2): 93-95.
24. Arte S, Pirinen S. Hypodontia. Orphanet Encyclopedia May 2004. http://www.orpha.net/data/patho/GP/UKhypodontia.pdf
25. Goya HA, Tanaka S, Maeda T, Akimoto Y. An orthopantomographic study of hypodontia in permanent teeth of Japanese pediatric patients. J Oral Sci. 2008; 50 (2): 143-150.
26. Kokich V. Early management of congenitally missing teeth. Semin Orthod. 2005; 11 (3): 146–151.
27. Peedikayil FC. Delayed tooth eruption. J Dent. 2011; 1 (4): 81-86.
28. Mitchell L and Bennett TG. Supernumerary teeth causing delayed eruption: A retrospective study. Br J Orthod. 1992; 19 (1): 41-46.
29. Moraes RS, Farinhas JA, Gleiser R, Primo LG. Delayed eruption of maxillary permanent central incisors as a consequence of mesiodens: a surgical re-treatment approach. J Clin Pediatr Dent. 2004; 28 (3): 195-198.
30. Gardiner J. Supernumerary teeth. Dent Pract Dent Rec. 1961; 12: 63–73.
31. Primosch RE. Anterior, teeth-assessment and surgical intervention in children. Pediatr Dent. 1981; 3 (2): 204–215.
32. Russell K.A., Folwarczna M.A. Mesiodens-diagnosis and management of a common supernumerary tooth. J Can Dent Assoc. 2003; 69 (6): 362–366.
33. Ooshima T, Ishida R, Mishima K and Sobue S. The prevalence of developmental anomalies of teeth and their association with tooth size in the primary and permanent dentitions of 1650 Japanese children. Int J Paediatr Dent. 1996; 6 (2): 87–94.
34. Baccetti T. Tooth rotation associated with aplasia of nonadjacent teeth. Angle Orthod. 1998; 68 (5): 471-474.
35. Zilberman Y, Cohen B, Becker A. Familial trends in palatal canines, anomalous lateral incisors, and related phenomena. Eur J Orthod. 1990; 12 (2): 135-139.
36. Mossey PA, Campbell HM, Luffingham JK. The palatal canine and the adjacent lateral incisor: A study of a West of Scotland population. Br J Orthod. 1994; 21 (2): 169-174.
37. Brenchley Z, Oliver RG. Morphology of anterior teeth associated with displaced canines. British J Orthod. 1997; 24 (1): 41-45.
38. Nelson SJ, Ash MM. The permanent canines: maxillary and mandibular. In: Wheeler's Dental Anatomy, Physiology and Occlusion. Saunders Elsevier Inc, China 2010 (9th ed); Pages 31, 107-111, 125.
39. Gomes CDO, Drummond SN, Jham BC, Abdo EN and Mesquita RA. A survey of 460 supernumerary teeth in Brazilian children and adolescents. Int J Paediatric Dent. 2008; 18 (2): 98-106.
40. Nagpal A, Pai KM, Sharma G. Palatal and labially impacted maxillary canine associated dental anomalies: A comparative study. J Contemp Dent Pract. 2009; 10 (4): 1-11.
41. Malcic A, Jukic S, Brzovic V, Miletic I, Pelivan I, Anic I. Prevalence of root dilaceration in adult dental patients in Croatia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006; 102 (1): 104-9.
42. Chohayeb AA. Dilaceration of permanent upper lateral incisors: Frequency, direction and endodontic treatment implications. Oral Surg Oral Med Oral Path. 1983; 55 (5): 519-20.
43. Ingle JI. Endodontics. 3rd edition. Lea and Febiger. Philadelphia, 1985. Pages 120-121.
44. Hamasha AA, Al-Khateeb T, Darwazeh A. Prevalence of dilaceration in Jordanian adults. Int Endod J. 2002; 35 (11): 910-912.
45. Barberia-Leache E, Suarez-Clus MC, Seavedra-Ontiveros D. Ectopic eruption of the maxillary first permanent molar: Characteristics and Occurrence in growing children. Angle Orthod. 2005;75 (4): 610-615.

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A simplified and evidence-informed approach to designing removable partial dentures

Part 1: Evidence-informed design principles

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Prof CP Owen[1]

SUMMARY

For many decades the literature has regularly reported that there is a discrepancy between what is taught in dental school and what is practised, especially in the field of removable partial dentures. Not only that, but for more than 60 years reports from around the world have shown that, usually, the majority of clinicians abdicate their responsibility to design a removable partial denture (RPD) and instead leave this to the dental technician, who has no knowledge of the clinical condition of the patient and works only from a cast. Most patients around the world who require RPDs to improve aesthetics and chewing can only afford a removable prosthesis simply because the majority are poor. But RPDs can improve these aspects and contribute to an improved quality of life.

The purpose of this series of articles is to derive the basic, evidence-informed principles of partial denture design and to suggest a simplified explanation and application of those principles in the hope that clinicians will increasingly take responsibility for the design of partial dentures. Part 1 summarises studies revealing what can only be described as the malpractice of abdication of responsibility for design by clinicians, and then explain the evidence-informed basic principles of design; Part 2 will look at the biomechanical basis of those principles in terms of support; Part 3 will do the same for the biomechanical basis of retention; Part 4 will provide a simple seven-step approach to design, applied to an example of an acrylic resin-based and a metal framework-based denture for the same partially edentulous arch; and Part 5 will provide examples of designs for RPDs that have been successfully worn by patients, for each of the Kennedy Classifications of partially dentate arches. Much of this is referenced from an electronic book on the Fundamental of removable partial dentures.[1]

Keywords

Removable partial denture, design, support, retention, acrylic-based, framework-based

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Conflict of interest

None

INTRODUCTION TO PART 1

As stated in the summary, many papers have reported on the lack of information prescribed by dentists to the dental technician. Rather than setting these out in narrative form, studies from the last 45 years are summarised in Table 1. The inevitable conclusion from these studies is that little has changed over the last many decades, where there still seems to be an enormous amount of what can only be described as malpractice when clinicians abdicate their responsibility for the design of removable partial dentures. This is the motivation for this series of papers, to try to simplify both the understanding and the application of design principles.

THE DESIGN PRINCIPLES

An article that discussed key turning points in RPD philosophy revealed that RPDs have been described in the literature for just over 300 years.[18] However, there seems to have been few changes over the last nearly 100 years. While there are no universally accepted principles for the design of RPDs, these can in fact be derived from evidence in the literature.

Tooth support

Early attempts to provide retention were described in the early 19th century as metal bands encircling the teeth. These often extended into the gingival sulcus with somewhat disastrous effects on the periodontium. A fortuitous effect of this was the realisation that tooth support was required, and the first occlusal rest was described in 1817.[19] This prevented components such as the bands sinking into the gingiva and mucosa and should have become a universally accepted principle. Sadly, there is much evidence that RPDs are still being made, more than 200 years later, with no tooth support (see Table 1), most notably as acrylic resin-based dentures or, more recently, as the so-called flexible denture.[16,20,21]

In a study comparing dentures with and without tooth support, it was found that patients who had adequate and sufficient rest seats were more satisfied with their dentures than those whose dentures had inadequate support.[22] Adequate support was one of the few criteria that correlated with successful wearing of mandibular Kennedy Class I RPDs.[23]

Clasps

A century after the concept of a clasp as a band, Roach pioneered the use of wrought wire as a circumferential clasp and as an "infra-bulge" clasp.[24] Clasps provide

Table 1. A selection of studies from the last 45 years on information supplied by clinicians to dental laboratories for removable partial dentures.

Year	Country	Study	Results	Reference
1978	England and Wales, UK	124 metal-based dentures and 44 maxillary acrylic-based dentures	54% had no instructions	2
1978	UK	14 laboratories, 1,858 partial dentures	36% had a written prescription of the design; 4.6% of the casts showed any evidence of tooth preparations such as for rest seats	3
1984	USA	303 laboratories	78% of the technicians designed most or all of the dentures; 76% of the master casts did not show adequate tooth preparation	4
1993	South Africa	148 dentists	82% of dentists instructed the technician to design the RPD; 64% did not survey the casts; 55% were not mounted on an articulator	5
1986	Scotland, UK	539 casts and dentures in one laboratory	34% were acrylic-based, 6% of which had clasps, but none had occlusal rests; 3.4% gave detailed instructions for acrylic-based dentures and 21.3% for metal-based dentures	6
2003	Ireland	122 sets of instructions to dental laboratories	53% lacked any design instruction; 9% of those requested the technician to design the framework; 7% of all the instructions included a diagram	7
2005	UK	8 laboratories, 134 prescriptions	40% included a diagram for a metal-based denture; 9% included surveyed study casts; 28% requested the dental technician to design the case	8
2006	Tanzania	328 prescriptions to a hospital laboratory	2.4% indicated a design for acrylic-based RPDs; 13.4% requested clasps; no other design parameters were requested	9
2007	Bahrain	131 prescriptions to 5 laboratories	76% requested the dental technician to design the denture, 79% for acrylic-based dentures and 57% for the metal-based dentures; 18% mentioned any design variables	10
2011	Wales, UK	68 master casts from impressions taken by 45 dentists using predetermined criteria for cingulum and occlusal rest seat preparations	48% did not have prescriptions or designs including rest seats; of those that did, only 30% had an obvious and visible rest seat preparation on the cast	11
2014	China	5 commercial laboratories in major cities across China	90% of the written instructions showed the type and position of clasps; 88% gave information regarding connectors; 48% of the tooth preparations were inadequate: there were no proper guide planes, rest seats or contours to accommodate components; 33% of technicians would contact the dentist for clarification when they felt it was needed	12
2018	Turkey	25 laboratories	38% of clinicians provided any instructions to the dental technician: 58% of prosthodontists, 33% of dentists. For those who did provide instructions, (47%) a diagram was the preferred choice	13
2020	Saudi Arabia	9 commercial laboratories, 162 prescriptions and casts	64.2% had no design instructions; 6% provided a diagram; 10% drew a design on the cast	14
2020	South Africa	60 cases from 3 commercial laboratories	55% had no rests overall; 65% of the acrylic-based dentures had no rests; 85% had no clasps, and none of the “flexible” dentures had rests or clasps	15
2022	South Africa	3 commercial laboratories, 114 cases	0% prescribed the design; 119 clasps were made, but only one cast was surveyed; 92% of the acrylic-based dentures had no tooth support; 11 (14%) of the 81 rests (in 25 of the dentures) were pre-prepared on the teeth	16
2023	China	916 prescriptions to a laboratory	86.8% had inadequate design diagram information; 74.2% were assessed as failing to meet an acceptable clinical quality standard	17

retention by the force exerted against the tooth as they flex while emerging from the undercut below the bulge of the tooth. However, the amount of this force and the ability of all clasp materials to bend many times without distortion has not been fully elucidated. A recent paper has provided some guidelines for cast clasps and stainless steel round wire[25] but there are still other casting alloys and pre-formed wrought wire clasps that need to be tested. Pre-formed and cast gingivally-approaching clasps were shown almost 40 years ago to be potentially more damaging to gingival health than circumferential clasps[26] so their use will not be advocated here.

Guide planes and guiding surfaces

A guide plane is the prepared surface of a tooth adjacent to to an edentulous space, and a guiding surface is that part of the denture which contacts the guide plane. Close contact of these provides for frictional resistance when the denture moves. It is important to realise that this resistance is least along the path of insertion, and greatest if the denture is

removed along any other path, rather like a drawer in a desk. This is a much underestimated contributor to retention, and when the remaining teeth are sufficiently distributed can provide all the retention needed without the use of clasps.[27]

These three basic design principles govern the features that should be considered for all RPDs. There are, of course, other factors that contribute to the successful use of RPDs. These include minimal gingival coverage wherever possible, and the elimination of redundant components without compromising biomechanical requirements.[28,29]

THE BIOLOGICAL PRICE OF RPDS

For too long, the observation of increased tooth loss following the wearing of RPDs was attributed to the forces placed on the abutment teeth, as the teeth usually carrying the clasps. This wasn't helped by the theoretical studies of Kratochvil as far back as 1963 in which he surmised that a distal extension base produced a tipping force on the abutment tooth, and advocated an RPI clasp (mesial rest, proximal plate and I-bar) to offset this.[30] This was based on the difference between compression of the mucosa under the distal extension and the compression of the periodontal ligament of the abutment tooth. It seemed logical and was followed by purely laboratory studies using photoelastic resin to "prove" the effects that the RPI design was supposed to overcome.[31] These are mentioned here because some believe it to this day, but there have never been any clinical studies to show this is indeed the case and it was refuted, also many years ago. [32]

So, while it seemed logical that a partial denture gripping an abutment tooth would exert a tipping and torquing force on that tooth, this has never been shown clinically. What has been shown clinically is that abutment teeth are indeed more likely to be lost,[3] but the reasons are multifactorial, not least of which is the influence of plaque. This is the severest biological price because a prosthesis provides many more surfaces for plaque to accumulate on, and this changes the ecology of the mouth, resulting in gingival and periodontal disease, root caries and stomatitis, especially in dentures without tooth support.[34-38]

The common conclusion of all studies is that intensive and meticulous oral hygiene should be a prerequisite for the insertion of RPDs.

DO THEY REALLY WORK?

This seems at first a strange question to ask, when so many RPDs are made all over the world. But it must be asked, because many papers have reported fairly high levels of dissatisfaction expressed by patients,[39] with one retrospective study finding that 39% of the dentures were no longer used after 5 years.[40] The adage that all dentures are easy to wear but not all are easy to use certainly applies to RPDs. The conclusion above has implications not only for the need to change patient behaviour but also, and importantly, for the design of the denture so that it can actually be used – and used successfully.

ARE THEY REALLY NEEDED?

This is not a strange question because, as will be shown in Part 4, the first step in designing an RPD is to establish the need. Not all missing teeth need to be replaced. The most common requested needs are to improve aesthetics and chewing ability. Aesthetics is an obvious one, but improving chewing ability may be vital for a number of reasons. The link between chewing ability and food choices has been established through several national surveys of large numbers relating loss of all or some teeth to adverse food choices.[41] Such (wrong) food choices place patients at risk of increasing morbidity, and so it would seem logical that improving masticatory ability by replacing missing teeth would also remove those risks of morbidity. Unfortunately, this is not necessarily the case, and merely improving mastication by providing prostheses does not guarantee an improvement in food choices and therefore overall nutrition.[42] The answer, therefore, is not to make such assumptions, but to provide, whenever placing a prosthesis for a patient, nutrition analysis and counselling. Unfortunately, this appears to be as rare among practitioners as is the designing of RPDs.

A somewhat still controversial additional reason for improving chewing ability is the link between the ability to chew and cognition, and especially cognitive decline and dementia. Interest in this aspect has increased in the last two decades, with the use of such instruments as functional magnetic resonance imaging and electrical brain activity recordings. A large body of literature now exists on this and it is generally accepted there is indeed an association between loss of teeth and masticatory ability and dementia. The question is, is this just an aspect of dementia in that dementia is a part or maybe a cause of loss of teeth (among other things), or is it the loss of teeth and difficulty with chewing that causes cognitive decline and dementia? The case for the latter is increasingly being made,[43,44] which has the potential to make the replacement of teeth, especially in the elderly, a public health measure.

Flying somewhat in the face of these arguments is the concept of the Shortened Dental Arch. Once again there is a large body of literature on this concept, first proposed in 1981, that for a dentition with loss of posterior teeth, bilateral contact on the premolars was sufficient.[45] There have been many papers testing this and, recently, some reviews of the clinical studies and while the concept remains somewhat controversial, it is generally considered to be valid, with the *proviso* that methodological problems with the clinical studies made it difficult to advocate for all cases.[46,47] This is a fair conclusion for many aspects of prosthodontics and means that treatment must always be patient-centred. The main problem is that the lack of posterior teeth can affect food choices adversely, so perhaps a nutrition analysis should always be the first step.

There is no doubt that if a prosthesis can be omitted then it should be.

SUMMARY

It is essential that all dentists and dental technicians have a clear understanding of the evidence-informed principles of all aspects of RPD design, and especially of the biological price exacted by these dentures. Meticulous preparation of the mouth prior to treatment is required, so that dentures are placed in a plaque-free environment, and that the patient must be committed to thorough oral hygiene practice and regular recalls.

The next part will deal with the biomechanical basis of support.

REFERENCES

1. Owen CP. Fundamental of removable partial dentures. 5th Ed. Electronic book, available at https://www.appropriatech.com/ Accessed 5 September 2023
2. Basker RM, Davenport JC. A survey of partial denture design in general dental practice. J Oral Rehabil. 1978;5(3):215-22. doi: 10.1111/j.1365-2842.1978.tb01238.x
3. Schwarz WD, Barsby MJ. Design of partial dentures in dental practice. J Dent. 1978;6(2):166-70. doi: 10.1016/0300-5712(78)90213-0
4. Dullabh HD, Slabbert JC, Becker PJ. Partial denture prosthodontic procedures employed by practising graduates of the University of the Witwatersrand, Johannesburg. J Dent Assoc S Afr. 1993;48(3):129-34
5. Owall B, Junggreen L, Yemm R. Removable partial denture production in Scotland. Quintessence Int. 1996;27(12):809-15
6. Taylor TD, Matthews AC, Aquilino SA, Logan NS. Prosthodontic survey. Part I: Removable prosthodontic laboratory survey. J Prosthet Dent. 1984;52(4):598-601. doi: 10.1016/0022-3913(84)90355-x
7. Lynch CD, Allen PF. A survey of chrome-cobalt RPD design in Ireland. Int J Prosthodont. 2003;16(4):362-4
8. Lynch CD, Allen PF. Quality of written prescriptions and master impressions for fixed and removable prosthodontics: a comparative study. Br Dent J. 2005;198(1):17-20. doi: 10.1038/sj.bdj.4811947
9. Carneiro LC. Specifications provided by practitioners for fabrication of removable acrylic prostheses in Tanzania. J Oral Rehabil. 2006;33(9):660-5. doi: 10.1111/j.1365-2842.2005.01611.x
10. Radhi A, Lynch CD, Hannigan A. Quality of written communication and master impressions for fabrication of removable partial prostheses in the Kingdom of Bahrain. J Oral Rehabil. 2007;34(2):153-7. doi: 10.1111/j.1365-2842.2006.01685.x
11. Rice JA, Lynch CD, McAndrew R, Milward PJ. Tooth preparation for rest seats for cobalt-chromium removable partial dentures completed by general dental practitioners. J Oral Rehabil. 2011;38(1):72-8. doi: 10.1111/j.1365-2842.2010.02130.x
12. Sui L, Wu X, Wu S, Gao P, Li R. The quality of written instructions for dental prostheses in China. J Prosthodont. 2014;23(8):602-9. doi: 10.1111/jopr.12163
13. Cebeci NÖ. Factors associated with insufficient removable partial denture design instructions. Dent Med Probl. 2018;55(2):173-7. doi: 10.17219/dmp/89646
14. Nassani MZ, AlOtaibi MS. Quality of communicating design features for cobalt chromium removable partial dentures in Riyadh, Saudi Arabia. Eur Oral Res. 2020;54(3):123-9. doi: 10.26650/eor.20200117
15. Farao W, Geerts G. Conformity of removable partial denture designs to agreed principles based on materials used - A preliminary study. SADJ. 2020;75:253-9
16. Daya R, Owen CP. Conformity of removable partial denture designs from three laboratories to a set of design principles. SADJ 2022;77(8):459-64 doi: 10.17159/2519-0105/2022/v77no8a1
17. Zhang N, Mao B, Dai Y, Chen S, You Z, Zhang J, Chen X, Dong H, Yue L, Yu H. Audit to assess the quality of 916 prosthetic prescriptions of removable partial dentures. Hua Xi Kou Qiang Yi Xue Za Zhi. (West China Journal of Stomatology) 2023;41(3):315-22. English, Chinese. doi: 10.7518/hxkq.2023.2021565
18. Waliszewski MP. Turning points in removable partial denture philosophy. J Prosthodont. 2010;19(7):571-9. doi: 10.1111/j.1532-849X.2010.00622.x
19. Delabarre CF: Discours d'ouverture d'un cours de medicine dentaire. Paris, 1817, 390 pp. Not read in the original: cited by Waliszewski, 2009
20. Horie N, Ouchi T, Nishiyama R, Usuda S, Morikawa S, Asoda S, Nakagawa T. Vertical Displacement in Unilateral Extension Base Flexible Removable Dentures. Bull Tokyo Dent Coll. 2019;60(4):233-9. doi: 10.2209/tdcpublication.2018-0068
21. Fueki K, Ohkubo C, Yatabe M, Arakawa I, Arita M, Ino S, et al. Clinical application of removable partial dentures using thermoplastic resin-part I: definition and indication of non-metal clasp dentures. J Prosthodont Res. 2014;58(1):3-10. doi: 10.1016/j.jpor.2013.12.002
22. Koyama S, Sasaki K, Yokoyama M, Sasaki T, Hanawa S. Evaluation of factors affecting the continuing use and patient satisfaction with removable partial dentures over 5 years. J Prosthodont Res. 2010;54:97-101
23. Frank RP, Brudvik JS, Leroux B, Milgrom P, Hawkins N. Relationship between the standards of removable partial denture construction, clinical acceptability, and patient satisfaction. J Prosthet Dent. 2000;83:521-7
24. Becker CM, Kaiser DA, Goldfogel MH. Evolution of removable partial denture design. J Prosthodont. 1994;3(3):158-66. doi: 10.1111/j.1532-849x.1994.tb00147.x
25. Owen CP, Naidoo N. Guidelines for the choice of circumferential wrought wire and cast clasp arms for removable partial dentures. Int Dent J. 2022;72(1):58-66. doi: 10.1016/j.identj.2021.01.005
26. Bazirgan MK, Bates JF. Effect of clasp design on gingival health. J Oral Rehabil. 1987;14(3):271-81. doi: 10.1111/j.1365-2842.1987.tb00719.x
27. Mothopi-Peri M, Owen CP. Guide-Plane Retention in Designing Removable Partial Dentures. Int J Prosthodont. 2018;31(2):145-8. doi: 10.11607/ijp.5525
28. Runov J, Kroone H, Stoltze K, Maeda T, El Ghamrawy E, Brill N. Host response to two different designs of minor connector. J Oral Rehabil. 1980;7(2):147-53. doi: 10.1111/j.1365-2842.1980.tb00431.x
29. Chandler JA, Brudvik JS. Clinical evaluation of patients eight to nine years after placement of removable partial dentures. J Prosthet Dent. 1984;51(6):736-43. doi: 10.1016/0022-3913(84)90366-4
30. Kratochvil FJ. Influence of occlusal rest position and clasp design on movement of abutment teeth. J Prosthet Dent. 1963;13(1):114-124
31. Kratochvil FJ, Caputo AA. Photoelastic analysis of pressure on teeth and bone supporting removable partial dentures. J Prosthet Dent. 1974;32(1):52-61. doi: 10.1016/0022-3913(74)90098-5
32. Berg E. Periodontal problems associated with use of distal extension removable partial dentures - a matter of construction? J Oral Rehabil. 1985;12(5):369-79. doi: 10.1111/j.1365-2842.1985.tb01542.x
33. Tada S, Ikebe K, Matsuda K, Maeda Y. Multifactorial risk assessment for survival of abutments of removable partial dentures based on practice-based longitudinal study. J Dent. 2013;41(12):1175-80. doi: 10.1016/j.jdent.2013.07.018
34. Brill N, Tryde G, Stoltze K, El Ghamrawy EA. Ecologic changes in the oral cavity caused by removable partial dentures. J Prosthet Dent. 1977;38(2):138-48. doi: 10.1016/0022-3913(77)90278-5
35. do Amaral BA, Barreto AO, Gomes Seabra E, Roncalli AG, da Fonte Porto Carreiro A, de Almeida EO. A clinical follow-up study of the periodontal conditions of RPD abutment and non-abutment teeth. J Oral Rehabil. 2010;37(7):545-52. doi: 10.1111/j.1365-2842.2010.02069.x
36. Emami E, Taraf H, de Grandmont P, Gauthier G, de Koninck L, Lamarche C, de Souza RF. The association of denture stomatitis and partial removable dental prostheses: a systematic review. Int J Prosthodont. 2012;25(2):113-9
37. Hussain KA, Azzeghaibi SN, Tarakji BRSS, Sirajuddin S, Prabhu SS. Iatrogenic Damage to the Periodontium Caused by Removable Prosthodontic Treatment Procedures: An Overview. Open Dent J. 2015;9:187-9. doi: 10.2174/1874210601509010187
38. Moldovan O, Rudolph H, Luthardt RG. Biological complications of removable dental prostheses in the moderately reduced dentition: a systematic literature review. Clin Oral Investig. 2018;22(7):2439-61. doi: 10.1007/s00784-018-2522-y
39. Frank RP, Milgrom P, Leroux BG, Hawkins NR. Treatment outcomes with mandibular removable partial dentures: a population-based study of patient satisfaction. J Prosthet Dent. 1998;80(1):36-45. doi: 10.1016/s0022-3913(98)70089-7
40. Koyama S, Sasaki K, Yokoyama M, Sasaki T, Hanawa S. Evaluation of factors affecting the continuing use and patient satisfaction with Removable Partial Dentures over 5 years. J Prosthodont Res. 2010;54(2):97-101. doi: 10.1016/j.jpor.2009.11.007
41. Walls AW, Steele JG. The relationship between oral health and nutrition in older people. Mech Ageing Dev. 2004;125(12):853-7. doi: 10.1016/j.mad.2004.07.011
42. Wöstmann B, Michel K, Brinkert B, Melchheier-Weskott A, Rehmann P, Balkenhol M. Influence of denture improvement on the nutritional status and quality of life of geriatric patients. J Dent. 2008;36(10):816-21. doi: 10.1016/j.jdent.2008.05.017
43. Ahmed SE, Mohan J, Kalaignan P, Kandasamy S, Raju R, Champakesan B. Influence of Dental Prostheses on Cognitive Functioning in Elderly Population: A Systematic Review. J Pharm Bioallied Sci. 2021;13(Suppl 1):S788-S794. doi: 10.4103/jpbs.JPBS_773_20
44. Kim MS, Han DH. Does reduced chewing ability efficiency influence cognitive function? Results of a 10-year national cohort study. Medicine (Baltimore). 2022;101(25):e29270. doi: 10.1097/MD.0000000000029270
45. Käyser AF. Shortened dental arches and oral function. J Oral Rehabil. 1981;8(5):457-62. doi: 10.1111/j.1365-2842.1981.tb00519.x
46. Khan SB, Chikte UM, Omar R. An Overview of Systematic Reviews Related to Aspects of the Shortened Dental Arch and Its Variants in Adults. Int J Prosthodont. 2017;30(4):357-66. doi: 10.11607/ijp.5287
47. Funke N, Fankhauser N, Mckenna GJ, Srinivasan M. Impact of shortened dental arch therapy on nutritional status and treatment costs in older adults: A systematic review. J Dent. 2023;133:104483. doi: 10.1016/j.jdent.2023.104483

CPD questionnaire on page 422

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

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

1. NeoMTA versus conventional white mineral trioxide (MTA) aggregate in revascularisation of non-vital immature permanent anterior teeth (a randomised controlled trial)

Damage to newly erupted anterior permanent teeth whose roots are still developing can be disastrous for young children and the aesthetic consequences thereof can have lasting effects on the wellbeing of the growing child. Also, there is the risk of fracture, discoloration due to pulp necrosis and a loss of the anterior permanent tooth at a young age which is costly to repair/replace.

Several techniques have been used for the management of non-vital immature permanent teeth including calcium hydroxide apexification and apical plug technique. Although these techniques were successful in achieving apical closure and healing of the periapical pathosis, they do not contribute to any quantitative or qualitative increase in root dimensions since a hard tissue barrier formation only occurs apically without further root development[1].

Revascularisation is a regenerative endodontic procedure (REP) that stimulates the continuation of root development. It is considered a valuable treatment as it strengthens the root walls by stimulating the deposition of hard tissues and promoting the development of normal apical morphology[1]. Mineral trioxide aggregate (MTA) has been widely used in revascularisation procedures for coronal sealing because of its biocompatibility, good sealing properties and marginal adaptation. However, its poor handling characteristics and potential coronal discoloration effects are the major disadvantages of using white mineral trioxide aggregate (WMTA)[1].

The NeoMTA (NuSmile) is pure MTA that is marketed as a cost-effective MTA intended to be used for paediatric pulp therapy as it has a fast setting time, easy handling and its most important modification is its non-staining formulation. Tantalum oxide (Ta_2O_5) has been added to NeoMTA as a radiopacifying agent instead of bismuth oxide (Bi_2O_3) which has been linked mainly to the cause of discoloration in conventional MTA which is a significant aesthetic concern[1]. Tawfeek and colleagues from Egypt (2023)[1] reported on a trial that sought to evaluate clinically and radiographically the effect of using two types of coronal plug materials in the revascularisation of non-vital immature permanent anterior teeth with special reference to assessment and evaluation of discoloration potential over a period of one year.

MATERIALS AND METHODS

This was a parallel, double-blinded, randomised controlled trial with a 1:1 allocation ratio with two groups of 15 teeth which was the unit of interest.

A total of 30 non-vital immature permanent anterior teeth in 25 children were enrolled in this study with the following inclusion criteria: children were 8-15 years old; free from any systemic diseases; upper traumatised permanent anterior teeth with non-vital pulp and immature root apex; with pulp space not needed for post and core. Children with poor oral hygiene or those with teeth with root resorption, luxation injuries and root fracture, and severe discoloration/unacceptable colour difference between affected tooth and contralateral tooth were excluded.

Pre-operatively, personal, medical, dental, trauma history and clinical examination were attained based on the checklist of the European Society of Endodontology for revitalisation's pre-operative diagnostic procedures[1]. Conventional pre-operative periapical radiographs were also taken. Preparation for digital radiographic procedures and construction of a radiographic stent was done to perform an individualised Extension Cone Paralleling (XCP) index for each patient. A radio-opaque object of known dimension (5mm stainless steel wire) was embedded in the acrylic stent before setting.

The 30 permanent immature teeth were randomly assigned by a simple randomisation procedure into two equal groups: Experimental Group (N) – 15 teeth treated with NeoMTA (NuSmile Neo MTA) and Control Group (W) – 15 teeth treated with Conventional WMTA (White Angelus MTA) using shuffled closed white opaque envelopes picked by a patient at the second appointment just before placement of the coronal plug step.

The participants and legal guardians were blinded. Additionally, the radiographic assessor, one of the clinical assessors for the colour change to avoid detection bias, and the statistician were blinded to avoid reporting bias.
Treatment of the selected teeth was performed according to AAE [12] clinical considerations for a regenerative procedure and the same procedures were applied to all teeth in the study. The only difference was the coronal plug material used.

At the first appointment, each tooth was locally anaesthetised using topical anaesthesia gel benzocaine 20% followed by labial infiltration using Articaine HCL 4% with 1:100,000 epinephrine, then isolated with a rubber dam. A conventional access cavity was done, then the working length was determined radiographically. Passive pressure irrigation using 1.5% sodium hypochlorite (NaOCl) (20ml/canal, 5 min) with a side vent needle placed 1-2mm from the apex, then sterile physiological saline (5ml), followed by 17% Ethylenediaminetetraacetic acid (EDTA) (20ml/canal, 5 min). Canal dryness was performed using suitable size paper points then placement of intracanal medication (double antibiotic paste) prepared from equal amounts of

Ciprofloxacin 500mg and Metronidazole 500mg with a ratio of 1:1. The mix was delivered into the canal using a disposable plastic syringe having plastic tips adjusted to be 2mm shorter than the working length. The excess paste was removed, and the access cavity was sealed with dry cotton and 3-4mm of light-cured resin-modified glass ionomer (RMGI), then the patient was dismissed for 4 weeks.

After 4 weeks, the response to the initial treatment done at the first appointment was assessed. Complete resolution of signs and symptoms which include pain, swelling, sinus or fistula was considered success of the first appointment. Tooth colour baseline T_0 was recorded for the affected tooth at the beginning of the second appointment using VITA Easyshade V digital spectrophotometer – three measurements were recorded then the mean colour was calculated. Intraoral photographs were captured for documentation using fixed settings of the camera with no flash.

At the second appointment, each tooth was locally anesthetised using topical gel and labial infiltration using 3% mepivacaine without vasoconstrictor. The temporary dressing was removed after isolation by rubber dam then irrigation with 17% (EDTA) (20ml/canal, 5 min) followed by canal dryness. Bleeding was obtained by overinstrumenting and rotating a pre-curved K-file at 2mm past the canal to have the entire canal filled with blood. A tight cotton pellet slightly wetted with sterile saline was inserted and left for 10-15min to allow the formation of a clot, then cleaning of any blood remnants on the walls of the cavity was done using a bond brush. A resorbable collagen matrix Colla-plug™ was placed over the clot followed by placement of the coronal plug material according to the tooth allocated in which group – either NeoMTA (NuSmile Neo MTA) or conventional WMTA (White Angelus MTA) – forming about 3mm thickness just underneath the cementoenamel junction (CEJ). Excess material on the cavity wall was removed, then a conventional periapical radiograph was taken to double-check the proper position of the coronal plug in relation to CEJ. Once the material became firm within 10-15min, RMGI followed by composite filling (3M, Filtek, Z350) was placed. Immediate postoperative (baseline) digital radiograph was taken at the end of the second appointment with a digital X-ray machine using a standardised paralleling technique by the (XCP) alignment system with the radiographic stent and the large 3x4cm phosphor storage plates (PSPs) imaging plate (Soredex DIGORA®). The DIGORA Optime scanner scanned imaging plates.

All patients were planned to be recalled for clinical follow-up after 1 week, 1 month, 3 months, 6 months and 12 months while radiographic follow-up was planned to be at 6 months and 12 months but, due to the Covid-19 lockdown, a modified follow-up was done as all patients were not able to attend the 6 months recall visit. Consequently, the following measures were done to assure the patients and their parents. Through a phone call, parents were asked about pain and change in colour if present. Parents were taught how to examine visually the vestibule. Moreover, parents were requested to send an intra-oral photo if possible. All the data that were collected during this period were just to check on patients but were not used for statistical analysis. In the follow-up visit the treated teeth were evaluated for clinical parameters: Pain on biting: reported by asking the patient about the presence of pain while biting (yes/no); Pain on percussion: detected by tapping the tooth with the back of an autoclavable mirror; Presence of swelling, sinus or fistula: checked by visual examination and palpation of the labial vestibule and the palatal area related to every affected tooth. Mobility was examined using the back of 2 autoclavable mirrors. The unit of measuring these parameters was binary (present/absent). For discoloration, parents reported discoloration (presence/absence of change in tooth colour) or there was visual assessment of discoloration by two assessors reported as the presence/absence of tooth colour change.

There was also a more objective quantitative assessment of colour change. The spectrophotometer measured the colour of teeth based on the Commission Internationale de l'Eclairage's CIELAB colour space system. The L* a* b* system allows colour specification within a three-dimensional space where the L* axis represents the degree of lightness within a tooth and ranges from 0 (black) to 100 (white); the a* plane represents the degree of green-red within a tooth, a* values range from red (+80a*) to green (-80a*); and the b* plane represents the degree of blue-yellow within the tooth and b* values range from yellow (+80b*) to blue (-80b*). Three measurements were recorded for each follow-up then the mean colour was calculated. The change in tooth colour was calculated by monitoring changes in ΔL, Δ a, Δ b by subtracting the baseline measurements from the follow-up measurements. Delta E (ΔE) is the total colour difference or the distance between two colours, (ΔE) was calculated. The proposed limit for colour difference adopted in this study was set at 3.7 Δ E units (perceptibility threshold) which means how much colour change is considered perceptible; differences beyond this limit were considered clinically perceptible.

Radiographic parameters assessed were presence of external or internal root resorption; assessment of periapical area – presence or absence of radiographic signs of infection; and root lengthening, which was measured on the Digora software.

RESULTS

During the follow-up period, four cases (26.7%) dropped out from each group and were excluded from the data analysis. Twenty children with 22 teeth completed the 12-month study period.

For clinical outcomes, all teeth showed normal clinical findings – there was a complete absence of signs and symptoms such as pain on biting, pain on percussion, swelling, sinus/fistula and mobility in both groups during all follow-ups so both groups were (100%) clinically successful with no statistically significant difference between groups.
In terms of discoloration, none of the parents reported discoloration at the 1-week follow-up, at 1 month only one parent in Group (N) reported the presence of discoloration in one tooth (9.1%) and two parents in Group (W) reported discoloration in 2 teeth (18.2%), at 3 and 12 months follow-up only one parent in Group (N) reported discoloration in one tooth (9.1%) and three parents in Group (W) reported discoloration in 3 teeth (27.3%) and the difference between groups was not statistically significant (p-value = 0.269).
The discoloration was also assessed visually by two clinicians. At 1 week no discoloration was detected in Group (N), while one tooth (9.1%) showed discoloration in Group (W). At 1 month, discoloration was detected in one

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tooth (9.1%) in Group (N) and three teeth (27.3%) in Group (W). At 3, 12-months follow-ups discoloration was detected in a single case (9.1%) in Group (N) and three cases (27.3%) in Group (W), and the difference between groups was not statistically significant (*p*-value = 0.269).

The change in colour between baseline and 12 months was quantified for each tooth by measuring the CIE L*a*b* values and calculation of ΔE. At the end of 12 months, it was found that the mean ΔL value of Group (W) was more than Group (N), in a direction indicating decreased luminosity with no significant difference between groups. The mean Δa value at the end of 12 months showed that Group (N) remained in the red values direction, while Group (W) showed a reduction in redness, thus an increasing change towards the green direction. The alterations observed in the WMTA group were significantly greater compared with the other group. The mean Δb value of Group (W) was more than Group (N), in a direction indicating a reduction of yellow colour, thus an increasing change towards the blue direction with no significant difference between groups. The mean and standard deviation values for initial root length in mm were 11.694 (±1.644)mm for Group (N) and 12.654 (±1.449)mm in Group (W). There was no significant difference in mean initial root length in both groups (*p*-value = 0.162).

Continued root lengthening was observed in this study, the mean increase in root length in mm and percentage between 12 months follow-up and pre-operative root length in Group (N) was 1.03 (±0.97)mm, 8.52 (±3.33)% and in Group (W) was 1.04 (±0.86)mm, 8.64 (±4.30)% with no significant difference between both groups.
Regarding the radiographic evaluation, all teeth in both Groups (N) and (W) were free of internal and external root resorption. Also, there was a complete absence of any radiographic signs of infection, accordingly the overall clinical and radiographic success rate was 100% for both Groups (N) and (W).

CONCLUSION

The researchers found that both NeoMTA and conventional WMTA were successful coronal plug materials in the revascularisation of non-vital immature permanent teeth, achieving a high level of clinical and radiographic success. For the primary outcome of discoloration, there was no statistically significant difference between both materials.

IMPLICATIONS FOR PRACTICE

The newer material NeoMTA marketed as an alternative with lesser potential for discoloration did not statistically outperform the conventional MTA material for the primary outcome of discoloration.

REFERENCE

1. Tawfeek HA, El-Bardissy AA, Abou El-Yazeed M, Youssef R, Abd Alsamad AM. Clinical and radiographic evaluation of Noemata versus conventional white mineral trioxide aggregate in revascularization of non-vital immature permanent anterior teeth (A randomized controlled trial). BDJ open. 2023 Apr 28;9(1):17.

2. Is iodine effective for decontamination of dental unit waterlines?

One of the more commonly neglected areas of infection control in the dental sugery is related to dental unit waterlines (DUWLs). Dental unit waterlines serve as pipelines to deliver fresh water for cooling and irrigating during dental procedures. Waterlines are made of silicone rubber or polymer tubes. This pipeline is always filled with water, creating an environment suitable for biofilm formation. Once formed in the waterlines, biofilms are extremely difficult to eliminate[1]. According to American Dental Association (ADA) standard, the prevalence of bacterial contamination of DUWLs was estimated to be as high as 85.0%, while the prevalence of pathogenic species such as *Legionella pneumophila* and *Pseudomonas aeruginosa* is 12.0% and 8.0%, respectively[1].

Various microorganisms, including bacteria, fungi, viruses and protozoa contaminate DUWLs. The most common form of microorganisms found in DUWL is gram-negative bacteria, some of which are opportunistic pathogens. These pathogens harm not only vulnerable groups of patients, such as the immunocompromised and the elderly, but also the dental staff in the clinic[1]. The Centre for Disease Control and Prevention (CDC) recommends that procedural water for nonsurgical dental procedures contain less than 500 CFU/ml of heterotrophic water bacteria[1].

There are many methods to reduce the contamination of DUWLs, including non-chemical and chemical approaches. Treatment by chemical agents can be performed as intermittent or continuous methods. Several products have been introduced for continuous chemical treatment methods, such as chlorine dioxide, hydrogen peroxide, chlorhexidine gluconate and iodine[1]. Iodine is a potent oxidising agent that can kill microorganisms such as bacteria by attaching to microbial plasma membranes and inhibiting protein function. The principal mechanism of oxidising agents in killing microorganisms is to disrupt cellular functions and reduce viability[1]. Iodine has been used for many purposes, such as wound antiseptic, water disinfection and preventing goitre by adding it to drinking water. There are many forms of iodine, including organic iodide compounds such as bis-glycinate hydroiodide, potassium tetraglycine triiodide, iodophors (iodine with solubilising compounds) and other iodine release systems such as iodine-incorporated resins. The DentaPure Independent Water Bottle Cartridge, a commercially available continuous iodine treatment system, releases a low dose of iodine to decontaminate DUWLs. Despite being widely used worldwide, the effectiveness of this device in real clinical settings has not been reported elsewhere. Petchphayaprai and colleagues from Thailand (2023)[1] reported on an in-vitro study that sought to investigate the efficacy of iodine-releasing cartridges in controlling bacterial contamination and biofilms in DUWLs from 10 similar dental chair units at a dental school.

MATERIALS AND METHODS

Ten similar dental chair units of the same model and use life at the faculty of Dentistry Chulalongkorn University, Thailand were randomly selected. The units were divided into two groups: five units of the control group with no intervention added to the waterlines and five units of iodine treated group in which the waterlines were continuously disinfected by installing iodine-releasing cartridge systems (DentaPure). The system contained non-allergenic iodinated resin beads, which released 2-6ppm of atomic isotopes of elemental iodine (I_2) during a typical dental treatment. During the experimental period, the dental chair units normally operated at official working hours, 5 days a week.

Sample collection was performed every Wednesday, in the middle of the week, to avoid the variability in the data from stagnant water during the holiday. Some 25ml of water

samples were collected from the airotor lines of each dental unit after flushing the pipe for 1 minute. As baseline water contamination, the samples were collected 1 month before installing iodine water treatment cartridge systems. Then the samples were collected every Wednesday continuously for nine weeks.

The water samples were sonicated for 10s to disperse the cluster of microorganisms. Serial tenfold dilution was performed, and 100µl of the samples were plated onto R2A agar plates. All plates were incubated at 35°C for 3-5 days, then bacterial colonies were counted. The numbers of colonies were converted into colonies forming units per ml (CFU/ml). The number of bacteria in each dental chair unit at each time point was compared to the initial amount at baseline, calculating the percent CFU reduction from the baseline data. The log CFU reduction was calculated by taking log[*A*/*B*] (*A* = the average amount of bacteria each week, *B* = the number of bacteria at baseline).

At the end of the experiment (at week 9), the DUWLs in the path that delivers water to the airotor line inside the control box of dental chair units were sectioned into 5mm lengths and kept in 0.9% sterile normal saline solution. The procedure was repeated at the same position in every dental chair unit of the control and iodine group. The lines were split in half. The biofilms were swabbed completely from a 5mm length of duct to remove all biofilms and the amount of adenosine triphosphate (ATP) measured by ATP testing kits (3M™ Clean-Trace). These kits can detect the presence of microbial contamination in DUWLs. The amount of ATP in relative light units (RLU) represents the relative bacterial vital activities.

After installing the iodine treatment cartridge for 11 months, the iodine concentration in water samples was determined by an iodide electrode and benchtop pH meter (Orion Star™). The electrode measures iodide ions represented by water electric potential in mV. Then it converts electric potential to iodine concentration by comparing it to the standard iodine solution at 1, 2, 2.5 and 5ppm. The water samples were collected again to measure bacterial contamination that represented the long-term effectiveness of the iodine cartridge.

RESULTS

Dental unit waterlines (DUWLs) of 10 dental chair units were highly contaminated with bacteria, with an average of 41,500 ± 21,016 and 61,500 ± 61,005CFUs/ml) in the control and iodine groups, respectively. During the experimental period, the highest average CFUs/ml of all DCUs in the control group was 32,750 ± 3,594 CFUs/ml (at week 5) compared to 1,452 ± 854 CFUs/ml in the iodine group (at week 7). The bacterial count in the iodine group was lower than 500 CFU/ml in almost all weeks, except weeks 6 and 7, which meet the standard of water contamination recommended by the US CDC for nonsurgical dental procedures. There were statistically significant differences in the bacterial count from DUWLs of the iodine and control groups. The percent CFU reduction in the iodine group ranges from 98% to 100%.

The number of bacteria drastically decreased from the first week of continuous iodine treatment. The average CFUs/ml of bacteria recovered from the airotor lines of the iodine group is 354 ± 541 CFUs/ml, significantly lower than the control group (18,591 ± 9,208 CFU/ml). The average CFU/ml was transferred into log reduction to compare the decontamination efficacy to the sterility assurance level at 6 log reduction. The effectiveness of the iodine treatment was determined in a log reduction ranging from 1.63 to 4.39 log, except in the fourth week when the log reduction could not be calculated because no bacteria was recovered from the sample.

At week 9, the viability of biofilms in DUWLs was assessed by the amount of ATP. Biofilms in the iodine group had slightly lower ATP than the control group, though not statistically significant.

After 11 months of installation, the iodine concentration was measured to determine the potency of the cartridge. The average iodine concentration released in DUWLs procedural water was measured to be 3.6ppm. This amount of iodine was still able to control bacterial contamination in the DUWLs, as demonstrated by the average bacterial CFU/ml (3,125 ± 2,499 CFU/ml) in the iodine group, which was significantly lower than the control group (59,250 ± 26,538 CFU/ml).

CONCLUSION

The researchers found that continuously supplying iodine in DUWLs effectively controls microbial contamination.

IMPLICATIONS FOR PRACTICE

DUWL decontamination is an often-overlooked procedure that can be a potential source of infection for both patients and dental staff, hence DUWL decontamination is an important part of the daily infection control routine at any dental surgery.

REFERENCE

1. Petchphayaprai C, Chotipan C, Sa-Ngiampak P, Thotsaporn K, Ampornaramveth RS. Effectiveness of iodine for continuous decontamination of dental unit waterline. BDJ open. 2023 Jul 22;9(1):34.

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Inaccessible specialised oral health services in South Africa – rationing policy uncertainty

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ABSTRACT

Background

Rationing by waiting lists is associated with patient costs such as pain, anxiety and poor health outcomes. Rationing is indicative of a mismatch between the demands and resources to service patients' needs. Long waiting times for specialised oral health services are concerning and unjustifiable. The majority of oral health care services are devoid of an explicit policy and mechanism to address this problem. This paper attempts to provide the ethical basis for waiting times. That is, whether the mechanisms used in the allocation of services (or placing patients on waiting lists) is consistent with ethical principles.

Methodology

The focus of the discussion will be on the theories of justice, which better explicate fairness, especially in the rationing of scarce resources. Among the dominant theories discussed are utilitarianism, egalitarianism and maximin.

Conclusion

Waiting times for specialised oral health services can be long, arduous and indefinite. This form of rationing can be viewed as unjust given the lack of transparent and objective policies and guidelines. The oral health services must develop and implement appropriate rationing regimes to strengthen equitable access to services and allocation of scarce resources.

CONTEXTUALISING WAITING TIMES FOR SPECIALISED ORAL HEALTH SERVICES

Waiting times – epitome of the failed two-tiered health system

Rationing can be defined as denying a potentially beneficial treatment to a patient on the grounds of scarcity.[1] Rationing of oral health services includes restrictions in the allocation of treatment options and procedures, especially specialised dental services. Rationing means that restrictions may be imposed on the type of services provided, and when and how often patients would be eligible for care.[2] Consequently, patients may not receive the care at point of service; treatment may be postponed or delayed, sometimes indefinitely. The failure to provide critical care impacts clinical outcomes and the quality of life. Long waiting times for dental care indicates the failure of a health system to meet the demands and needs of patients. Long waits, postponement of critical treatment or deferment of services are symptoms of an oral health service that is incapacitated or overburdened or dysfunctional.

Extended waiting times are particularly prevalent in a two-tiered system, which invariably perpetuates health inequality and poor access to care.[3] First, the private health sector services a small minority of patients requiring specialised oral health services. For example, and depending on the medical aid cover, patients may not have adequate benefits for orthodontics, prosthodontics or even endodontic treatment. The resultant "dumping" occurs when desperate patients are forced to seek dental care in the public sector, as their dental cover runs out.[4] This situation culminates in an overburdened public sector, which further compromises the delivery of services in this sector. The private sector is also prone to overservicing of a few insured individuals. This practice is inefficient, wasteful and perpetuates inequity in oral health.[5]

Second, the public sector tends to experience overcrowding and long waiting times as it grapples with servicing the uninsured majority (85%).[6] With limited resources, decaying infrastructure and poor maintenance, this sector is unable to always provide the required services for all patients, at all times. Additionally, public oral health care in South Africa does not enjoy special dispensation regarding funding and resourcing. Over the years, public funding of this sector has been gradually attenuated. This underresourcing was aggravated by incorporating and amalgamating oral health into other services and programmes. For example, oral health is funded under specialised services and classified under the noncommunicable diseases cluster. This repositioning has resulted in critical funding not being ring-fenced for oral health. This has led to underresourcing and a plethora of adverse outcomes for the sector. Under these circumstances, it is inconceivable how the oral health services will manage the ever-increasing specialised oral health needs. Currently, the oral health services are inundated with the management of pain and sepsis. It is thus incumbent on services to develop innovative policies

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3. Prof Pusetso D Moipolai – 35%

and interventions to tackle waiting lists and improve access to critical care. Unless such policies are adopted, millions of patients will continue to wait for oral health services in perpetuity.

Waiting times – dental schools as the last resort

In the context of South Africa, specialised oral health services include procedures ordinarily offered by dental practitioners. For example, basic prosthodontic procedures, minor oral surgery, endodontic treatment and, in some desperate circumstances, basic dental services such as direct restorations are scheduled. For most patients seeking specialised oral health services in South Africa, the dental schools are absolutely the last resort. These institutions are publicly funded and largely use the services of postgraduate clinical candidates to provide essential oral health services as part of their training. Unlike medical schools, dental schools are resource intensive and require dedicated funding to perform optimally. Unfortunately, dental schools remain severely underresourced to provide costly specialised services. A typical dental school employs not more than 100 clinicians to manage an average of 3,000 patients every month. The huge demand for specialised oral health services, additional academic responsibilities of the clinicians, dysfunctional public oral health system and unaffordable private health care are some of the challenges facing the oral health service. This quadruple burden on the staff and services implies that patients will be placed on a waiting list (sometimes indefinitely) or will wait for extended periods of time before receiving the appropriate treatment. For the purpose of this paper, waiting times and waiting lists are used interchangeably.

Aims and objectives

Despite the widespread use of waiting times in the allocation of oral health services, little has been published about the moral justification of these scarce resources. Limited discussions about waiting time focus on problems of application, such as the association of waiting times with social privilege. Focusing only on the application of waiting times misses critical normative questions about the justification of rationing schemes. Consequently, no moral guidance can be incorporated into future allocations using waiting times. The objective of this paper is to explore the ethics of waiting times in oral health services. That is: (i) which moral framework has been adopted in rationing oral health services, if any? ii) whether waiting times or waiting lists policies are adequately designed to usher just and fair rationing of limited resources.

JUSTICE – THE BASIS OF RATIONING POLICY CHOICES

The argument for rationing policy is based on the following premises: (i) health resources are not infinite, and the health needs are ever-increasing (ii) rationing of health care resources is inevitable and necessary, more so in resource-deprived settings; (iii) a just rationing policy is a critical element of a just health system; (iv) equitable health services ought to develop and implement just and explicit rationing policy.

The constitution provides a legal and moral framework for health services to develop and implement explicit and just rationing policy. In practice, however, health services allocate scarce resources based on unclear, unwritten and implicit rationing regimes. Consequently, the services are unable to express (i) clearly and consistently who shall and who shall not receive care; (ii) when, how and what criteria are applied when rationing limited resources. Unclear rationing policies undermine the right to health and compromises the delivery of equitable and accessible health for all.

We premise our moral claim for just rationing regime on (i) Daniels[7] argument for a strong right to health care and (ii) Rawls[8] justice principle of "fair equality of opportunity". These philosophers purport that the denial of health services increases propensity of disease and disability, and invariably diminish people's "normal species functioning"[9] and results in a restriction of the range of opportunities open to them. Waiting times or long waiting lists are tantamount to the denial of health services, which limits the individual's opportunities. Unless the processes and procedures regarding the waiting lists are fair, then the allocation of services cannot be deemed to be just.

Several rationing regimens have demonstrated potential to improve access and allocation of limited health resources: (i) first come first served basis[10]; (ii) treatment of the worst-off patients[11]; (iii) prioritisation of those who are able to benefit the most from the intervention[12] (*ceteris paribus*). While some of these regimens have been implemented in health services, their moral underpinnings remain indeterminate. Below are theories of justice that explain the rationing of scarce health resources.

MORAL THEORIES AND WAITING TIMES

a. Utilitarianism

Utilitarianism is a consequentialist approach, rooted in the belief that moral rightness is dependent on the consequences of the act or rule and nothing else. This philosophical view emphasises the maximisation of benefits or outcomes. According to Bentham and Mill, an act or rule is morally right if and only if it results in "the greatest happiness for the greatest number".[13,14] Classical utilitarianism is complex, as it seeks to be explicit about the nature and the maximisation of the value of consequence or utility. To fully comprehend the utility of actions, programmes or policies, the nature of the consequence must be clearly defined. Additionally, the utility of the action or programme must be objectively measured. Failure to define and quantify the utility of the policy could invalidate the evaluation of the policy.[15]

According to utilitarianism, access to care, priority setting,or reduction in waiting times should be based primarily on the actual or anticipated change in health outcomes of the affected patients. Accordingly, (i) the young would be prioritised ahead of the old; (ii) those with the least cost per gain would be chosen; and (iii) those most likely to benefit are selected for care. In so doing the outcomes will result in the maximised benefits and huge returns on the investments (health services provided). The first on the waiting list will be those most likely to increase the utility of the health service and nothing else.

b. Egalitarianism

The egalitarian theories of justice deal with the question "what should be equal or be distributed equally?" In a resource constrained environment, it is not feasible to distribute everything equally, more so in health care. Hence the question, what specific aspects of health care service should be equal or equalised? Should it be (i) equality of health or in health? That is health outcomes or quality of

life; (ii) contribution towards health (including services); and (iii) equality in the use of health services (access). Applying the egalitarian principle of justice to equality of health would mean that (i) all individuals must enjoy the same levels of health; and (ii) the only consideration should be the need. Therefore, the health system should prioritise those with poor health to "restore" to equal health. This state of health can only be achieved by shifting resources away from and to the detriment of those with better health. This concept of "fair earnings" suggests that people above a certain defined health threshold are luckily living on "borrowed health" and have surpassed or extended their health benefits.[16,17] Similarly, the persons below this threshold are being denied the opportunity to realise equal or comparable health positions. An egalitarian approach to rationing may not be the most efficient or effective way of achieving the overall goal of health care, which is to improve the health and wellbeing of the population. The application of this moral theory could have unintended consequences for the following reasons: First, the health outcomes of healthier patients could deteriorate due to limited care for this group. Second, the health benefits of interventions might not be fully realised in patients with the worst health status. Ultimately, this system might result in a lose-lose situation. This egalitarian approach has two serious limitations: (i) it is oblivious to antecedent factors and their impact on future health status; (ii) the assumption that healthcare services can completely address, resolve, reverse and equalise the existing differences in health conditions is flawed. Regarding the contribution towards health care, the egalitarians advocate for proportional contribution commensurate with income and the ability to pay. This approach is reflected in modern health system policies such as the National Health Insurance (NHI). Ultimately, the egalitarian view of just health care supports equal access to care and the use of services. Therefore, the costs of care should be reduced or be free for low-income groups.

Regarding waiting times, this framework implies the following:

- equalising access to the same treatment for the same illness;
- similar waiting times irrespective of the type of treatment, and reasons for the intervention; and
- prioritising those with greatest needs to achieve equality of health outcomes.

This framework is not explicit when the costs of treatment and treatment outcomes are comparable between two candidates. Should priority be given to the individual likely to benefit the most from the treatment, the worst-off or on first come first served? Similarly, this moral theory cannot fully explain how justice can be assured when two different patients (demographics, clinical attributes) require similar treatment.

c. Maximin principle (principle of good)

This principle is aimed at maximising liberties or opportunities and minimising inequality or disadvantage.[18] This distributive justice principle is premised on the assumption that all rational beings will develop the best solution for any situation provided they: (i) operate behind the veil of ignorance and (ii) their starting point is in the original position. Applied to health care, this theory indicates that priority should be given to maximise outcomes, especially among the worst off. Therefore, the indigent, with the worst economic and social opportunities, need to be prioritised and given more access to care. Furthermore, those who are likely to suffer the worst health outcomes if left untreated should be attended to urgently or promptly. This is tantamount to minimising disadvantage among those with "bad" health outcomes. Simultaneously, those with fair to moderate health are deprioritised. Therefore, one's health must be the worst among the cohort to receive treatment. Those "having bad luck" should not receive further misfortune by not receiving health care. This theoretical stance does not support health promotion and prevention initiatives. In terms of access to care (reduction of waiting times), those likely to have the worst complications should be treated first.

COMPARISON OF MORAL THEORIES

Table 1 illustrates the favoured health outcomes of 24 hypothetical patients under three different moral theories. Group A represents the ideal rationing position, and a fictitious scenario in which resources are allocated equally based on all the theories. This situation does not exist in real life, as health care services are fraught with scarcity of resources. For utilitarianism (Group B), efficacy or net benefit is the goal for rationing at the expense of distributive fairness, equity or capacity to benefit. Therefore, patients who are prioritised for specialised oral health services under this moral theory must have reasonable to good oral health, which is likely to result in greater utility. Patients in this group have comparatively better oral health and may require minimal interaction with the health system. These patients are few and far in between in South Africa, which is inundated with a huge burden of oral diseases. There is a disproportionate prevalence of oral conditions such as dental caries, periodontal diseases and trauma among the uninsured indigent majority.

Egalitarianism (Group C) should ensure the most equal and fair distribution of benefits and costs at the expense of total health. Irrespective of moderating factors, such as income, education etc, patients will enjoy the same level of dental care for the same conditions or needs. Egalitarianism can be viewed as a means of respecting the equal moral worth and dignity of every human being, and avoiding discrimination or unfairness based on factors that are beyond the individual's control. Group D maximises the outcomes for the worst off and neglects equity and efficacy.

Table 1. Allocation scenarios based on the three moral theories

Groups	Group A	Group B	Group C	Group D
Healthy	8	11	7	5
Moderate	8	8	8	7
Ill (worst off)	8	5	9	12
Rationing criteria		Utility/efficiency	Equality (access/need)	Severity
	Ideal Scenario	Utilitarianism	Egalitarianism	Max – Min Principle

Adapted from ethics and waiting times (Mattisson 2017)

The severity of the health condition is the only measure to be considered. Patients with the worst oral health status will receive priority and not be placed on waiting lists whenever possible. All the rationing scenarios that moral theories seek to address exist simultaneously and in varying degrees in the public oral health system.[19] Hence the observed hesitancy or unwillingness to develop and implement a singular or combination of these rationing strategies.

DISCUSSION

Waiting time is widely used in health to make resource allocation decisions, yet no general account of the moral significance of waiting time exists. We premise this discussion on the claim that oral services in South Africa do not have a clear and transparent rationing policy. Notwithstanding the legal and constitutional provisions, there ought to be – at the health facility level – some form of a detailed plan to implement the letter of the law regarding the delivery of health care. According to the South African constitution, no patient can be refused care in the public service because of (i) their inability to pay; (ii) their oral health status; (iii) the type of service they need, specifically dental emergencies. However, waiting lists and deferment of oral health care is inevitable in resource-scarce health systems. Subjectively, the essence of the right to health is that it is absolute. Objectively, not as a matter of theory but as a matter of fact, no right, including health, can be absolute. Hence, what a health service can grant or allow is never absolute. However, oral health services should find a way to allocate scarce resources to meet the desired outcomes of the patient.

We argue that, in practice, patients are placed on waiting lists because there is a lack of a clear rationing policy. Clinicians and administrators use their own prerogative in assigning patients spots and places on the waiting lists, a practice that is ill-informed, unethical, unlawful and unjustifiable. Rationing by clinicians is largely informed by the "medical condition" rationale and, in many cases, nothing else. Therefore, other compelling factors outside the medical reasoning are ignored and not explicitly embedded into the rationing formulary. In most circumstances, patients will receive care if and when health officials deem it necessary. Public oral health services generally adhere to public priority-setting guidelines as a rationing tool and reject the market-based utility-maximisation and efficiency paradigm. In other words, publicly funded services have a prima facie preference for egalitarianism and maximin principles than the utilitarian framework. That is, the public service will not consider how removing a patient from a waiting list would then maximise quality-adjusted life-year (QALYs).[20,21] This economic measure represents the utilitarian paradigm,

which does not support the notion that all citizens contribute to the fiscus and cannot be subjected to market principles. Alternatively, non-utilitarian assumptions such as societal preference should be incorporated into the economic theory for rationing in the public health service to improve its acceptability. We contend that waiting times are not intrinsically morally significant, but how they are used across a range of clinical scenarios is. First, oral health services have a duty of fairness in servicing waiting lists where a sufficiently just queue exists. Second, where patients are in relevantly similar circumstances, the use of waiting times to allocate services is efficient and maximises distribution equality.

Beyond the scope of this paper, further questions relating to rationing should be explored to get a fuller grasp of the intricacies of waiting lists: (i) How can the value of health be measured and objectively quantified? (ii) What does it mean that a treatment is "good value for money"? (iii) What value is derived from indefinite deferment of health services? (iv) What distributive principles – utilitarian, egalitarian or prioritarian – should be relied on in rationing specialised oral health services?

CONCLUSION

The policies and guidelines used to ration specialised oral health care services in South Africa lack transparency and are not underpinned by explicit moral theory. Consequently, eligible and deserving patients might not receive appropriate care at the appropriate time. It is incumbent of oral health services to develop and implement just and explicit policies to allocate scarce resources.

REFERENCES

1. Moosa MR, Luyckx VA. The realities of rationing in health care. Nature Reviews Nephrology.2021; 17(7): 435-6
2. Tauber AI. Medicine, public health, and the ethics of rationing. Perspectives in Biology and Medicine.2002; 45(1):16-30. https://doi.org/10.1353/pbm.2002.0018
3. Human A. A Comparison of Health Care Systems: South Africa vs. Canada. UBC Medical Journal.2010; 2(1): 33
4. Rice MF, Jones W Jr. The uninsured and patient dumping: recent policy responses in indigent care. J Natl Med Assoc. 1991;83(10):874-80
5. McQuoid-Mason DJ. 'Over-servicing', 'underservicing' and 'abandonment': What is the law? South African Medical Journal.2015; 105(3):181-182
6. Moosa S, Carmichael T, Luiz J, Peersman W et al. Insights of private general practitioners in group practice on the introduction of National Health Insurance in South Africa. African Journal of Primary Health Care and Family Medicine.2016; 8(1): 1-6
7. Daniels, Norman. "Rights to health care and distributive justice: programmatic worries." Health Rights. 2017: 23-40
8. Alexander LA. Fair equality of opportunity: John Rawls'(best) forgotten principle. Philosophy Research Archives.1985; 11:197-208
9. Lanoix M. From normal species functioning to capabilities, is it enough? The American Journal of Bioethics. 2013; 13(8): 20-1. https://doi.org/10.1080/15265161.2013.804337
10. John TM, Millum J. First come, first served? Ethics.2020; 130(2):179-207
11. Veatch RM. Healthcare rationing through global budgeting: the ethical choices. The Journal of Clinical Ethics.1994; 5(4):291-6
12. Persad G, Wertheimer A, Emanuel EJ. (2009). Principles for allocation of scarce medical interventions. The Lancet.2009;373(9661):423-31. https://doi.org/10.1016/S0140-6736(09)60137-9
13. Bentham J. (1830). The greatest happiness of the greatest number. Bentham's political thought.1830: 309-310
14. Veenhoven R. Greater happiness for a greater number: Is that possible? If so, how. Designing Positive Psychology. 2011: 396-409
15. Mill JS. Utilitarianism. In Seven Masterpieces of Philosophy.2016: 329-375
16. Farrant A. The fair innings argument and increasing life spans. Journal of Medical Ethics.2009; 35(1):53-56. http://dx.doi.org/10.1136/jme.2007.023762
17. Bognar G. Fair innings. Bioethics.2015; 29(4):251-261. https://doi.org/10.1111/bioe.12101
18. Harsanyi JC. Can the maximin principle serve as a basis for morality? A critique of John Rawls's theory. American Political Science Review. 1975;69(2):594-606. https://doi.org/10.2307/1959090
19. Savulescu J, Cameron J, Wilkinson D. Equality or utility? Ethics and law of rationing ventilators. British Journal of Anaesthesia.2020;125(1):10-5. https://doi.org/10.1016/j.bja.2020.04.011
20. Ashcroft RE. Quality of life as the basis of health care resource allocation: a philosopher's perspective on QALYs. AMA Journal of Ethics.2005; 7(2):195-9
21. Wong DA. Rationing treatments based on their cost per QALY. AMA Journal of Ethics.2011;13(3):220-3

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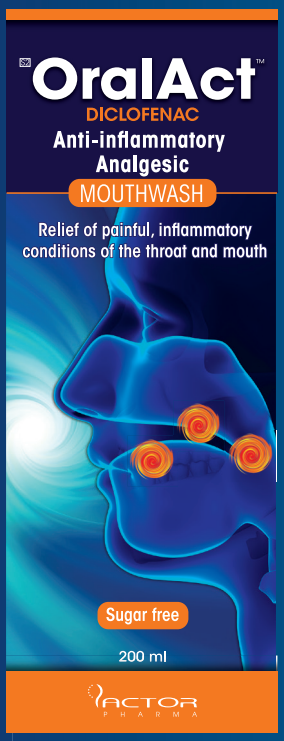

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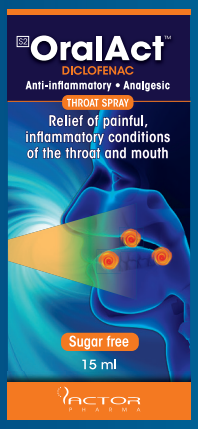

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MAXILLOFACIAL RADIOLOGY

Ectodermal dysplasia

SADJ September 2023, Vol. 78 No.8 p420-421

L Merbold[1], Chané Smit[2]

CASE

A 9-year-old female patient presented to the clinic with a main complaint of abnormally shaped and missing teeth. Upon clinical examination, the patient had a repaired cleft lip and palate and sparse hair of her eyebrows. Intraoral and radiological examination revealed generalised enamel hypoplasia, multiple conical-shaped teeth and multiple congenitally absent teeth.

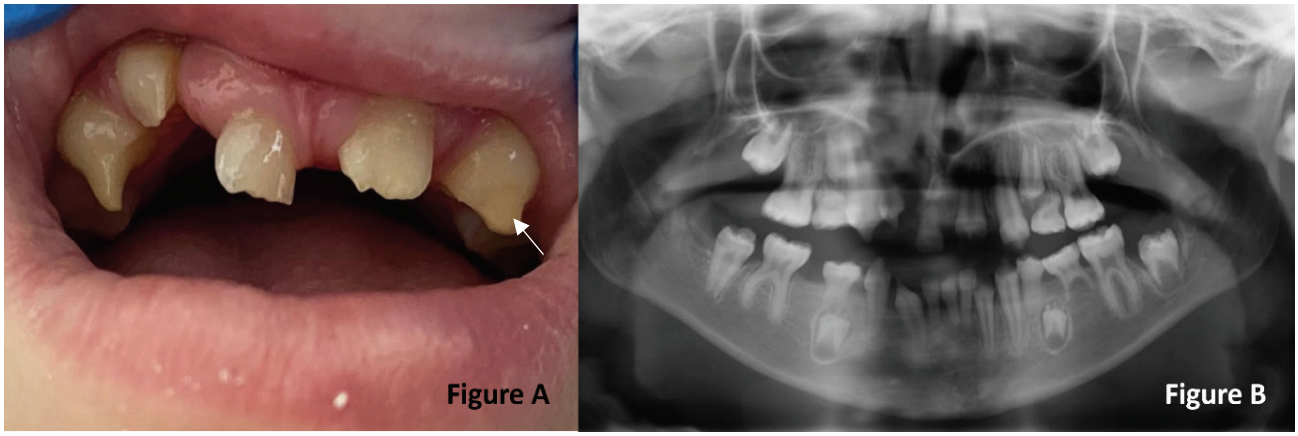

Figure A: Clinical image showing the enamel hypoplasia (white arrow). Figure B: Panoramic radiograph showing congenitally missing teeth, enamel hypoplasia and conically shaped teeth.

INTERPRETATION

Ectodermal dysplasia (ED) characterises a group of disorders where two or more structures derived from the ectoderm exhibit developmental disturbances.[1] These include teeth, skin, hair, nails and sweat gland defects.[2] In some cases, ED may cause problems with hearing and vision and might also be associated with cleft lip and/or palate.[2] ED is a rare, diffuse, non-progressive, hereditary disorder[3] with more than 150 subtypes.[1] There are different forms of ED – the first form occurs as X-linked recessive and the second form as autosomal dominant. In the X-linked recessive form males more commonly develop ED, while females only present as carriers of the abnormal gene. The autosomal dominant form is clinically present if either of the parents has ED, thus there is a 50% chance of ED transmission to their child.[4]

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1. Lené Merbold (primary author) 70%
2. Chané Smit (secondary author) 30%

The head and neck manifestations of ED include the following:[1-3]

- Enamel hypoplasia
- Malformed teeth (teeth that are smaller and pointed)
- Anodontia or hypodontia
- Malocclusion or ectopically-positioned teeth
- Cleft lip and/or palate
- Reduction in salivary flow
- Thin or sparse hair
- Reduced density of eyebrow/eyelash hair
- Nail dystrophy
- Abnormal functioning of the sweat glands
- Frontal bossing
- Saddle nose
- Periocular skin wrinkling and pigmentation

Diagnosing ED requires a multidisciplinary approach. ED is usually diagnosed during early childhood but, due to the wide range of clinical symptoms, some individuals are only diagnosed in adulthood.[4] Many children with ED are diagnosed after a dental examination when the primary teeth have a delayed eruption pattern or when the teeth in the oral cavity are atypical in shape.[5] Agenesis of teeth is a common finding – this includes anodontia (complete absence of permanent teeth), oligodontia (if six or more teeth are absent) and hypodontia (if less than six teeth are absent). The most common absent teeth are the maxillary lateral incisors and first premolars, followed by the mandibular central incisors and first premolars.[5] Dental agenesis can affect jaw growth of the alveolar bone and favours a tendency for skeletal class III development.[6] A thorough clinical and radiological

examination should be performed and, if ED is suspected, the patient should be referred for genetic testing to confirm the diagnosis.[2]

Treatment often depends on the case's complexity and the patient's age, with some treatments only commencing after growth is completed.[2] Treatment may include preventive oral care, including good oral hygiene with regular dental visits. Functional and aesthetic rehabilitation should be performed via a multidisciplinary team approach. The goal of early treatment is to resolve the problem of multiple missing teeth and to enhance jaw growth to achieve better function.[7] The initial dental treatment should mainly focus on prevention of caries and restoring tooth alterations to improve the patient's occlusion.[7] Rehabilitation of the occlusion includes partial or complete removable dentures, orthodontic expansion devices, dental implants and/or crowns.[1] Together with this approach, a psychologist and speech therapist should aid the patient to improve social acceptance.[8] After growth is completed, the specialities of maxillofacial surgery together with orthodontics and prosthodontics will be required.[5] This case report highlights the importance of dentists identifying the clinical and radiological features of ED as they may be the first line of diagnosis.

AUTHORS' DECLARATION

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethics approval

This study was approved by the University of Pretoria Ethics Committee (Reference no 360/2023). All procedures followed the ethical standards of the Helsinki Declaration of 1975, as revised in 2008.

REFERENCES

1. Neville BW, Damm DD, Allen CM, Chi AC. (2016) Oral & Maxillofacial Pathology. 4th Edition, WB Saunders, Elsevier, Missouri, 741-743
2. Visinoni Átila F, Lisboa-Costa T, Pagnan NAB, Chautard-Freire-Maia EA. (2009). Ectodermal dysplasias: clinical and molecular review. American Journal of Medical Genetics Part A, 149a(9), 1980-2002. https://doi.org/10.1002/ajmg.a.32864
3. Halai T, Stevens C. (2015). Ectodermal dysplasia: a clinical overview for the dental practitioner. Dental Update, 42(8), 779-80
4. Kariya R, Kadota T, Okawa R, Ochiai M, Okuda M, Nakano K. (2023). Two cases of ectodermal dysplasia diagnosed based on congenital absence of multiple teeth. Pediatric Dental Journal, 33(2), 147-151. https://doi.org/10.1016/j.pdj.2023.03.001
5. Cerezo-Cayuelas M, Pérez-Silva, A, Serna-Muñoz C, Vicente A, Martínez-Beneyto Y, Cabello-Malagón I, Ortiz-Ruiz AJ. (2022). Orthodontic and dentofacial orthopedic treatments in patients with ectodermal dysplasia: a systematic review. Orphanet Journal of Rare Diseases, 17(1). https://doi.org/10.1186/s13023-022-02533-0
6. Bondarets N, Jones RM, McDonald F. (2002). Analysis of facial growth in subjects with syndromic ectodermal dysplasia: a longitudinal analysis. Orthodontics & Craniofacial Research, 5(2), 71-84. https://doi.org/10.1034/j.1600-0544.2002.01159.x
7. Wimalarathna AAAK, Weerasekara WBMCRD, Herath EMUCK. (2020). Comprehensive management of ectodermal dysplasia with interceptive orthodontics in a young boy who was bullied at school. Case Reports in Dentistry, 2020, 6691235-6691235. https://doi.org/10.1155/2020/6691235
8. Celli D, Manente A, Grippaudo C, Cordaro M. (2018). Interceptive treatment in ectodermal dysplasia using an innovative orthodontic/prosthetic modular appliance. A case report with 10-year follow-up. European journal of paediatric dentistry, 19(4), 307-312. https://doi.org/10.23804/ejpd.2018.19.04.11

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CPD questionnaire

Knowledge and attitude of adolescents regarding E-cigarettes: A systematic review

1. **Choose the CORRECT answer. Which ingredient is found in the Electronic cigarette liquid?**
   A. Acetone
   B. Propylene Glycol
   C. Chloroform
   D. Carbon tetrachloride

2. **Which of the following is CORRECT. In which year did Electronic cigarettes enter the global market?**
   A. 2006
   B. 2002
   C. 2004
   D. 2005

3. **Select the CORRECT answer. What percentage (%) of high school students in the USA are using Electronic Cigarettes?**
   A. 19.6%
   B. 21.1%
   C. 19.1%
   D. 17.5%

4. **Choose the CORRECT option. As of February 2020, how many cases of e-cigarette or vaping product use-associated lung injury (EVALI) hospitalizations have there been?**
   A. 2100
   B. 1898
   C. 2807
   D. 3120

The prevalence of food insecurity in South African dental schools: A cross sectional study

5. **Select the CORRECT answer. What is the prevalence of self-perceived food insecurity of undergraduate dental students in South Africa?**
   A. 50%
   B. 20%
   C. 5%
   D. 35.5%
   E. 64.7%

6. **Which answer is CORRECT. What percentage of students have money to buy a packed lunch?**
   A. 25.7%
   B. 27.5%
   C. 32.5%
   D. 78.9%
   E. 97.8%

7. **Choose the CORRECT answer. What percentage of students skip a meal daily?**
   A. 27.1%
   B. 39.5%
   C. 31.9%
   D. 25.7%
   E. 28.9%

8. **Select the CORRECT option. What are the odds of experiencing food insecurity if the student skips a meal daily compared to if the student skips a meal a few times a week or never?**
   A. 7.9
   B. 11.2
   C. 1.83
   D. 4.85
   E. 1.98

9. **Which of the following is CORRECT. What percentage of participants felt that they did not have to borrow money for food from friends?**
   A. 61%
   B. 29%
   C. 5.2%
   D. 30%
   E. 65%

A mixed dentition radiographic assessment of the association between dental anomalies and the presence of pre-eruptive canine ectopia

10. **Select the CORRECT answer. The percentage of canine ectopia cases in the study which showed no developmental anomalies**
    A. 80%
    B. 50%
    C. 20%
    D. 10%

11. **Select the CORRECT answer regarding this mixed dentition radiographic assessment of the association between dental anomalies and the presence of pre-eruptive canine ectopia**
    A. There is no significant reciprocal associations that have been demonstrated between canine ectopia and certain developmental anomalies.
    B. This study confirmed that infraocclusion and canine ectopia have a significant relationship
    C. There were 10 cases in this sample that showed the presence of 3 anomalies occurring simultaneously with canine ectopia.
    D. One of the theories of canine eruption is that the root of the lateral incisor provides the erupting canine with guidance.

A simplified and evidence-informed approach to designing removable partial dentures. Part 1. Evidence-informed design principles

12. **Select the CORRECT statement. One of the design principles when making removable partial dentures is that of support. Which one of the following statements should apply to all partial dentures:**
    A. Support from occlusal forces should be directed to the edentulous ridge
    B. Support should be derived from some of the remaining teeth as well as the edentulous ridge
    C. Although teeth can provide support, they do not need to be prepared to receive rests
    D. All of the above must apply

13. **Select the CORRECT statement. One of the design principles when making removable partial dentures is that of retention. When considering retention, which one of the following statements should apply:**
    A. Not all removable partial dentures require retention
    B. Clasps provide passive retention
    C. All removable partial dentures require retention but they do not all require clasps
    D. Clasps must absolutely be aesthetically pleasing especially when providing passive retention.

14. **Which of the following statements is CORRECT. A removable partial denture is least retentive when:**
    A. It has no clasps
    B. It is removed along the path of insertion
    C. It is moved in a direction away from the path of insertion
    D. Chewing sticky foods

15. **Select the CORRECT option. In many studies, tooth loss in patients wearing removable partial dentures has been shown to:**
    A. increase
    B. decrease
    C. stay the same
    D. none of the above

16. **Which option is CORRECT. Tooth loss subsequent to wearing removable partial dentures is primarily due to:**
    A. Torquing forces on the abutment teeth
    B. Inadequate biofilm/plaque control
    C. Tipping forces on the abutment teeth
    D. Poor crown/root ratios

Evidence-based Dentistry

17. **Select the CORRECT answer. In the Tawfeek et al study, the unit of interest was**
    A. 25 children
    B. 30 teeth
    C. 15 teeth only
    D. Teeth and children

18. **In the Tawfeek et al study, which statement is CORRECT?**
    A. For the primary outcome of discoloration, there was a statistically significant difference between both materials.
    B. For the primary outcome of discoloration, there was a statistically significant difference that favoured NeoMTA
    C. For the primary outcome of discoloration, there was a statistically significant difference that favoured MTA
    D. For the primary outcome of discoloration, there was no statistically significant difference between both materials.

19. **In the Petchphayaprai et al study, which of the following statement is CORRECT?**
    A. The bacterial count in the iodine group was lower than 500 CFU/ml in almost all weeks, except week 6 and 7
    B. The bacterial count in the iodine group was lower than 500 CFU/ml for all weeks
    C. The bacterial count in the iodine group was lower than 500 CFU/ml in almost all weeks, except week 6
    D. The bacterial count in the iodine group was lower than 500 CFU/ml in almost all weeks, except week 7

20. **In the Petchphayaprai et al study, which of the following statement is CORRECT?**
    A. At 11 months, the average iodine concentration released in DUWLs procedural water was measured to be 2.8 ppm.
    B. At 11 months, the average iodine concentration released in DUWLs procedural water was measured to be 3.0 ppm.
    C. At 11 months, the average iodine concentration released in DUWLs procedural water was measured to be 3.4 ppm.
    D. At 11 months, the average iodine concentration released in DUWLs procedural water was measured to be 3.6 ppm.

Ethics: Inaccessible Specialised Oral Health Services in South Africa - Rationing Policy Uncertainty

21. **The following statement is CORRECT about waiting times for oral health services.**
    A. waiting times are not intrinsically morally significant.
    B. waiting times are not a form of rationing of services.
    C. Waiting times are better explained using principilism.
    D. Waiting times are indisputable in the allocation of oral health resources.

22. **Select the CORRECT option. Rationing of oral health services means**
    A. Patients are denied a potentially beneficial treatment.
    B. unregulated dumping of patients into the private oral health service
    C. restrictions in the allocation of treatment options due to scarcity
    D. embodiment of the successful the oral health service

23. **Which of the following is CORRECT. The basis for rationing of specialised oral health services in South Africa**
    A. health resources are infinite.
    B. oral health needs have plateaued and stabilised.
    C. a rationing policy increases burden on a health system
    D. rationing of health care resources is inevitable and necessary.

24. **Choose the CORRECT option. The following explains utilitarian moral theory**
    A. is a moral theory underpinned by “respect for persons”.
    B. the old would be prioritised ahead of young.
    C. those gravely sick likely to benefit are selected for care.
    D. Maximises benefits for the maximum numbers.

25. **Select the CORRECT percentage. The public sector provides oral health services to a majority of South Africans.**
    A. 85%
    B. 80%
    C. 90%
    D. 75%

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Instructions to authors

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

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

We shall be obliged if your submission is prepared respecting all the details listed in these Instructions. This facilitates our process and ensures more rapid responses to you. Please use and submit the Checklist for Authors suplied on page 645 for confirmation. Thank you.

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The Editorial Assistant Mr Dumi Ngoepe
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For submission instructions kindly refer to the "Submission instructions" page.

Language

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

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

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

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

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2. Drafting the work or revising it critically for important intellec-tual content, AND
3. Final approval of the version to be published, AND
4. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (www.icmje.org).
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To be kept as brief, clear and unambiguous as possible.

Abstract

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

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

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

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

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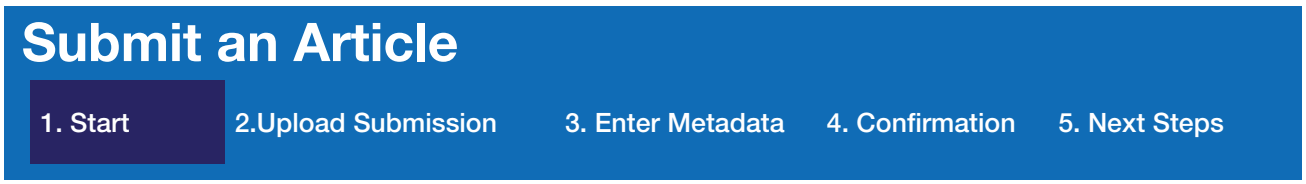

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6. Have you submitted questions for the CPD section? (four or five multiple choice, one correct answer)?
7. Have you submitted details of the contribution of each author... can be percentage or descriptive... or both?
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12. Have all authors signed the Letter of Submission?

NOTES

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