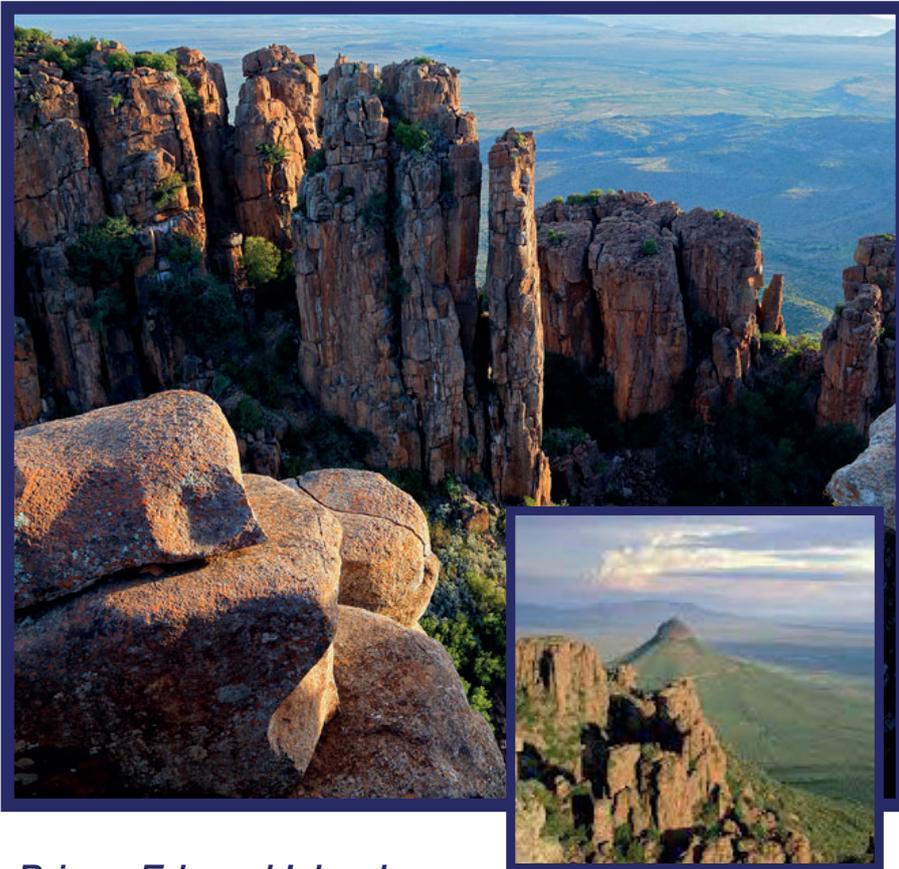


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Prince Edward Islands

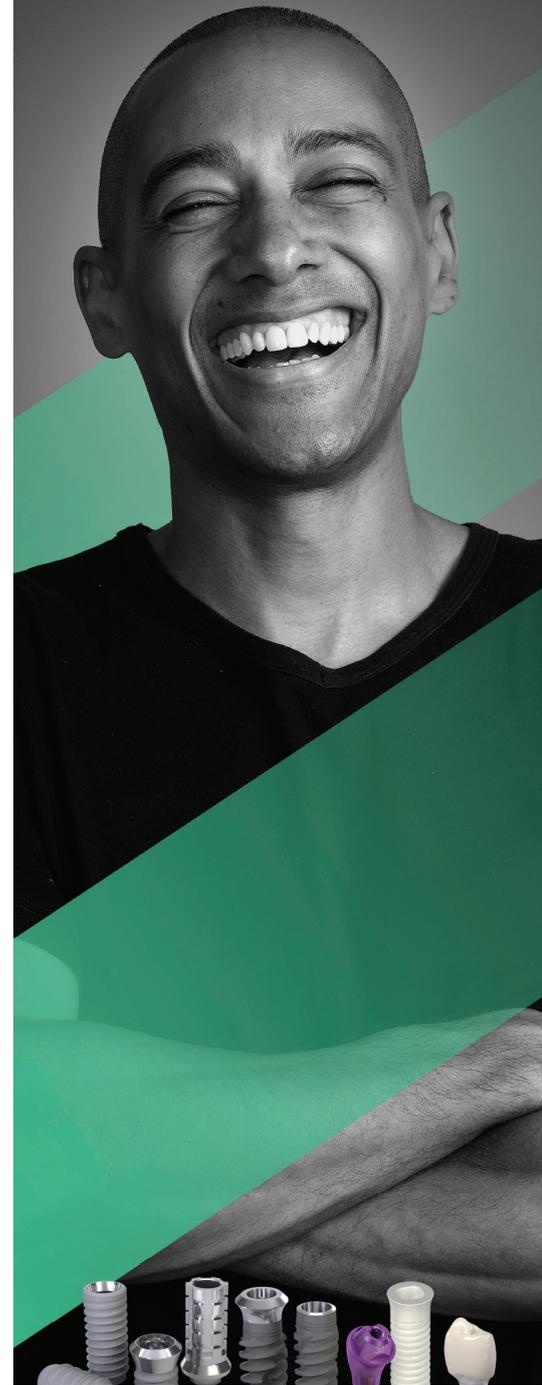
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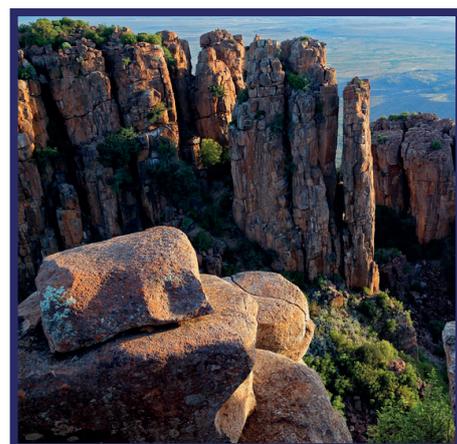
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Prince Edward Islands

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Environmental sustainability in dentistry: A call for ethical and eco-conscious practices

SADJ August 2023, Vol. 78 No.7 p333-334

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

Dentistry is no exception to the global paradigm shift towards environmental sustainability. Dental professionals, as guardians of oral health and wellness, have a moral obligation to combat environmentally unfriendly practices that have long been part of the industry. In this editorial I will examine ineffective and environmentally harmful dental treatment, make an argument for needed reform, and highlight the ethical need to implement greener processes. A healthier world is essential to overall health, which is why the dental community must rise to this challenge.

Wasteful practices and environmental impact Like many medical specialties, dentistry has a long history of generating a lot of waste. Some of the most obvious problems are the increasing use of plastic, single-use items and waste of water. The massive plastic waste crisis is largely the result of single-use plastic items, including gloves, syringes and packaging. Traditional dental products, including amalgams and gypsum, create harmful contaminants to aquatic habitats. Older sterilisation techniques used a lot of energy and water, which combined with the habit of operating machines unnecessarily. In addition to harming the environment, these wasteful practices also reflect badly on the dental profession as responsible healthcare providers.

There is a need for a critical assessment of the pros and cons of adopting environmentally friendly alternatives in dental practice. On the one hand, moving to environmentally responsible operations will require upfront investments in new machinery, supplies and technology, which can put a strain on the budgets of some operations. Initially, efficacy and patient numbers may be affected by the learning process of adopting new procedures. Also, buying durable products can be a bit more expensive than using conventional materials. However, these initial difficulties are insignificant compared to the many advantages.

Why would there be resistance to adopting more environmentally friendly or greener behaviours and equipment in dental practices?

- **Lack of understanding:** Many dentists may not be fully aware of the extent to which traditional techniques have a detrimental impact on the environment. Without insights, it may not be clear how urgent it is to switch to eco-friendly options.
- **Initial expenses:** New equipment, materials and technologies developed for sustainability in the first place



can be very expensive, which can be a barrier to smaller operations with more limited resources. Because of financial worries, dentists may see these investments as a burden and refuse to change.

- **Tradition and inertia:** Dentistry, like any profession, can be slow to adapt due to the inertia of long-standing habits. Since traditional methods have long been part of dental education and training, it can be difficult to deviate from what is known and comfortable.
- **Perceived disruption:** Switching to eco-friendly methods can be seen as breaking the usual schedule and workflow. Dentists and staff may be concerned that the implementation of new techniques and supplies will temporarily impede operations or require additional training.
- **Lack of infrastructure:** A dental clinic may need to significantly upgrade its infrastructure to transition to greener clinics. It takes time, effort and sometimes structural adjustment to implement water-saving technologies, waste management processes and digital storage systems.
- **Misconceptions:** Some dentists may believe that green solutions are less effective or of lower quality than conventional solutions. Education must be used to dispel these myths to promote change.
- **Time limit:** Oral healthcare practitioners often have busy schedules and little free time to experiment with and apply new techniques and technologies. It can be difficult to consider learning and integrating new techniques and processes that are not directly responsible for the generation of income.
- **Industry standards and regulatory incentives:** In some areas, the absence of industry standards or regulatory incentives for environmentally responsible practices may prevent practitioners from taking proactive steps to promote sustainability.
- **Competitive priority:** Dental practitioners have to perform a variety of tasks that include patient care, office work and continuing education, among others. The issue of environmental sustainability can be overshadowed by the imperatives of everyday practices and commitments.
- **Access to accurate information may be limited:** It may not be easy to access comprehensive information about the various eco-friendly options. Dentists can benefit from centralised resources that provide in-depth advice on environmentally friendly supplies and procedures.

Rationale for change

The dental community's dedication to environmental sustainability is not only ethically necessary but also a means to ensure the survival of dental care. Adopting environmentally friendly methods is a wise move, considering resource depletion and the severity of compounding environmental problems. Waste generation and carbon emissions can be significantly reduced by switching to digital recording and photography, using energy-efficient technology, and using recyclable and biodegradable materials. The financial return in this regard is undeniable with substantial cost savings as clinics use less energy, less water and have better waste



management systems. Dental professionals can improve their services while reducing their environmental impact by reinvesting these savings in advanced technology and patient care.

Ethical responsibilities of dental professionals

Dental practitioners have intrinsic ethical obligations to patients, to society and to the environment as healthcare providers. They are dedicated to the wellbeing of their patients beyond the dental chair because they are responsible for the patient's wellbeing. This includes protecting the health of the community and, by extension, the planet. Dentists are dedicated to the long-term health and vitality of their patients and the environment by implementing environmentally friendly procedures. Using sustainable materials, reducing plastic waste and saving water are all ethical requirements, not just alternatives. Dental professionals are uniquely positioned to help patients understand the importance of making informed decisions and the environmental impact of oral health practices. An environmentally conscious and conscientious generation can be nurtured through this education.

The environmental impact of dental practices can be significantly reduced by subscribing to sustainable practices. Patients are looking for environmentally conscious healthcare providers, which can increase patient loyalty and attract new customers. By implementing environmentally responsible processes, dental professionals can take the lead in environmental stewardship and health care, enhancing their status in the community and in the care setting.

In conclusion, environmental sustainability in dentistry is an urgent requirement, not a distant aspiration. The dental community has the ability to lead by example, to act as an agent of change and to reshape the industry so it reflects the ideals of a sustainable society.

Dentists can help to create a healthier and sustainable future by reviewing and modifying unnecessary processes, adopting innovative technology and using environmentally friendly materials. Keep in mind that the health of our world is closely tied to the health of our patients as we survey the evolutionary horizon in dentistry. Dental professionals can lead the way to a brighter, more sustainable future by adhering to their ethical obligations and promoting environmentally sustainable principles.

Let us work towards a world where healthy smiles coexist harmoniously with a thriving environment.

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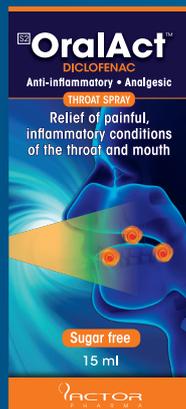
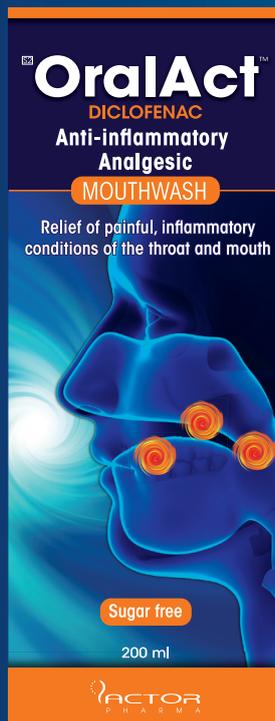
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A Remarkable Triumph of the 2023 Oral & Dental Health Congress & Exhibition

SADJ August 2023, Vol. 78 No.7 p290-291

Mr KC Makhubele – CEO, South African Dental Association

I am honoured to share with you a comprehensive report on the South African Dental Association's (SADA) standout event of the year, the SADA Oral & Dental Health Congress & Exhibition, which took place from August 25th to 27th, 2023, at the Cape Town International Convention Centre (CTICC).

This year's congress, with aptly structured and mixed learning content, was a resounding success that left an indelible mark on our dental community. Allow me to take you through the highlights and achievements of this extraordinary gathering of dental professionals, speakers, exhibitors, and thought leaders.

Unprecedented Attendance and Overwhelming Response: The 2023 congress saw an unprecedented level of engagement, with a staggering 40 International and local speakers gracing our stages. The program featured a diverse array of speakers who addressed a wide range of topics catering to various segments of our dental community. These included General Practitioner Dentists, Specialist Dentists, Dental Technicians, Dental Therapists, Oral Hygienists, Dental Assistants, Dental Receptionists, Practice Managers, and even their spouses. Additionally, a dedicated section was included to empower and celebrate "Women in Health Leadership." The event garnered exceptional interest, evident in the sale of 914 congress tickets for delegates—an astonishing 31% over-subscription rate. Additionally, we were privileged to host

78 Dental traders, including 66 local and 12 VDDI (German) traders, accompanied by over 330 trader delegates. This overwhelming response demonstrated the enthusiasm and commitment of our dental community to advancing oral and dental health care in South Africa.

Exceptional Feedback from Delegates, Speakers, and Traders:

The heartwarming feedback we received from delegates, speakers, and traders was a testament to the congress's success. Delegates expressed their appreciation for the wealth of practical knowledge gained during the event, knowledge that can be readily applied in their practices. Speakers, both international and local, were praised for their ability to engage, inspire reflection, and facilitate learning. Our traders were also celebrated for their quality products and services. Many individuals remarked that this was the most impactful dental conference they had attended in over a decade.

Dental Excellence in Action:

As CEO, I had the privilege of personally visiting 99.9% of the trade stands, where I witnessed firsthand the dedication, innovation, and commitment of our exhibitors. This direct interaction reaffirmed the vitality of our dental industry and the potential for advancement through collaboration and knowledge exchange.

It is with immense gratitude and appreciation that we extend our heartfelt thanks to every one of you who contributed to the resounding success of the SADA Oral & Dental Health Congress & Exhibition held at the CTICC from August 25th to 27th, 2023, without you this event would not have been the success it was.

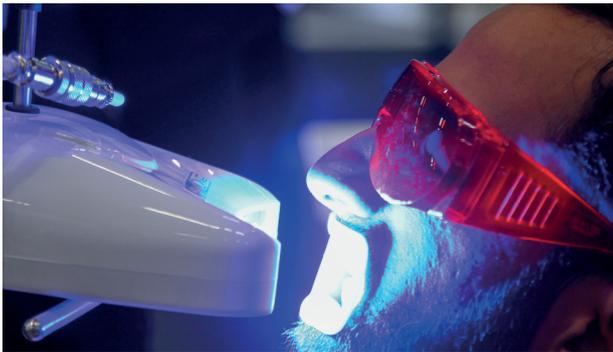


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CONGRESS AND EXHIBITION

25–27 AUGUST 2023

CTICC, Cape Town



A Glimpse into the Future:

Looking ahead, we are already gearing up for the SADA Oral & Dental Health Congress & Exhibition in 2024, scheduled at Times Square from August 31st to September 1st. Moreover, recognizing the short period between these two significant events, we are actively planning for the 2025 Congress to ensure continued excellence and growth within our community.

Acknowledgements:

I extend my heartfelt gratitude to the members of the SADA Scientific Advisory Committee for their exceptional work in organizing this congress. A special salute goes to Dr. Jean van Lierop, the committee's chairperson, for his exemplary leadership and dedication. Our Committee members included:

- Dr Jean van Lierop (Chair)
- Dr Mark Bowes
- Prof Howard Gluckman
- Dr Ridhwaan Haffajee
- Dr Avish Jagathpal
- Prof Riaan Mulder
- Prof Dirk Smit

I also take an opportunity to thank all my operational staff who worked on this (Rebecca Mokwatlo, Kevin Woolward, Ann Bayman, Tshepo Moletsane), but a special thanks go to Marilize Janse van Rensburg for being an awesome organiser of the entire event.

Final Thoughts:

In conclusion, the 2023 SADA Oral & Dental Health Congress & Exhibition was a testament to the collective spirit of our dental community. It showcased our commitment to advancing oral and dental health care, fostering innovation, and nurturing professional growth. As we embark on the journey towards future congresses, we do so with a deep sense of purpose and a vision of a brighter, more prosperous future for South African dentistry.

I invite you all to stay tuned for the detailed feedback and survey results that will guide us as we plan our path forward. Thank you for being part of this remarkable journey and for your unwavering support in our mission to elevate oral and dental health care in South Africa.



Dental therapist job satisfaction and intention to leave: A cross-sectional study

SADJ August 2023, Vol. 78 No.7 p338-346

P Sodo¹, V Yengopal², S Nematandani³, T Muslim⁴, S Jewett⁵

INTRODUCTION AND BACKGROUND

Dental therapy is a mid-level oral health profession that was introduced to the South African health system more than four decades ago, during the apartheid era. The purpose for the introduction of this profession was to meet the oral health needs of the underserved majority population^{1,2,3}. However, even with the dismantling of apartheid and the creation of a democratic state, disparities in access to basic oral healthcare persist.¹ Local studies have reported limited access to oral health services, especially among the disadvantaged and vulnerable population groups where the highest burden of oral diseases has been reported.^{4,5,6}

The scope of dental therapists includes treating and preventing the most prevalent oral health problems in South Africa, such as dental caries.^{1,2,4,5,6} Globally, dental therapists play a significant role in providing basic dental services at a low cost compared to dentists, especially to children and underserved communities.⁷ One strategy for reducing health disparities is to lower the unit cost of providing services by substituting higher-cost labour associated with hiring dentists with low-cost labour, such as dental therapists.⁷ The dental therapy profession is not a replacement for dentists; however, it is an economically sustainable professional mid-level workforce category where you can employ up to three dental therapists with the salary of one dentist.⁷ Despite the need for this professional group, anecdotal data reveals

that fewer dental therapists are being trained compared to dentists. Furthermore, there is imminent attrition among dental therapists which threatens the profession and limits the benefits conferred by this category of workers.

Attrition among dental therapists is a threat to the potential benefits of this category of worker. A study conducted among dental therapists in Western Australia reported that 28% of dental therapists were no longer working within the profession due to new careers, family commitments, relocation, poor pay, injury or stress.⁸ In South Africa, although dental therapists are trained and produced every year from the Sefako Makgatho University (SMU) and the University of KwaZulu-Natal (UKZN), the numbers of graduate dental therapists registered with the Health Professions Council of South Africa (HPCSA) remain low.⁹ A regional study in KwaZulu-Natal (KZN) reported a high voluntary attrition among dental therapists¹⁰. The study reported that 26% of dental therapists left the profession, of whom 19% returned to university to study dentistry while 7% no longer work in the dental profession. A more recent South African nationwide study of dental therapist attrition reported 40% attrition over a 42-year period and attrition of 9% over the 10-year period of 2009-2019.¹¹

Voluntary workforce attrition is a major public health problem globally, which may lead to staff shortages. Some of the downstream effects of voluntary attrition are increased workload, unavailability of healthcare workers and limited access to healthcare, leading to a higher burden of untreated diseases. Furthermore, this has a huge impact on a country's economy.¹² Voluntary attrition has been identified as an essential issue that needs to be addressed for workforce planning.¹² There are many reasons why a person might voluntarily leave their job. Previous studies have cited low salaries, lack of access to professional development and further education, lack of effective supervision, weak regulatory environments, isolation for those in rural or remote areas, poor working conditions, large workload, lack of motivation and low job satisfaction as major contributors to voluntary attrition.^{12,13,14,15,16,17,18} Furthermore, studies conducted among mid-level health workers reported that these cadres leave because they are becoming demotivated due to poor career development and promotion prospects, lack of positive supervision, feedback and recognition, which leaves them feeling unsupported and undervalued as professionals.^{14,19,20,21,22} One study conducted among anaesthetists reported that 47.8% of participants had the intention to leave their profession due to low remuneration and lack of opportunities for professional development.²³ Factors contributing to job dissatisfaction and, ultimately, attrition, can be conceptualised using Herzberg's two-factor theory (see Figure 1). According to this theory, intrinsic

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1. Pumla Sodo	50%
2. Veerasamy Yengopal	15%
3. Simon Nematandani	10%
4. Tufayl Muslim	10%
5. Sara Jewett	15%

factors (motivators) such as recognition, achievement, work itself, responsibility and advancement will all lead to job satisfaction; whereas factors that lead to job dissatisfaction include the absence of key extrinsic factors (hygiene factors) such as policies and administration, supervisory practices, salary, interpersonal relations, physical working conditions, benefits and job security.^{24,25} Herzberg's two-factor theory describes intrinsic factors as motivators that contribute to job satisfaction and extrinsic factors as major contributors to dissatisfaction, if absent.^{24,25}

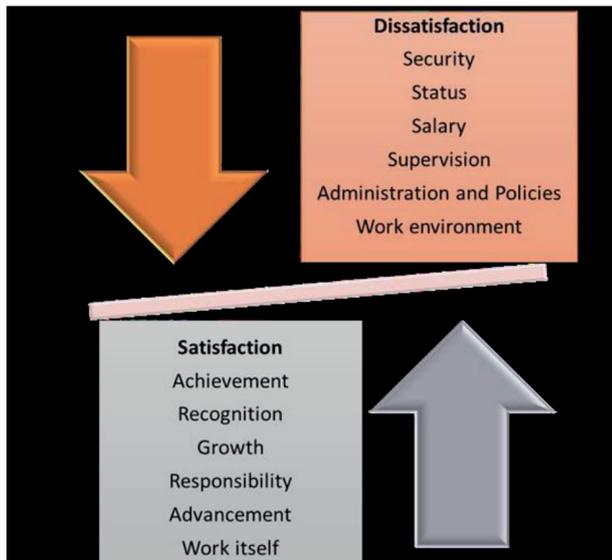


Figure 1. Herzberg's two-factor theory adapted from literature.

A study conducted among different categories of healthcare workers in three countries, including South Africa, reported an association between low job satisfaction and intention to leave¹⁸ among the three countries (Tanzania, Malawi and South Africa). The lowest job satisfaction and the highest intention to leave were in South Africa, where 47.9% of those surveyed were dissatisfied with their current jobs and 41.4% were actively seeking other jobs.¹⁸ Other studies also have reported the intention to leave as the strongest predictor of voluntary workforce attrition.^{12,14}

Documenting the factors that contribute to job dissatisfaction, intention to leave and attrition is essential for human resource planning and the development of strategies to reduce voluntary attrition. There is limited information on factors contributing to attrition or an intention to leave the dental therapy profession in South Africa. Hence, the purpose of this study was to investigate factors that impact on job dissatisfaction and the intention to leave the dental therapy profession.

METHODOLOGY

Study design

A cross-sectional study was conducted among dental therapy graduates using an electronic survey instrument called Research Electronic Data Capture (REDCap).

Study population

The targeted study population included all the graduate dental therapists.

Recruitment of participants

Participants were recruited through the online platforms

of the South African Dental Therapy Association (SADTA), which had a membership of 200 dental therapy graduates at the time of data collection. The SADTA platforms used for recruitment included emails and WhatsApp groups. The survey link generated by REDCap was shared through these platforms; participants were also encouraged to forward the link to other dental therapists who were not members of SADTA. The calculated minimum sample size for this study was 198 based on the total number of dental therapists registered by 2019 (714), using a 90% confidence interval and 5% marginal error.²⁶

DATA COLLECTION

Data collection instrument

The study used a self-administered questionnaire that was adapted and modified from existing previously validated studies^{20,21,27}, some of which used the constructs of Herzberg's Two-Factor Theory of Motivation. These previous studies captured the predictors of job satisfaction and intention to leave the profession as well as factors contributing to attrition. The questionnaire for our study captured demographics, individual factors, extrinsic factors and intrinsic factors as well as job satisfaction and intention to leave. The intention to leave the dental therapy profession and job satisfaction were the outcome variables of interest. Job satisfaction was explored as a binary variable (yes/no), as Herzberg's two-factor theory identified it as the major factor in the decision to quit or stay in a job or profession.²⁵ Measurement of variables

The questionnaire requested information on sociodemographic characteristics, including age, gender, race, province of residence, highest degree, year of qualification, institution where participants qualified, employment sector and their year of qualification.

Two additional questions were measured through binary (yes/no) variables: whether dental therapy was the study participants' first choice and if the participants were funded for their dental therapy degree.

Five questions were related to intrinsic variables. These included four binary (yes/no) variables, including the awareness of available postgraduate prospects for dental therapists, whether the dental therapy profession received professional growth, satisfaction with the current dental therapy scope of practice, and one nominal variable such as the stage at which participants became aware of dental therapy scope of practice. Three questions probed extrinsic variables, of which two required binary (yes/no) responses. These included the availability of job opportunities and whether participants felt that the dental therapy profession was valued like other mid-level health professionals in South Africa, and one numerical variable which included the period that it took for the participants to get a job after graduation. The questionnaire also included an open-ended question to gain insight into participants' reasons behind their dissatisfaction with the dental therapy profession, using their own words. Data were collected between April 2020 and March 2022.

Participation was voluntary and informed consent was obtained electronically from all the participants. The survey link had the information sheet for participants to read and understand the purpose of the study and conditions of their participation which included anonymity and that participation

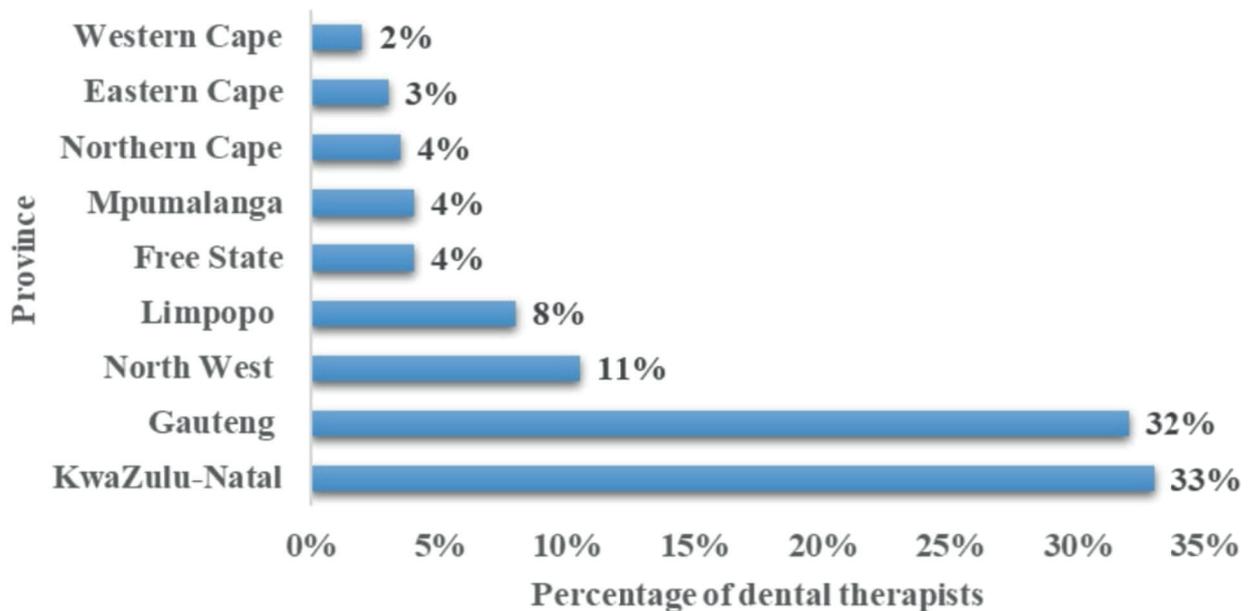


Figure 2. Distribution of the dental therapist by province

was voluntary; thereafter there was a consent statement informing participants that "by proceeding to complete the survey, they consent to participate in the study".

Data management and analysis

The first author transferred data from REDCap into Excel for cleaning and then transferred the clean dataset to STATA 15, LP, College Station, TX, US, for analysis. Missing cases were excluded from the analysis. Overall, 234 participants participated in the study, of which 34 responses were excluded because they had many missing responses, leaving us with 200 responses.

Descriptive statistics were done to describe the study sample in terms of socio-demography and key participant characteristics; this included frequencies and percentages for categorical variables, while means and standard deviations were computed for continuous variables. Job satisfaction and intention to leave were also determined using descriptive statistics. Associations between either job satisfaction or intention to leave and participant's characteristics were explored using bivariate analysis. All characteristics that were significant (below 0.05) were included in the multivariable logistic regression. We reported adjusted odds ratios, their corresponding 95% confidence intervals and p values. A p-value <0.05 was considered statistically significant.

Thematic analysis was used to analyse the open-ended questions, following the process detailed by Braun²⁸ through gaining familiarity with the data; generating initial codes or labels; searching for themes or main ideas; reviewing themes or main ideas; defining and naming themes or main ideas; and producing the report. The first author led this analysis, with support from the last author at the stage of reviewing and defining themes.

RESULTS

The responses of 200 dental therapist graduates were included in the final analysis. Figure 2 below shows that most participants resided in KwaZulu-Natal and Gauteng (33.0% and 32.0% respectively).

Table 1 shows that the average age of the participants

was 38 years. The sample was dominated by females (62.0%), those who self-identified as African (74.5%) and those employed in the private sector (67.9%). Only 24.6% had a postgraduate qualification. When asked about the circumstances of entering the profession, more than half (52.5%) reported that dental therapy was not their first choice at the time of enrolment, 78.5% were unaware of the dental therapy scope of practice until after enrolment, with 67.5% reporting dissatisfaction with the dental therapy scope. Just above half (53.5%) reported that they had no job opportunities after graduation. The vast majority (90.5%) believed that the dental therapy profession did not support career development and 93.0% indicated that the profession is not valued in South Africa. Job dissatisfaction was high at 69.5%, with more than half (51.5%) expressing their intention to leave the profession.

Job satisfaction among the dental participants

As shown in Table 2, bivariate analysis revealed several factors that were associated with job satisfaction. There was an association between job satisfaction and the institution where participants qualified; those who qualified from SMU were more satisfied with their jobs as compared to UKZN graduates (66.1% vs 33.9%). The majority of those for whom dental therapy was not their first choice in university were more satisfied than those whose first choice was dental therapy (66.7% vs 33.3%). Surprisingly, more than two-thirds (76.7%) of those who were not satisfied with the scope of practice were satisfied with their jobs.

Those who had job opportunities available after graduation were more satisfied with their jobs as compared to those who had no jobs (68.3% vs 31.7%). There was a significant association between awareness of and access to postgraduate opportunities; the majority (67.8%) of those who were aware of postgraduate opportunities were satisfied with their jobs.

In contrast, a large majority (81.8%) of those who only became aware of dental therapy scope of practice after enrolling for the degree were dissatisfied with their jobs. Almost all (97.8%) of those who believed that dental therapists are not as valued as other mid-level health professionals in South Africa were dissatisfied with their jobs.

Table 1. Key characteristics of the study sample of dental therapists

Variables	Categories	Totals n (%)
Gender	Female	124 (62.0)
	Male	76 (38.0)
Self-identified race	African	149 (74.5)
	Indian	51 (25.5)
* At which institution did you qualify?	UKZN	100 (50.8)
	SMU	97 (49.2)
Was dental therapy your first choice for study?	No	105 (52.5)
	Yes	95 (47.5)
Was your dental therapy degree funded?	No	91 (45.5)
	Yes	109 (54.5)
* When did you qualify?	1977-1999	56 (28.4)
	2000-2009	80 (40.6)
	2010-2019	61 (30.9)
* Did you have a job post-graduation	No	106 (53.5)
	Yes	92 (46.5)
When did you become aware of the scope of the dental therapy profession?	Before registration	43 (21.5)
	After registration	157 (78.5)
Are you satisfied with the scope of dental therapy ?	No	135 (67.5)
	Yes	65 (32.5)
* Where do you work?	Private	129 (67.9)
	Public	61 (32.1)
* Are you aware of postgraduate opportunities for dental therapists?	No	110 (55.3)
	Yes	89 (44.7)
* What is your highest qualification?	Bachelor's only	150 (75.4)
	Post bachelor's	49 (24.6)
* Do dental therapists get career development like other mid-level health professionals?	No	180 (90.5)
	Yes	4 (2.0)
	Do not know	15 (7.5)
Are dental therapists valued like other mid-level health professionals?	No	186 (93.0)
	Yes	14 (7.0)
* Are you satisfied with your job?	No	137 (69.5)
	Yes	60 (30.5)
Do you intend to leave dental therapy profession?	No	97 (48.5)
	Yes	103 (51.5)

* Varying total because of missing values.

As shown in Table 3, some factors were no longer significant after adjustment, such as age, dental therapy being their first choice, whether their studies were funded and whether they were satisfied with the dental therapy scope of practice. However, several factors remained significant after adjustment. For instance, there was positive association between job satisfaction and being a graduate of UKZN (AOR=2.28, CI: 1.06-4.91), having job opportunity available after graduation (AOR=3.87, CI: 1.73-8.69), being aware of postgraduate opportunities available for dental therapists (AOR=2.28, CI: 1.05-4.96) and believing that the dental therapy profession is valued like other mid-level health professionals (AOR=6.19, CI: 1.45-26.36). Conversely, job satisfaction was negatively associated with only becoming aware of the dental therapy scope of practice after enrolment (AOR=0.31, CI: 0.12-0.81).

The responses to open-ended questions about job dissatisfaction provided additional insights on what

was contributing to their feelings, with the responses corresponding to the quantitative results that emphasised issues such as career opportunities and whether they felt valued. We classified these themes into broad intrinsic and extrinsic factors as stipulated in the Hertzberg framework.

Intrinsic factors

There were three themes related to intrinsic factors: lack of respect, limited responsibility and limited career growth. While these all related to lack of recognition as professionals, which was also significant in the quantitative analysis, the qualitative responses enabled us to explore the reasons underlying their responses.

Participants believed that their role within the health system was not well understood; hence, other health professionals undermined and took advantage of them. A common theme that emerged from their responses was the lack of respect or appreciation afforded to those in the dental

Table 2. Job satisfaction among the dental participants

Characteristic	Category	SATISFIED WITH YOUR JOB				P value
		No		Yes		
		N	%	N	%	
* Age	Mean	38.4	9.84	39.1	10.4	0.64
* Gender	Female	84	61.3	37	67.7	0.96
	Male	53	38.7	23	38.3	
* Race	African	106	77.4	42	70.0	0.27
	Indian	31	22.6	18	30.0	
* At which institution did you qualify?	UKZN	79	58.5	20	33.9	<0.001
	SMU	56	41.5	39	66.1	
* Was dental therapy your first the choice for study?	No	64	46.7	40	66.7	0.01
	Yes	73	53.3	20	33.3	
* Was your dental therapy degree funded?	No	57	41.6	31	51.7	0.19
	Yes	80	58.4	29	48.3	
* What is your highest qualification?	Bachelor's only	104	76.5	44	73.3	0.63
	Post bachelor's	32	23.5	16	26.7	
* When did you qualify?	1977-1999	39	28.9	17	28.8	0.97
	2000-2009	55	40.7	25	42.4	
	2010-2019	41	30.4	17	28.8	
* Did you have a job post-graduation?	No	86	63.2	19	31.7	<0.001
	Yes	50	36.8	41	68.3	
Where do you work?	Private	85	65.4	44	73.3	0.27
	Public	45	34.6	16	26.7	
* When did you become aware of the scope of the dental therapy profession?	Before registration	25	18.2	18	30.0	0.06
	After registration	112	81.8	42	70.0	
* Are you satisfied with the scope of dental therapy?	No	86	62.8	46	76.7	0.05
	Yes	51	37.2	14	23.3	
* Are you aware of postgraduate opportunities for dental therapists?	No	89	65.0	19	32.2	<0.001
	Yes	48	35.0	40	67.8	
* Are dental therapists valued like other mid-level health professionals?	No	134	97.8	49	81.7	<0.001
	Yes	3	2.2	11	18.3	

* Varying total because of missing values.

therapy profession. This included allusions to the racialised nature of the profession and its historical role in the apartheid government:

Leadership viewed us as second-class dentists, who are also incompetent. Everyone looked down upon us: employers, government, dentists, medics, institutions, including other races (we are mostly black). (Female, 54).

We are seen as robots and slaves and get undermined a lot. The way other professions think of dental therapists and react to them demonstrates a disregard for the profession. The state as the employer sees dental therapists as instruments of cheap labour just as apartheid aimed it to be. (Male, 34).

Participants linked this disrespect to a second theme of being given **limited responsibility**. For instance, some described being overlooked for management positions or promotion opportunities. Reinforcing the idea of being treated as "second-class" citizens, one female dental therapist (age 28) complained: *"We are hardly recognised and given responsibility. Always expected to work under a dentist."*

Limited career growth was a third theme that caused great dissatisfaction among dental therapists. They felt that they played a critical role in-service provision, yet they perceived few career growth opportunities, going beyond what the survey measured. One explained:

Options to study further are mainly in public health and when you are done there are no posts that are designed for dental therapists who did MPH (master's in public health), or anything related to that. Even if you do the postgraduate diploma in dental public health, there will be no post for you in government. You are supposed to apply for the ordinary post like any person with an undergraduate degree. (Male, 32).

Extrinsic factors

We identified five themes related to extrinsic factors: limited job opportunities, inequitable remuneration, unfair medical aid practices, government disregard and poor interpersonal relations.

While these all related to job satisfaction, which was also significant in the quantitative analysis, the qualitative responses enabled us to explore the reasons beyond their job satisfaction. The intrinsic sense of frustration about career growth opportunities was reflected in the extrinsic theme of there being **limited job opportunities**. The following example highlights how the absence of jobs in the public sector has driven some to shift into the private sector, despite the need for dental therapists in the public sector.

[There are] no job opportunities in the public sector and demand for mid-level workers to provide primary healthcare is high. The implementation of NHI (National Health Insurance) will need the mid-level worker to strengthen oral health promotion and prevention in the integrated school health programme. Because no one, not even our own government, and the Department of Health has space for us. We are trained so that post-graduation we fend for ourselves in the private sector, which predisposes us to be underpaid and overworked. (Female, 51).

Recently I checked the OSD (Occupational Service Dispensation) scale only to learn that oral hygiene entry-

level post pays a lot more than a dental therapy post. Salary levels and other benefits are not aligned with other health professionals in public institutions. The question is what informs the salary scale of professions if not the scope of practice? (Male, 30).

A closely related theme had a narrow focus on the practices of unfair medical aid schemes, which focused on how participants believed that medical aid schemes are unfair to dental therapists in terms of remuneration. In one case, a study participant left the profession as a consequence:

I felt abused by the system with less remuneration in all aspects, at both public and private sectors. In government, it was worse. The unregulated medical aid schemes were also not remunerating us according to the work done, but less or no payments due to the fact that we are therapists. I felt that we were not protected by anyone against this abuse. I had to leave the profession. (Female, 54).

Some of the complaints about medical aid structures were very specific:

Medical aids dictate what should be done by therapists, for example you can't treat more than 4 teeth in a year while patients might require more. These limitations are not there for other professionals. (Female, 30).

Participants felt the dental therapy profession was **disregarded by the government**. Two examples were mentioned by participants who believed that dental therapists were excluded from policies such as commuted overtime and community service, where other health professionals were included:

The government refuses to give us community service programmes immediately after graduation in the public sector but instead provides it to other professions. We are thus not recognised and not taken seriously. (Male, 23).

Table 3. Predictors of job satisfaction among the dental therapists: multivariable regression model

Characteristic	Categories	Adjusted or	95% CI	P-value
Age	Mean (SD)	0.99	0.96-1.03	0.72
At which institution did you qualify?	Smu	1		
	UKZN	2.28	1.06-4.91	0.04
Was dental therapy your first choice for study?	No	1		
	Yes	0.72	0.32-1.61	0.42
Was your dental therapy degree funded?	No	1		
	Yes	0.89	0.41-1.96	0.78
Did you have a job post-graduation?	No	1		
	Yes	3.87	1.73-8.69	0.001
When did you become aware of the scope of the dental therapy profession?	Before registration	1		
	After registration	0.31	0.12-0.81	0.02
Are you satisfied with the scope of dental therapy?	No	1		
	Yes	0.53	0.21-1.30	0.17
Are you aware of postgraduate opportunities for dental therapists?	No	1		
	Yes	2.28	1.05-4.96	0.04
Are dental therapists valued like other mid-level health professionals?	No	1		
	Yes	6.19	1.45-26.36	0.01

Finally, intricately linked to the intrinsic theme of lack of respect, some participants also reported **poor interpersonal relations**. One female dental therapist (age 30) lamented: "There is hatred and discrimination against the dental therapy profession everywhere, from dentists, management, medical aid administrators etc." Other dental therapists used words like "discrimination" and "oppression" to describe the way they were treated. As one explained, this type of treatment also affected their relationship with patients:

We are taken for granted and there is so much oppression. We are also believed to not know or carry out our scope of practice with excellence that leads to patients not trusting us. (Female, 31).

Intention to leave among the dental participants

Table 4 shows the bivariate analysis of intention to leave and its correlates. There was a significant association

between intention to leave and age, race, funding for dental therapy degree, highest qualification, year of qualification and job satisfaction. More younger participants had the intention to leave their jobs than the older participants. Those participants who identified as African race reported high intention to leave (83.5%). High intention to leave was reported among those participants who were funded for their dental therapy degree (63.1%). More than two-thirds (81.4%) of participants who did not have postgraduate qualification. High intention to leave was reported among those participants who qualified between the years 2000-2009 and between 2010-2019 (43.1% and 41.2% respectively). The majority (82.2%) of participants who were dissatisfied with their jobs reported an intention to leave. Finally, although not significant, high intention to leave was reported among the majority of participants who reported that the dental therapy profession was not valued in South Africa (96.1%).

Table 4. Intention to leave among the study participants

Characteristic	Categories	No		Yes		P-value
		N	%	N	%	
Age	Mean (SD) years	41.8	10.7	35.2	08.3	<0.001
Gender	Female	57	58.8	67	65.0	0.36
	Male	40	41.2	36	35.0	
Race	African	63	65.0	86	83.5	0.003
	Indian	34	35.0	17	16.5	
* At which institution did you qualify?	UKZN	49	51.6	51	50.0	0.82
	SMU	46	48.4	51	50.0	
* Was dental therapy your first choice for study?	No	56	57.7	49	47.6	0.15
	Yes	41	42.3	54	52.4	
Was your dental therapy degree funded?	No	53	54.6	38	36.9	0.01
	Yes	44	45.4	65	63.1	
* What is your highest qualification?	Bachelor's only	67	69.0	83	81.4	0.04
	Post bachelors	30	30.9	19	18.6	
* Which year did you qualify?	1977-1999	40	42.1	16	15.7	<0.001
	2000-2009	36	37.9	44	43.1	
	2010-2019	19	20.0	42	41.2	
* Did you have a job post-graduation?	No	52	53.6	54	53.5	0.98
	Yes	45	46.4	47	46.5	
* Where do you work?	Private	64	67.4	65	68.4	0.87
	Public	31	32.6	30	31.6	
When did you become aware of the scope of the dental therapy profession?	Before registration	25	25.8	18	17.5	0.15
	After registration	72	74.2	85	82.5	
Are you satisfied with the scope of dental therapy?	No	65	67.0	70	68.0	0.89
	Yes	32	33.0	33	32.0	
* Are you satisfied with your job?	No	54	56.3	83	82.2	<0.001
	Yes	42	43.7	18	17.8	
* Are you aware of postgraduate opportunities for dental therapists?	No	53	54.6	57	55.9	0.86
	Yes	44	45.4	45	44.1	
Are dental therapists valued like other mid-level health professionals?	No	87	89.7	99	96.1	0.07
	Yes	10	10.3	4	3.9	

*Varying totals because of missing values.

Predictors of the intention to leave

As shown in Table 5 some factors were no longer significant after adjustment, such as having dental therapy as first choice of study, being funded for dental therapy degree, highest degree obtained, year of qualification, awareness of dental therapy scope of practice, and reporting that dental therapy profession is valued in South Africa. However, other factors remained significant after adjustment. For instance, the intention to leave was negatively associated with older individuals (AOR=0.93, CI: 0.86-0.99); those who identify as Indian race group (AOR=0.30, 95% CI: 0.13-0.72) and those who have job satisfaction (AOR=0.25, CI: 0.21-4.16).

DISCUSSION

The study explored job satisfaction and intention to leave among South African dental therapists. Only 30.5% of the participants reported being satisfied with their jobs, while 51.5% expressed their intention to leave the profession, with a significant association between job dissatisfaction and the intention to leave. This aligns with Hertzberg's two-factor theory and implies that if employers prioritise job satisfaction, they will reduce attrition.

Our study sample was dominated by African race (74.5%), which is consistent with two other studies of dental therapists in South Africa.^{10,29} This is aligned with the South African racial profile, where 81% of citizens are Africans³⁰ and also, in part, explained by the fact that dental therapists in South Africa were and are still trained at only two historically black universities.

This study sample predominantly resided in KZN and Gauteng, which are the only provinces where dental therapy training is provided. A recent review of HCPSA records also reported an unequal distribution of dental therapists across South African provinces, with most located in KZN (44%) and Gauteng (27%).¹¹ To ensure equitable distribution of dental therapists throughout the country, training offerings should either be expanded to other provinces or existing programmes should

consider more targeted recruitment of future students to be more reflective of underserved provinces.

The majority of study participants worked in the private sector, similar to a previous study on UKZN dental therapy graduates where 47% were in private practice.¹⁰ This trend is also seen among dentists, with 70%-80% working in the private sector, which serves about 20% of South Africa's population.³¹ This concentration in the private sector is partly due to limited job opportunities in the public sector.¹⁰ To address dissatisfaction among public sector dental therapists, government should focus on reviewing and properly implementing policies related to recruitment, retention and remuneration in order to attract and retain more dental therapists within the public sector that is utilised by more than 80% of South African citizens.⁴

The majority of participants in our study expressed job dissatisfaction. Factors influencing job dissatisfaction included the institution where participants qualified, availability of job opportunities, awareness of scope and not feeling valued. These findings align with similar studies conducted in South Africa, the UK and New Zealand.^{32,33,34} However, these sources of dissatisfaction are not universal among dental therapists. For instance, Australian dental therapists reported satisfaction with the work itself, supportive environment, career development, autonomy and professional recognition.⁸ Closer to home, a study in West Ethiopia found that more recognition for outstanding performance correlated with higher job satisfaction.^{34,35} These findings are consistent with Hertzberg's two-factor theory³⁶ and point the the value of addressing perceptions of "lack of respect" and "poor recognition" as strategies for retaining experienced healthcare professionals.

Lack of career pathing was a significant factor contributing to job dissatisfaction among our participants and has been linked to job dissatisfaction and intention to leave in previous studies.^{8,12} The University of Rwanda provides an

Table 5. Intention to leave among the dental participants: multivariable regression model

Characteristic	Categories	Adjusted or	95% CI	P-value
Age	Mean (SD)	0.93	0.86-0.99	0.04
Race	African	1		0.01
	Indian	0.30	0.13-0.72	
Was dental therapy your first choice for study?	No	1		0.74
	Yes	0.89	0.44-1.78	
Was your dental therapy degree funded?	No	1		0.22
	Yes	1.55	0.76-3.16	
What is your highest qualification?	Bachelor's only	1		0.72
	Post bachelor's	1.86	0.38-1.97	
Which year did you qualify?	1977-1999	1		0.41
	2000-2009	1.62	0.52-5.02	
	2010-2019	1.28	0.21-7.64	
When did you become aware of the scope of the dental therapy profession?	Before registration	1		0.48
	After registration	0.72	0.29-1.78	
Are you satisfied with your job?	No	1		0.001
	Yes	0.25	0.11-0.57	
Are dental therapists valued like other mid-level health professionals?	No	1		0.93
	Yes	0.93	0.21-4.16	

example of where this concern has been addressed through the introduction of honours and master's programmes in dental therapy, which have expanded the scope of practice and resulted in no reported attrition in the country.³⁷ South African universities, together with HPCSA, should explore if similar postgraduate programmes could be introduced to expand the scope of practice for dental therapists, aiming to attract and retain more professionals in the field.

Availability of job opportunities post-graduation was associated with high job satisfaction in our study. Perceptions of job opportunities could be improved by offering dental therapists community service jobs immediately after graduation, like other professionals.³⁸ Additionally, community service helps to enhance their skills post-graduation.³⁸ It is crucial for the government to include dental therapists in community service to improve coverage and address the burden of untreated oral diseases.⁴

Poor remuneration was a significant factor contributing to job dissatisfaction across private, public and academic sectors. Similar studies among dental therapists in South Africa have reported similar frustrations with remuneration,^{20,21} which has been cited as a top reason for attrition across other professions.³⁹ This calls for improvement of dental therapy salaries and financial benefits for those employed in both the public and academic sectors, this includes salaries (for those employed in the public, academic and private sectors) and retention incentives for those employed in the public sector. Regarding low reimbursement fees by medical aids, dental therapists are allowed to charge what they believe their service is worth; however, the cost should be reasonable and the patient must agree to the cost prior to treatment.

This study has limitations, including potential selection bias due to the nonrepresentative sample of 200 participants, which limits generalisability of the findings. Also, intention to leave a profession is not the same as having already left. However, a strength of the study is the inclusion of qualitative responses that provide additional insight into participants' answers. Future research should employ a qualitative approach to gather more in-depth information on factors contributing to attrition, particularly from dental therapists who have left the profession.

CONCLUSION

Job dissatisfaction and intention to leave among dental therapists in South Africa is prevalent. If study participants act on their intention to leave, the resources invested in their training will have been wasted and communities will continue to be underserved. The intrinsic and extrinsic factors that contributed to job dissatisfaction in this study also point to possible solutions. Managers, universities, policymakers, decision-makers, regulators and medical aid administrators can address these issues by implementing strategies to recruit and retain dental therapists in South Africa. Addressing modifiable factors is crucial for human resources planning, to retain dental therapists within the profession. Of priority is the need to review and revise policies around recruitment and retention, career pathing and remuneration in the private, academic and public sectors. Beyond retention of existing dental therapists, South Africa also needs to act on strategies to expand dental therapy training offerings, with particular attention to proactive recruitment strategies for candidates from underserved parts of the country. In acting on the findings of this study, there is an opportunity to increase access to basic oral health services to underserved populations in South Africa.

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Embracing technology for improving dental records and record keeping in the Republic of South Africa. A review.

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ABSTRACT

Forensic odontology (FO) techniques are used to identify unknown remains and play an integral role in dental-legal cases. The utility of FO relies on accurate antemortem records – the creation and management of which continues to be a global challenge, albeit more acutely presenting in developing countries. Inadequate record keeping and management by the dental fraternity has made application of FO techniques for identifying unknown remains challenging. In addition, dental-legal cases such as in homicides, rapes, patient mismanagement and fraud are sometimes unresolved due to record keeping and health system shortcomings. This current status quo affects families and society: bereaved families are deprived of closure, and protracted litigations ensue, leading to various socioeconomic consequences.

Digital technology-based solutions can potentially mitigate challenges associated with poor dental record creation, maintenance and storage. The solution offered by introducing digital technology in other sectors of developing countries can similarly benefit oral health services and, by extension, the practice of forensic odontology.

This review aims to highlight the inadequacies in dental record keeping in the Republic of South Africa and propose ways to improve the systems by incorporating digital technologies, ensuring a sustainable, efficient and universally accessible method of record keeping.

Introduction

A dental record is an official document that corroborates a patient's contact with a healthcare provider.¹ This can be in a

paper or electronic format, and includes information such as the patient's details, clinical notes, investigation results and clinical correspondence.¹ Dental records can also be used to provide antemortem information for forensic investigations, evidence for legal proceedings and establish patient care continuity.

The regulations governing the enforcement of dental record keeping vary across nations, regions and legislatures worldwide. However, there is insufficient literature on the enforcement of the stipulated guidelines related to dental record keeping.²⁻⁴ In the US, dental record keeping enforcement and guidelines differ across the states, while in England, the Care Quality Commission was established as an independent regulatory body that ensures adherence to the National Health Service standards of dental care and record keeping.⁵ In contrast, the oral health services in African countries are characteristically plagued by inadequate policies and strategic plans affecting the frameworks and guidelines on dental records.^{6,7}

In the Republic of South Africa (RSA), dental records are mandated by the Health Professions Council of South Africa (HPCSA) through detailed statutory guidelines.⁸ The guidelines mandate practitioners to store records for at least six years from the date the contact with the patient becomes dormant, and longer for mentally incompetent individuals and minors.⁸ HPCSA guidelines emphasise the need to create records that will "improve clinical outcomes, reduce waste and ensure stakeholder engagement and satisfaction", as part of the expected standards of the dental team in the treatment and management of patients.^{9,10}

Dental records are also expected to comply with the other legal instruments such as the National Health Act [No.61 of 2003].¹¹ The National Health Act is a framework that structures a uniform health system and service delivery in RSA.¹¹ The Act outlines a practitioner's obligation to create, protect and maintain records for a minimum of six years, failure of which may result in a fine, up to one year's imprisonment, or a combination of the two.¹¹

RSA has additional legislative frameworks that are relevant to dental records. These include The Electronic Communication and Transaction Act [No.25 of 2002]; Protection of Personal Information Act [No. 4 of 2013]; National Archives of South Africa Act [No. 43 of 1996]; Promotion of Access to Information Act [No. 2 of 2000]; Copyright Act [No.98 of 1978]; and The Protection of State Information Bill, B6-2010.¹¹ The Occupational Health and Safety Act (No. 85 of 1993) states that health records must be retained for 20 years after treatment commenced.⁸ Although the country

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has adequate legislations, the effective execution as guided by the frameworks remains a challenge.²

The potential role of dental records in forensic investigations

South Africa is plagued by numerous social issues, such as unemployment, inadequate infrastructure, an overburdened health care system, high unemployment and crime, to name a few. As one of Africa's premier economic hubs, the country accommodates between 2 and 4.2 million legal and illegal migrants.¹² Economic expansion will result in rural-urban migration, projected to be as high as 71.3% of the population by 2030, resulting in further displacement of people.¹² As an example of crime statistics in South Africa, 9,516 rapes, 6,424 murders, 65,636 thefts and 11,000 cases of grievous bodily harm were reported between April and June 2022.^{13,14} Internal migration, societal fragmentation, the population's high mobility, poor documentation of citizens, undocumented individuals and a homeless community of 100,000 to 200,000 have led to an exponential rise in the number of unidentified bodies in forensic services of major urban centres.¹⁵⁻¹⁸ The Gauteng Department of Health recorded 898 unidentified individuals between 2020 and 2021.¹⁴ The Western Cape reported 472 unclaimed bodies in the same period.¹⁵ The forensic odontology identification techniques could be critical in aiding the nation's forensic scientists and the authorities.

The collaboration between forensic services, investigating authorities and forensic odontologists is hampered due to insufficient dental antemortem data.¹⁶ It is essential to investigate and evaluate the causative factors leading to inadequate dental records. Additionally, the review will examine the potential of digital technologies in dental record keeping, and advocate for the introduction of the aforementioned technology as a means to improve practitioner compliance.

The role of dental records in disaster management

Natural, man-made and hybrid disasters are ever increasing globally, leading to loss of lives and widespread destruction of properties.¹⁸ When available and adequate, dental records provide an inexpensive, fast and reliable means of identification in disaster scenarios.¹⁹ The Australian bushfires of 2009 led to 173 casualties, 60% of which were identified with dental records input, while 40% of individuals were identified using dental records alone.²⁰ When complete, dental records assist with victim identification, bite mark analysis, age, gender and race determination.¹⁹ The South Asian Tsunami disaster of 2004 affected countries along the coast of the Indian Ocean, resulting in the deaths of 217,000 individuals.²¹ The availability of antemortem data enabled the successful identification of 67.6% of victims by forensic odontologists (FOs).²² The identification success was exceptionally high (90%>) for victims from the developed regions of Europe, North America and Oceania. In comparison, only 2% of Thai victims were identified using dental records, with the outcome attributed to the poor state of record keeping by Thai dentists.²² The higher success in the identification of victims from developed countries was due to numerous legislative and regulatory mandates on dental records, utilisation of digital technology and state-instituted financial incentives.²³

The disaster victim identification (DVI) protocols were developed by the International Criminal Police Organization

(Interpol) in 1988 to assist with disaster victim identification.²⁴ DVI protocols have ensured international uniformity, standard methodology and guidelines, culminating in high victim identification rates.²⁴ In the terrorist attacks, 17.05% (n=21) of total victims (n=129) were identified using dental records.²⁵ In this disaster, advanced DVI operation techniques involving forensic odontologists were employed.²⁵ The techniques included the use of computerised tomography (CT) scans for extraction of maxillofacial data to link to odontological records, principles of double examination to ensure validity of odontological records, reconstruction of 3-dimensional scans to replicate antemortem radiological data and registration of dentists' private contact numbers onto a national dental council registry in the event of a forensic emergency.²⁵ The forensic odontology community is urged to use Interpol DVI protocols for victim identification. The protocols reduce the challenges associated with differences in dental codes among nations, unreliable and inconsistent antemortem records, and a lack of digitised records.²⁵ These protocols can be amended and adopted to suit regional needs, to allow for speed, coordination and accurate results.²⁵

The state of dental record keeping practices

The state of dental record keeping remains inadequate in many regions of the world, with little to no difference between developed and developing countries.^{3,6} In a study from Australia, 74% of practitioners summoned for Professional Standards Panel (PSP) hearings for various complaints had inadequate records.²⁶ In Worcestershire, England 87.5% of dental records could be used in forensic investigations. However, incomplete information was prevalent, with 36% of the dentists failing to record information related to soft tissues; 30% did not report patient periodontal status; and 27% failed to perform a radiographic review (n=184).²⁷ In the studies from the Indian subcontinent, Astekar *et al.* described insufficient record keeping where (62%) of dentists in Rajasthan State, India (n=100) failed to maintain complete records.²⁸ Only 32% recorded patients' personal details.²⁸ In those with patient details recorded, the information on drugs prescribed, telephonic conversations, referral letters or personalised denture markers was not available.²⁸ Sohail *et al.*²⁹ reported 45% (n=350) of dental practitioners in Lahore, Pakistan did not maintain dental records with only 1% of the practitioners having a record retention of 10+ years.²⁹ In Croatia, Pavicin *et al.*²⁷ noted that while 87% of respondents (Croatian dentists) recorded the dental status in the first visit, only 46% recorded additional data of forensic value (abrasion, erosion, attrition and other dental anomalies), with only 33% of respondents keeping X-rays longer than five years.²⁹

The reports on the status of dental record keeping in RSA have revealed various inadequacies, ranging from inconsistencies in records creation and management to the fabrication of dental records. Van Niekerk and Bernitz³⁰ reported on the adequacy of dental records in a series of 40 cases requiring antemortem record analysis. The records revealed a failure to adhere to the requirements stipulated by the HPCSA guidelines on dental records.³⁰ The state of dental records at academic institutions do not fare any better. A quality assurance study by Kopsala and Rudolph at the University of the Witwatersrand revealed subpar record keeping standards.³¹ In a recent study conducted at the Medunsa Oral Health Centre, Mthethwa and Matjila³² described an unsatisfactory completion and poor retention

of dental records. Only 3.6% of the records sampled (n=543) were fully completed, with half being less than 80% complete. The records of a third of the patients seen at the oral health centre more than six years prior to the study were missing.³² This situation, in a teaching institution, can be very detrimental to forensic services in the country as future oral health practitioners from the institution are likely to have poor skills in record keeping, leading to the likelihood of patient mismanagement, compromised patient safety and care, and may result in adverse outcomes in case of litigation.^{33,34}

In a study comparing the country security status classifications and dental records retention time in the military health services South Africa, a medium risk country, was reported to retain the dental records for a minimum of 11 years. While the study highlighted that the long retention period increased the probability of identification, it did not report the dental records' forensic acceptability.³⁵ Opperman³⁶ investigated dental record keeping practices in the private sector in Cape Town Metropolitan, South Africa. Despite the limited sample size (n=34), the investigation demonstrated only 25.3% of dental files contained complete odontograms; 32.1% of the files had dental codes, denture identification was never recorded, while a dismal 14.7% of the practices retained dental records after 10 years.³⁶

The reasons suggested for the poor state of dental record keeping in South Africa include high patient volumes, poor management of records [missing, misplaced and duplicated files], lack of interplay between the various departments, lack of standardised record keeping practices in the various facilities, complacent staff and budgetary constraints.^{32,37-39} The World Health Organisation (WHO) recommends a dentist-to-population ratio of 1:7,500 in developing countries.⁴⁰ In South Africa, this ratio is 1:8,817, with the dental specialist to population ratio being 1:118,947.⁴¹ These ratios make it difficult to maintain quality records and attend to clinical matters as the system is under immense strain. Binarti and Fitriyan⁴² summarised five main factors affecting the quality of medical records: man, material, method, machine and other factors. The other factors include poor communication, crippling workload, the absence of checklists to ensure the completeness of records, and an absence of guidelines, policies and standard operating practices.⁴² Health workers also highlighted poor motivation to complete dental records due to the absence of benefits for this duty.⁴²

Advances in electronic dental records

A digital dental record is the recording and storage of patient-centred health information in a patented, digital format.⁴³ Digital dental records are a comprehensive platform where all social, demographic, medical and dental information is stored on the facility's hardware and/or in the cloud, should the need to restore or replicate patient information arise.³⁶ Other advantages of digital dental records include the increased ability to coordinate care, more data for research and decision making, improved coordination between practitioners and ease of identifying individuals.⁴⁴

A study conducted by Schwei *et al.*⁴⁵ revealed that the use of electronic dental records (EDRs) is prevalent in first-world countries. By 2009, 85%> of dental practices in the US possessed computers (n=166 000), with 14.3% of standalone practices and 14.3% of group practices using

EDRs.⁴⁵ The affordability of EDR systems was described as a barrier preventing the mass roll-out of electronic records in lower-income countries.⁴⁵ Electronic dental records save the healthcare sector money by reducing healthcare inefficiencies, although the true economic value of this technology will be difficult to express as some healthcare factors cannot be translated monetarily.⁴⁶

The provision of oral health services relies on clinical and laboratory procedures and modalities that have benefited from digital technology platforms.

Technological modalities such as intra-oral (digital) photography, speech recognition, digitised diagnostic aids (study models, digicephs, xero-radiography, digital radiography, CT and MRI scans, 3D facial imaging, intra-oral scanning and CAD/CAM technology, fluorescence imaging and digitally guided implant surgery), artificial intelligence and information management have been identified as adjuncts to dental charting.

The widespread adoption and integration of these technologies to health information systems, particularly electronic dental records, aims to streamline forensic odontology investigations, reduce duplication of information, enhance digital/paper-based or mixed records, reduce instances of lost records and aberrant clinical decisions.⁴⁷ The adjunct technology may have the additional benefit of improving the usability of health information systems. These advancements may address issues of concern for end-users such as poor customisation of information systems to suit dental departmental needs, consumption of time (particularly to dental charting and overall system usability) and excess burden to clinicians.⁴⁷ Ultimately, the adjuncts must serve three critical functions: create stability during periods of continuous system enhancements, enable implementation into a wider electronic health record, and encourage standardisation of dental records for forensic investigations.

Introduction of eCharts technology in South Africa

In the 2000s, the South African government proposed a National Electronic Health Record (eHR.ZA), whose primary goal was integrating patient data between the public and private sectors. By 2009, the programme was halted as the national department cited expenditure-related issues with suppliers and had no desire for software systems that needed to be interoperable.⁴⁸ The eHealth Strategy of South Africa 2012-2017 was developed to create a coordinated and interoperable system.⁴⁸ Currently, South Africa's Digital Health strategy (2019-2024) is a top priority digital health programme aiming to ensure that quality healthcare service is delivered.⁴⁹ Therefore, good monitoring of patient outcomes is vital, necessitating the need for exceptional electronic health records. Thus far, the Department of Health has approved the National Health Normative Standards Framework (HNSF) to allow for interoperability in eHealth.⁴⁹ This framework will outline how eHealth systems will function, interoperate and ensure patient-centred continuity of care at all levels between the private and public health sectors.⁴⁹ Ultimately, the eHealth solution should enhance the National Health Insurance (NHI) initiative.

Currently, South Africa has an excess of 40 separate health information systems.⁵⁰ More than half of these do not adhere to local or international standards, with a further 25%> of

these being individual platforms that fail to share information locally or externally.⁵⁰ Local standards include the need for open source software, a standardised reporting system to be submitted on a monthly or quarterly basis, user-friendliness, storage systems for data collected, integrated data repositories that are accessible at all levels, data security and integrity, creation of unique patient identifiers, creation of mobile systems to improve information system efficacy, and access control.⁵¹ Health information systems in developing countries are often uncoordinated and create replication of functionality across departments.⁵² As a result, information is incoherent, inconsistent, inefficient and often contradictory.⁵² Fragmentation and duplication of healthcare systems is often due to numerous donors and development partners participating in a country's healthcare sector. Market suppliers often create systems that aren't customised to the local health environment, are preferred by a particular stakeholder, or fail to consider the financial obligations of the various provinces.⁵² Legislation, enforcement and monitoring by agencies such as HPCSA or even the Independent Communications Authority of South Africa (Icasa), if deemed appropriate, will greatly assist in regulating this industry.

Digital transformation in records-intensive services sectors in developing countries

Globally, significant strides in digital transformation are observable across various services-based sectors and industries. Between 2000 and 2015, 130 countries introduced digitised identification (ID) systems.⁵³ Digital transformation has streamlined social protection for citizens, improved access to services and allowed linkages into different platforms and datasets.

The introduction of digitised ID systems allowed countries to expand social programmes while mitigating costs. According to Lowe⁵³, linking unique ID numbers to social program databases has saved Argentina \$143m over an eight-year period, while Botswana saved \$1.7m by removing 25% of fraudulent transactions.⁵³ In the same note, the potential of linking ID systems with digitised dental records will not only advance the corroboration of state information between various departments, but will assist with victim identification and the resolution of forensic cases.

The benefits of digital transformation are evident in other service-based sectors with wide reach in the population. In RSA, digital transformation and the introduction of biometric cards in the management of social grants saved the country more than R11.8bn.⁵⁴ The South African Revenue Service (SARS) commenced with digitisation of tax processing in 2007 with further upscaling being rolled out in 2013. This move encouraged taxpayers' compliance and drastically reduced tax-related fraud.⁵⁴ The collaboration between the two departments, SARS and the Department of Labour's U-Filing system, has allowed workers and employers to contribute, apply and access the Unemployment Insurance Fund.⁵⁴ Other e-Government services benefiting from digital transformation include ENaTIS (an online system that allows motorists to pre-book for learner's and driver's licence renewals); National Student Financial Aid Scheme (NSFAS), an online system that allows thousands of low to middle-income students to apply for financial aid; and the Department of Home Affairs' online booking system (BABS) that allows citizens to make online appointments to apply for passports, identity documents and other services.

In Africa, digital transformation has offered notable benefits in governance areas such as the electoral processes, census and financial services. Twenty-seven African countries have partial or fully digitalised elections with concomitant benefits of transparency and accountability in the electoral process. In the recent Kenyan election, the utilisation of digital technology in voter registration, verification and result transmission assisted in curbing electoral insufficiencies and ensured free and fair elections.⁵⁵

Digital transformation in the services sector was of particular importance during the Covid-19 pandemic, to ensure that marginalised communities had continued access to social protection and assistance programmes.⁵³ In the wake of the Covid-19 pandemic, academic institutions also had to adapt to new teaching conditions modalities – coping with closures, social distancing and remote learning activities. Onsite lectures and practical activities were replaced by online lectures and e-learning technologies. Augmented reality (AR) and virtual reality (VR) systems were also employed to simulate environments by creating artificial interactions in third and fourth dimensions through users' visual, auditory and motor sensations.^{56,57} A review of the educational quality enhancements from digital transformation in the dental curriculum demonstrated that digitalisation offers great potential to revolutionise the dental curriculum and education overall.⁵⁸ This includes implementing 24/7 facilities, virtual reality systems and web-based knowledge transfer.⁵⁷

The development in digital technologies such as software programs, wide-reaching and accessible fibre and Wi-Fi connectivity, improved data transfer speeds and continuous development have supported the exponential rise of mobile banking services.⁵⁴ The constant threat of fraudulent third-party attacks in the vulnerable online banking sector has led banks to utilise biometrics to protect sensitive information.⁵⁹ Tyme Bank, South Africa's first digital only bank, has 685 biometric kiosks in the country that require the use of a high-resolution camera, fingerprint and ID document scanning to access personal data.⁵⁴ The rapidly evolving, cutting-edge digital technologies could be applied to digital dental records to limit access to patient files, maintain patient confidentiality and standardise the transfer, processing, storage and protection of information. While dental record keeping remains paper-based in many developing countries such as South Africa, the abovementioned large-scale digital transformations demonstrate that a nationally implemented electronic health record is achievable, and may have a positive and wide-ranging impact on the healthcare system and the practice of forensic odontology.

Challenges in the adoption of electronic health records

RSA has developed policies and frameworks that generally govern dental and medical records. The implementation and enforcing of the guidelines and concomitant quality of dental records has faced challenges, whose true extent remains unknown.⁶⁰ This, coupled with maladministration, lack of infrastructure, budgetary constraints, poor accountability by legislative agencies and technological innovation are some factors that result in poor dental record keeping.^{42,60} Most public centres still employ paper-based dental records systems, despite eHealth strategies.⁶¹ The development of digital dental records will alleviate the abovementioned administrative and clinical challenges. Data received from the platform will raise awareness and priority for oral health,

enable the formulation of additional digital regulatory frameworks, and encourage innovation and adaptive management.

Reports from developing countries allude to paper-based records as the most predominant records and storage modality.^{60,61} The predominance of paper-based records may result from convenience, affordability and lack of home-grown technological solutions. Two studies in India found that most dentists still used pre-printed forms: 53% (n=38) and 62.8% (n=242) of dentists, with only 56.2% keeping the dental records for future retrieval.^{62,63}

Electronic dental records stand to benefit immensely from the continent's migration into a digitally-mediated era. Additional support from the internet of medical things (IoMT), internet and communication technologies, social media, augmented and virtual reality, and artificial intelligence further streamlines oral health care by facilitating workflow, decreasing cost, relieving dentist and dental auxiliary staff from routine and laborious tasks, and also igniting a participatory approach in personalised oral health care.⁴⁷ Notable disadvantages of digitisation include cost implications; restricted access in remote geographical areas; usability; questionable reliability; possible breaches in data security and external factors such as power outages and internet access.⁴⁵

The introduction of digital technologies and health information systems in dental records will culminate in efficient service delivery. It will lead to a decrease in administrative delays (as locating patient files will be easier), improved patient management, treatment outcomes and overall health of the population.⁴⁷ Medico-legal cases will be well regulated, with adequate documentation to correlate any incidents.⁶⁵ The data collected by the health information systems can also be used to conduct research and population studies, improving monitoring, facilitate surveillance and optimise budgeting of resources towards oral healthcare.⁶⁵

CONCLUSION

This review has demonstrated that the current dental record keeping practices in RSA are – similar to other developing countries – inadequate, inefficient and unlikely to assist in forensic identification and resolve dento-legal cases. The introduction of digital technology platforms can address the limitations associated with inadequate dental record keeping practices. This will bridge the gap between technology, oral health care and proper record keeping. The digitisation of medical records will likely save the time required to generate adequate dental records, assist in alleviating the patient burden, increase patient turnover and improve the rendering of oral healthcare. Finally, as the South African health sector prepares to migrate towards universal health care, digital dental records will make integrating with other health information systems easier and reduce associated costs.

KEYWORDS

South Africa, forensics, forensic odontology, dental records, digital technologies in dentistry

CONFLICT OF INTEREST

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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.



Bacterial contamination of curing light guides: prevalence and students' knowledge and awareness of measures to maintain sterility

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ABSTRACT

Introduction

It is generally accepted that inadequately sterilised dental curing light guides pose risks of infection and cross-contamination.

Aims and objectives

To determine the presence and level of bacterial contamination among curing light guides used by students during patient care at a dental school in South Africa and to describe students' knowledge and awareness of measures used to maintain their sterility.

DESIGN

A two-part descriptive study consisting of microbiological testing and a cross-sectional survey.

Methods

Swabs were collected from curing light guide tips before and after use for aerobic culture and a questionnaire was used to collect data pertaining to students' knowledge and awareness of measures used to maintain their sterility.

Results

The prevalence of contamination increased after use (54.5% vs 45.5%). Grades of bacterial growth higher than 1+ were not detected. Isolated bacteria were contaminants. The response rate for the questionnaire was 42.5%. Fifth-year students were overall more knowledgeable than fourth-year students (81.6% vs 67.5%) and were more aware of the existence of the different types of disposable barriers (27.5% vs 12.8%) and the impact of infection control barriers on curing light intensity (52.4% vs 15%).

Conclusion

Contamination occurred despite high levels of knowledge and awareness of the risk.

INTRODUCTION AND BACKGROUND

Healthcare-associated infections are a major global safety concern for both patients and healthcare professionals.¹⁻³ In dental settings, infections may be acquired directly through contact with blood, oral fluids or other secretions; indirectly through contact with contaminated instruments, operating equipment or environmental surfaces; and through inhalation or contact with microorganisms present in aerosols or spatters of oral and respiratory fluids or in dental unit waterlines.^{4,5} The cross-contamination potential of light-curing units, defined by Dolly and Sasa (2019) as "handheld devices that are used for the polymerisation of visible light-activated dental materials"⁶, has long been recognised.⁷ However, very few studies have investigated their microbial contamination. Janoowalla and colleagues (2010) found bacterial contamination on the base button, fan and handle of the light-curing units before and after use. The isolated bacteria included *Staphylococcus aureus*.⁸ Bacterial contamination of the light guide has not previously been described.

The four types of light-curing units that are currently available include quartz-tungsten-halogen (QTH), light-emitting diode (LED), plasma arc curing (PAC) and Argon laser units.⁶ The two most commonly used are halogen and LEDs. They are generally provided to the user as nonsterile devices. ANSI/ADA and ISO standards recommend manufacturers provide appropriate cleaning and disinfection directions to use on the unit which should be followed between each patient.⁹

Light-curing units are categorised as semicritical in the Spaulding classification scheme of patient-care items. Light guides come into direct contact with mucous membranes and have the potential for saliva or blood contamination.¹⁰ Just as with other instruments that come into contact with bodily fluids, light guides must be disinfected to control for infection and cross-contamination.⁹ Ideally, the curing lights should have removable, autoclavable light guides and easily disinfected surfaces. However, an autoclavable light guide is impractical for many curing lights that do not use a light guide and instead have the LED emitter at the light tip.¹¹

Numerous studies researching the use and maintenance of curing lights recommend that: light guides be routinely autoclaved or soaked in disinfectant after each patient or

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(to avoid damage by these processes) the light curing tips may be covered with disposable sheaths or barriers; the disinfection of the unit body should be done by spraying an appropriate disinfectant on to a 4 x 4 gauze and using this to wipe the LCU. The disinfectant should not be sprayed on to the hand piece or charger surface to avoid internal damage.^{7,12-14}

There is a large volume of published studies describing the impact of infection control barriers on light output from dental curing lights.¹⁵⁻¹⁸ Recent evidence suggests that the method of application of plastic barriers significantly influences the amount of reduction in light output. Soares and colleagues (2020) found that correctly applied plastic barriers reduced the light output by 5-8% compared to the incorrectly applied (14-26%).¹⁸

This study was intended to indirectly assess compliance with infection control practices at the dental school.

OBJECTIVES OF THE STUDY

To determine the presence and level of bacterial contamination among curing light guides used by students during patient care at a dental school in South Africa.

To describe students' knowledge and awareness of measures used to maintain the sterility of curing light guides.

MATERIALS AND METHODS

Study design

This two-part descriptive study consisted of microbiological testing of the light guides of curing light units and a cross-sectional survey.

Target populations

The two populations studied over a period of one week during the 11h00 to 13h00 clinic session in June and August 2022 were dental students who provided care to patients and the curing light units they used.

Dental student population

A tiny fraction of the population size of 143 third-year (49), fourth-year (71) and fifth-year (23) dental students had clinic sessions.

Curing lights population

A total of 20 sequentially numbered quartz-tungsten-halogen curing light units were available to be used by third- and fourth-year students. Half the population size was actually used. A lone fifth-year student used the individually issued portable LED curing light unit.

Data collection

Microbiological testing

Sterile swabs, premoistened with sterile saline, were used to collect samples for aerobic culture from the tip of the

light guide of numbered curing light units at the clinics over a period of one week during the 11h00 to 13h00 session before the units had been used and after they had been used. The third- and fourth-year clinics were held separately in the same floor of the hospital. Consequently, students signed for the same curing lights which were kept in the common control room. Samples were collected separately three months apart. All samples reached the laboratory within 2 hours of collection and were processed immediately upon arrival. Each labelled swab was uncapped and lightly rolled over the entire surface of a blood agar plate with the same label and incubated at 37°C for 48 hours. Resultant colonies were graded on a scale of 0 to 4+ based on the number of quadrants on each plate that showed positive growth according to the procedure used by Bible and colleagues (2009).¹⁹ They were classified according to the Gram stain procedure of Engelkirk and Duben-Engelkirk (2008).²⁰ A selection of colonies was sub-cultured in blood agar and the bacteria identified in VITEK®2, an automated instrument used for identification and antimicrobial susceptibility testing.

Cross-sectional survey

A self-administered, structured closed questionnaire was used to collect data from the classes of third-, fourth- and fifth-year dental students enrolled at a dental school in Gauteng, South Africa in 2022. The questionnaire surveyed students' knowledge and perception of infection control measures used to disinfect curing light guides. It consisted of 19 questions. The response variable of the questionnaire consisted mainly of a dichotomous or multiple choice of items.

Definition of variables and terms

Overwhelming majority refers to a majority that is around 70% or more. Vast majority refers to a majority that is 85% or more.

Ethical considerations

The study protocol was approved by the University Ethics Committee (SMREC/D/209/2020:PG). Permission to conduct the study was granted by the Chief Executive Officer (CEO) of the Oral Health Centre.

Statistical analysis/Hypothesis testing

Collected data was captured and analysed in SPSS software. Means and proportions (percentages) were calculated. The Chi-squared tests was performed to test for the statistical significance of the differences in proportions of responses to questions on knowledge and perception. McNemar's test was performed to test the hypothesis that the proportions of contaminated curing light guides were equal before and after use. The chosen significance level for the tests was a p-value equal to or less than 0.05.

Results

The results of microbiological testing and the cross-sectional survey are presented separately.

Table 1: Grades of bacterial growth observed by clinics before use

Clinics	Grades of bacterial growth		Total number of curing lights
	0	1+	
3 rd year	4	6	10
4 th year	7	3	10
5 th year	1	0	1
Total number of curing lights	12	9	21

Microbiological testing

Data obtained from microbiological testing of swabs were analysed.

Bacterial contamination was detected from nine out of 21 (42.9%) light guides before use. Grades of contamination higher than 1+ were not observed.

Table 2: Bacterial growth observed by clinics before and after use

Clinics	Session period	
	Before use	After use
3 rd year	-	√
	√	√
	√	√
	-	√
	√	-
	-	-
	-	-
4 th year	√	√
	-	-
5 th year	-	-
Total number of curing lights	11	11

√ = 1+ growth - = No growth

Bacterial growth (1+) was observed from 36.4% (4/11) light guides before and after use. The overwhelming majority (75%) of these curing lights were used in the third-year clinic. Two curing lights, which were uncontaminated before use, were contaminated after use.

Table 3: Comparison of the proportions of contaminated light guides before and after use

Before use	After use		Total number of pairs	2-sided McNemar's Test
	No growth	1+ growth		
No growth	2	4	6	1.000
1+ growth	3	2	5 (45.5%)	
Total number of pairs	5	6 (54.5%)	11 (100)	

The prevalence of contamination increased after use (54.5% vs 45.5%). However, there was insufficient evidence ($p=1.00$) to reject the null hypothesis of no difference in the prevalence of contamination before and after use in the population.

Microscopy

A mixed picture was observed on stained slides under the light microscope. The overwhelming majority of the bacteria were Gram positive i.e. they stayed purple, and only a few were Gram negative i.e. they turned pink. Cocci in pairs, clusters or chains predominated. Rod-shaped single cells were also seen.

Bacterial identification

Table 4: Identity of bacteria isolated before and after use

Bacteria	Session period	
	Before use	After use
Staphylococcus epidermidis	-	√√√
Kocuria varians	√√	-
Staphylococcus hominis	√	√
Sphingomonas paucimobilis	√	-
Granulicatella	√	-
Dermacoccus	-	√
Corynebacterium species	-	√

√ = Numbers of 1+ growth isolated - = no growth

Bacteria of the genus *staphylococcus* were the most common isolates. *Staphylococcus epidermidis* was isolated solely after use. *Staphylococcus hominis* was the only bacteria isolated before and after use.

Cross-sectional survey

Survey data collected from the fourth- and fifth-year classes were analysed. The response rates were 32.8% and 91.3% respectively. The third-year class was excluded from the survey after they failed to return the completed questionnaire two months after being issued with them. The frequency of responses to questions on the topics of knowledge, attitude and behaviour are reported separately.

Demographic characteristics of study participants

Table 5: Sex of study participants

Year of study	Sex		Total	Fisher's Exact test
	Male n (%)	Female n (%)		
4 th year	8 (40)	12 (60)	20 (100)	0.410
5 th year	5 (25)	15 (75)	20 (100)	
Total	13 (32.5)	27 (67.5)	40* (100)	

More than twice as many females as males participated in the study. The difference in proportions between male and female students in the fourth and fifth years of study was, however, not statistically significant ($p=0.410$).

Table 6: Age of study participants

Year of study	Mean age	SD	T-test
4 th year	24.75	4.44	0.932
5 th year	24.85	2.83	

The mean age of the fifth-year class was 0.1 year larger than that of the fourth-year class. However, the difference was not statistically significant ($p=0.932$).

Questionnaire responses

The differences in the proportions of responses to the question about the categories of patient-care items between the fourth- and fifth-year classes were statistically significant ($p=0.021$).

A vast majority of students from both classes understood clearly that: curing light could cause transmission of infection among patients; universal precautions should

Table 7: Student responses to questions on knowledge by year of study

Question	Response options	Frequency of response by year of study		Fisher's Exact test
		4 th n (%)	5 th n (%)	
In which category of Spaulding classification scheme of patient-care items does the curing light belong?	Critical	6 (30)	2 (9.5)	0.021
	Semicritical	5 (25)	15 (71.4)	
	Noncritical	5 (25)	1 (4.8)	
	No response	4 (20)	3 (14.3)	
Total		20 (100)	21 (100)	
Curing light can cause transmission of infection among patients	Yes	18 (90)	20 (95.2)	0.481
	No	2 (10)	1 (4.8)	
Total		20 (100)	21 (100)	
Disposable infection control barriers affect the light intensity of the light-curing unit	Yes	3 (15)	11 (52.4)	0.027
	No	15 (75)	9 (42.9)	
	Do not know	1 (5)	1 (4.8)	
	No response	1 (5)	0 (0)	
Total		20 (100)	21 (100)	
Universal precautions (gloves, masks, protective eyewear or face shield, and gowns) should always be used when working on a patient using a curing light	Yes	19 (95)	19 (90.5)	1.00
	No	0 (0)	1 (4.8)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	
It is my responsibility to ensure that the light guide is sterile at the start of the day, between patients, and at the end of the day	Yes	17 (85)	20 (95.2)	0.409
	No	1 (5)	0 (0)	
	No response	2 (10)	1 (4.8)	
Total		20 (100)	21 (100)	
Wiping the light guide with a suitable disinfectant or applying barrier protection between patients is	Necessary for infection control	19 (95)	18 (85.7)	0.737
	Unnecessary for infection control	0 (0)	2 (9.5)	
	Necessary but impractical and needs much effort	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	

always be used when working on a patient using a curing light; it was their responsibility to ensure that the light guide was sterile at the start of the day, between patients, and at the end of the day and that wiping the light guide with a suitable disinfectant or applying barrier protection between patients was necessary for infection control.

Almost thirty-eight percent (37.4%) more fifth-year students than fourth-year students understood that the light intensity of the light-curing unit affected disposable infection control barriers. The differences in the proportions of responses to the question about whether disposable infection control barriers affect the light intensity of the light-curing unit was statistically significant ($p=0.027$).

An overwhelming majority of students from both classes were not aware of the manufacturer's recommendation for the maintenance of sterility of the curing light guide.

Almost twice as many fifth-year students as fourth-year students (38.1% vs 20%) had seen or were aware of different types of disposable barriers available to cover the curing light guide such as tip sleeve and plastic wrap. The difference in the proportions of fourth- and fifth-year students who had seen the plastic wrap was statistically significant ($p=0.029$).

DISCUSSION

This study set out to determine the presence and level of bacterial contamination of curing light guides used by dental students during patient care and describe students' knowledge and awareness of measures used to maintain their sterility.

Microbiological testing

Microbial contamination of the light guides has not previously been described – comparable studies were not found. Bacterial contamination of the base button, fan and handle of the curing light has, however, been established.⁷

The results of this study show that bacterial contamination before use was prevalent at 42.9%. The findings of the current study are consistent with those of Janoowalla and colleagues (2010) who detected bacteria on the base button, fan and handle of almost 40% of the curing lights sampled in the morning before use.⁷ This combination of findings suggests that disinfecting curing lights before use might be a problem at dental teaching hospitals.

This study did not detect levels of bacterial contamination higher than 1+. These results are somewhat encouraging considering the fact that light guides have the potential for

Table 8: Students' responses to questions on awareness by year of study

Question	Response options	Frequency of response by year of study		Fisher's Exact test
		4 th n (%)	5 th n (%)	
Are you aware of the manufacturer's recommendation for the maintenance of sterility of the curing light guide?	Yes	4 (20)	2 (9.5)	0.697
	No	15 (75)	18 (85.7)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen or are aware of the existence of autoclavable guides?	Yes	6 (30)	3 (14.3)	0.628
	No	13 (65)	17 (81)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen or are aware of the existence of single-use presterilised plastic guides?	Yes	6 (30)	4 (19.1)	0.734
	No	13 (65)	16 (76.2)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen or are aware of different types of disposable barriers available to cover the curing light guide?	Yes	4 (20)	8 (38.1)	0.573
	No	15 (75)	12 (57.1)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen the tip sleeve?	Yes	2 (10)	3 (14.3)	1.00
	No	17 (85)	17 (81)	
	No response	1(5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen the plastic wrap?	Yes	4 (20)	12 (57.1)	0.029
	No	15 (75)	8 (38.1)	
	No response	1(5)	1 (4.8)	
Total		20 (100)	21 (100)	
Have you seen finger cots?	Yes	1(5)	0 (0)	0.737
	No	18 (90)	20 (95.2)	
	No response	1 (5)	1 (4.8)	
Total		20 (100)	21 (100)	

saliva or blood contamination.

The most interesting result was that bacterial contamination was detected from 36.4% of the curing light guides sampled before and after use. These findings are rather disappointing. They suggest poor compliance with the manufacturer's instruction to disinfect the curing light between each patient.

Another important finding was that the prevalence of contamination increased after use compared to before use (54.5% vs 45.5% respectively). This was, however, not statistically significant ($p=1.00$). The findings of the current study are consistent with those of Janoowalla and colleagues (2010) who detected contamination on almost 40% of the curing lights before use and 64% after use.⁷

Microscopic identification

The results of this study show that Gram positive cocci were the predominant organisms. These findings accord with those of Janoowalla and colleagues (2010).⁷

Biochemical identification

The results of this study indicate that bacteria detected were contaminants. The isolated bacteria included *Kocuria varians*, *Staphylococcus epidermidis*, *Staphylococcus hominis*, *Granulicatella*, *Dermacoccus* and *Sphingomonas paucimobilis*. It seems possible that these organisms could have originated from hand contact or oral contamination as they naturally inhabit the skin and mucous membranes.^{21,22}

Cross-sectional survey

Students' awareness of measures used to maintain the sterility of curing light guides has not previously been researched.

Response rate

The results of this study indicate that the response rate of the fourth-year class was 32.8%. This low response rate accords with that found in questionnaire-based studies in dental literature.²³ The data collected in this study needs to be interpreted with caution because the sample is not representative of the population as a whole. There are several possible explanations for this result. They include:

students were away on off-campus rotations; patients did not honour appointments; and the days of data collection for the study coincided with test dates.

Demographic information

The results of this study indicate that more than twice as many female students as male students participated. This finding is not representative of the gender distribution within the classes. It is due to the fact that more female than male students were available to participate in the study.

The results of this study indicate that the mean age of the fifth-year class was 0.1 year larger than that of the fourth-year class. This marginal difference in mean age between the classes was contrary to expectations. It could be attributed to the presence of outliers in the fourth-year class as evidenced by the large standard deviation.

Awareness

The current study found that awareness of the existence of the different types of disposable barriers among students was poor. This was demonstrated by the results that show that: 29.1% of all students had seen or were aware of different types of disposable barriers available to cover the curing light such as tip sleeve and plastic wrap; the difference in the proportions of fourth- and fifth-year students who had seen the plastic wrap was statistically significant ($p=0.029$) (Table 8). These results were not very encouraging. They indicate that students are not keeping up with the latest technological developments in the field.

Knowledge

The current study found a huge discrepancy in the knowledge of Spaulding classification scheme of patient-care items between the fourth- and fifth-year year classes. Nearly three times as many (2.86 times) fifth-year as fourth-year students knew that curing lights belonged to the semicritical category ($p=0.021$). These findings are rather disappointing considering that this classification scheme is a universal framework used by infection control professionals and others when planning methods for disinfection or sterilisation.^{24,25}

The results of this study show that a vast majority of students from both classes understood clearly that: a curing light could cause transmission of infection among patients; universal precautions should always be used when working on a patient using a curing light; it was their responsibility to ensure that the light guide was sterile before use, between patients, and at the end of the day and that wiping the light guide with a suitable disinfectant or applying barrier protection between patients was necessary for infection control. This combination of findings is encouraging. It indicates that students are aware of the potential risk of infection transmission from contaminated curing light guides. The most interesting finding was that 52.4% of the fifth-year class and only 15% of the fourth-year class was aware of the impact of infection control barriers on curing light intensity. This finding reflects the difference in the level of clinical experience between the fourth-year and fifth-year classes. It is rather disappointing considering that a great deal of the previous work has reported a reduction of light intensity related to the use of gloves or other opaque barriers.¹⁵⁻¹⁸

Limitations of the study

The small sample size and low response rate threatens the internal validity of this study.

CONCLUSION

The current study found that contamination occurred despite high levels of students' knowledge and awareness of the risk of infection transmission from contaminated curing light guides

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Restorative considerations in children with congenital dental anomalies

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ABSTRACT

Children with congenital dental manifestations may have to endure challenges due to their abnormal tooth development, altered skeletal growth, compromised masticatory and speech function and poor aesthetics. This may further lead to psychosocial problems. These children may have deficient ridge height and volume in edentulous areas, missing teeth, malformed or malpositioned teeth and often the added complication of xerostomia. These anomalies complicate conventional treatment and have led clinicians to consider alternative restorative treatment options. Recent literature suggests that osseointegrated implant therapy may be a viable option for children

with congenital dental defects. However, studies are scarce, with no standardisation of success or survival criteria, and little long-term follow-up results. This paper explores the various restorative options and highlights the need for a multidisciplinary team approach.

INTRODUCTION

Dentofacial aesthetics may influence how individuals are treated by society. In children a deviation from the accepted dentofacial form can lead to bullying from contemporaries¹. Dental anomalies may have a psychological effect on the self-esteem of children and adolescents, most notably during this early phase of psychosocial development². Congenital defects, trauma and conditions causing oligodontia, aplasia and malocclusion can cause functional, aesthetic and psychosocial challenges for growing patients³. Tooth absence, excluding the third molars, can be divided into hypodontia, oligodontia and anodontia. Hypodontia is the absence of less than six teeth, oligodontia is the absence of six or more teeth (excluding the third molars), and anodontia is the complete absence of teeth^{4,5}.

Conditions affecting odontogenesis can also affect the underlying alveolar bone and, in extreme cases, the maxillofacial skeleton⁴. Oligodontia may be treated with removable complete dentures, partial dentures, overdentures, tooth-supported fixed prostheses or implant-retained prostheses. Conventional treatment to replace

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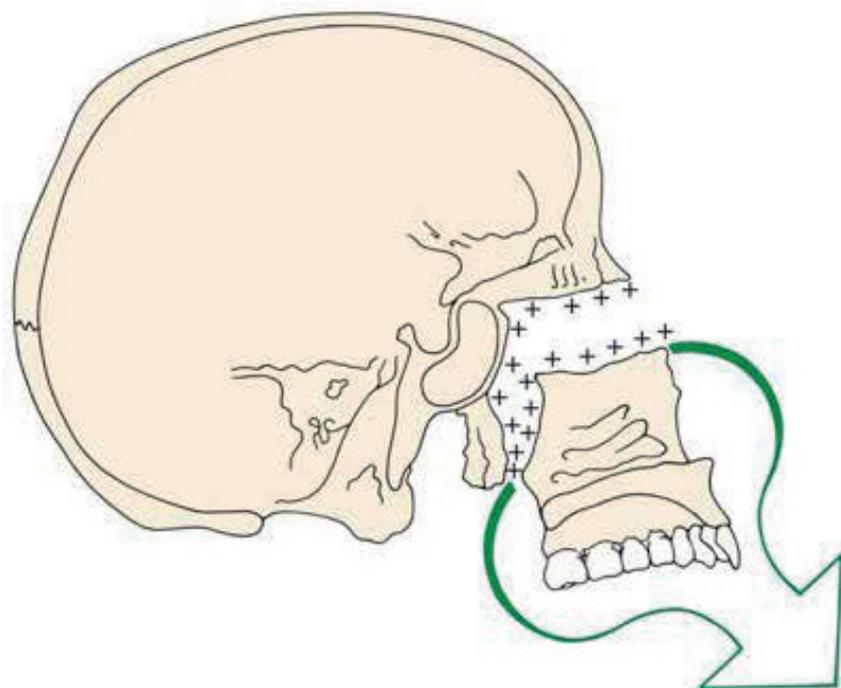


Figure 1. New bone added along the lines of the maxillary sutures⁷

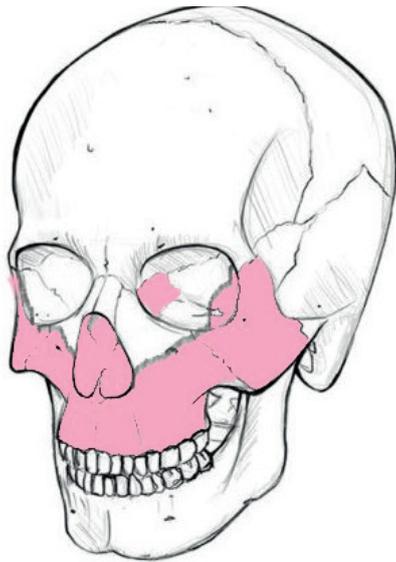


Figure 2. Areas of resorption (yellow)

missing teeth and restore function and aesthetics may pose difficulties in those cases where patients also have severely resorbed, atrophic or knife-edge alveolar ridges in the edentulous areas. It may thus be pertinent to consider implant therapy in children with congenital dental anomalies as opposed to conventional treatment modalities⁶.

Growth of the maxilla and mandible

Growth in the maxilla is due to apposition of bone at the sutures that connect the maxilla to the cranium and cranial base and by surface remodelling. This growth moves the maxilla forwards and downwards relative to the cranium and cranial base, with the forward movement facilitated by the growth of the cranial base and downward movement by growth at the sutures. After the age of 7, sutural growth is solely responsible for the growth of the maxilla (Fig 1)⁷.

As the maxilla grows forward the anterior part simultaneously gets resorbed, as is highlighted by the yellow areas (Fig 2)⁸. Simultaneously, remodelling of the palate moves it downwards and widens it. This is achieved by bone removal from the floor of the nose and bone apposition on the surface of the palate (Fig 3)⁷.

Mandibular growth

Growth of the mandible was originally described in relation to the cranial base, but has more recently been analysed using data from vital staining experiments. In the latter, 2% Alizarin Red S, a dye with a high affinity for calcium, is injected intraperitoneally or intravenously to reveal areas where there is a high calcium concentration, thus revealing where bone is being deposited and resorbed in the mandible. If the cranial base is used as a reference, then the chin appears to move downwards and forwards (Fig 4A). However, contrary to this theory, vital staining data revealed minimal changes in the body and chin area, with only the ramus, condyle and coronoid processes having substantial growth in the mandible (Fig 4B). Thus, staining suggests that the mandible grows longer by apposition of bone in the posterior part of the ramus, with simultaneous

removal of large amounts of bone from the anterior ramus. Essentially the body of the mandible grows longer as the ramus moves away from the chin⁷. These observations are important to bear in mind if fixed restorations or implants are to be considered in children, as mandibular growth patterns will affect their final position⁷.

Definitions of common congenital tooth abnormalities

Anodontia – is the complete absence of tooth development⁸

Hypodontia – is the absence of development of less than six teeth, excluding third molars⁵

Oligodontia – is the absence of development of six or more teeth, excluding third molars⁸

Malformation – refers to any tooth form outside the normal range of size and shape. It includes macrodontia, microdontia, gemination, fusion and concrescence, among others⁸

Malposition – is the incorrect buccolingual or mesiodistal tooth position or angulation of a tooth⁸

Transposition – refers to a normal tooth erupting in an incorrect position⁸

Delayed eruption – is when the tooth has not emerged within a year of its normal range or when the tooth has not emerged even though 75% of the root has formed⁸

Impaction – refers to teeth that stop erupting before they fully emerge into the oral cavity⁸

Ankylosis – is where eruption stops after emergence of a tooth into the oral cavity, but only when this is due to union of the tooth cementum or dentine to the alveolar bone⁸

Syndromes associated with congenital dental anomalies

Odontogenesis is a complex process between the enamel epithelium, underlying mesenchyme and signalling factors (FGF, SHH, BMP and Wnt). Many factors, including physical obstruction, disruption of the dental lamina, space limitation, functional abnormalities of the dental epithelium, failure of initiation of the underlying mesenchyme and environmental influences such as trauma, infections, ionising radiation, drugs and hormonal influences may affect odontogenesis^{5,9}. Any interruption in tooth development may affect the morphology, number or differentiation of teeth^{10,11}. Neville et al (2016)⁸ reported on more than 50 congenital syndromes associated with oral and dental manifestations. However, Bohner et al's 2019 systematic review highlighted cleft palate, congenital aplasia, ectodermal dysplasia and non-syndrome agenesis as the most common disorders associated with congenitally missing teeth³.

Oral characteristics of oligodontia

Dentoalveolar characteristics commonly associated with oligodontia include:

1. Occlusal disturbances such as crossbite, deep bite, steep maxillary incisal inclination, abnormal attrition, narrow alveolar ridge and vertical defects^{9,12}.
2. Loss of vertical dimension due to less growth in the maxilla compared to the mandible, leading to a class III skeletal relationship¹³.
3. Eruption disturbances including overeruption of teeth opposing edentulous areas, impacted Ds and Es, infraocclusion of Ds and Es, ectopic eruption, delayed eruption, rotation of teeth, multiple diastemas, severe attrition of retained primary teeth, altered tooth morphology, microdontia, conically shaped teeth and any number of other malformations^{9,12}.

Psychological effects of tooth loss in children

Bzoch stated “the development of a child takes place within the context of interactions with others”, and that “early developmental events can influence later behaviour”. In children with congenital defects, their life experiences may be affected by their disorder as well as the number and types of associated disorders they must bear¹⁴. Congenital oro-facial defects can have an impact on growth and development, speech and hearing, mastication, sight and smell and aesthetics. These in turn can affect the mother-child relationship as well as the child’s interactions with others. Furthermore, these children often need to attend many visits to hospitals and clinics, where they will encounter a number of strangers and undergo various procedures, which can all be frightening and stressful for them. At the same time, they miss out on normal childhood activities and schooling, which can impact their social and academic development and their oral health related quality of life (OHQoL).

OHQoL can be assessed using the Child Perceptions Questionnaires (CPQ). There is a short and a long version of this questionnaire available. Both questionnaires divide children into age categories from 8-10, 11-14, 15-17 and 18+. And both are subdivided into 4 parts that address oral symptoms, functional limitations, emotional wellbeing and social wellbeing. Each question can be answered on a 5-point Likert scale as either never (=0), once/twice (=1), sometime (=2), often (=3) and everyday/almost every day (=4). Final scores can range from 0-148 and 0-64 in the long and short questionnaires respectively. The higher scores correlate with a higher impact of conditions on OHQoL¹⁵. Liang et al (2010) compared the psychosocial impact of

hypodontia with moderate to severe dental malocclusion on children. They reported that patients with moderate to severe malocclusion and those with hypodontia both had a similar psychosocial status¹. Wogelius et al (2011) found an interesting observation that children with fixed orthodontic treatment had a higher CPQ value (22) than those with healthy oral conditions (9), cleft lip and palate defects (9) and those with rare dental anomalies¹⁶.

Conditions associated with hypodontia or oligodontia may negatively affect the OHQoL in young patients who may fear exposing their removable dentures to their peers, being bullied due to their differences or having a fear of dentists¹⁶. Furthermore, as children grow they become more aware of their oral health status, especially girls, who tend to have higher CPQ scores than boys¹⁵. Issues of bullying, embarrassment or shame associated with oligodontia affect the psychological and social wellbeing of children, especially in the important adolescent years.

To curb these negative aspects and emotions, treatment of these patients should aspire to improve aesthetics, promote craniofacial growth, improve the profiles, address masticatory and speech function and, to some extent, lead to better psychosocial development¹⁷. An added complication is that some conditions that affect odontogenesis may also affect the salivary gland development and function, leading to xerostomia, which has several negative repercussions on the teeth and oral environment. Edentulous areas often have narrow, sharp or deficient ridges. When this is compounded by other dental manifestations including missing teeth and xerostomia, restorative treatment becomes that much more difficult. Once again, this will impact negatively on

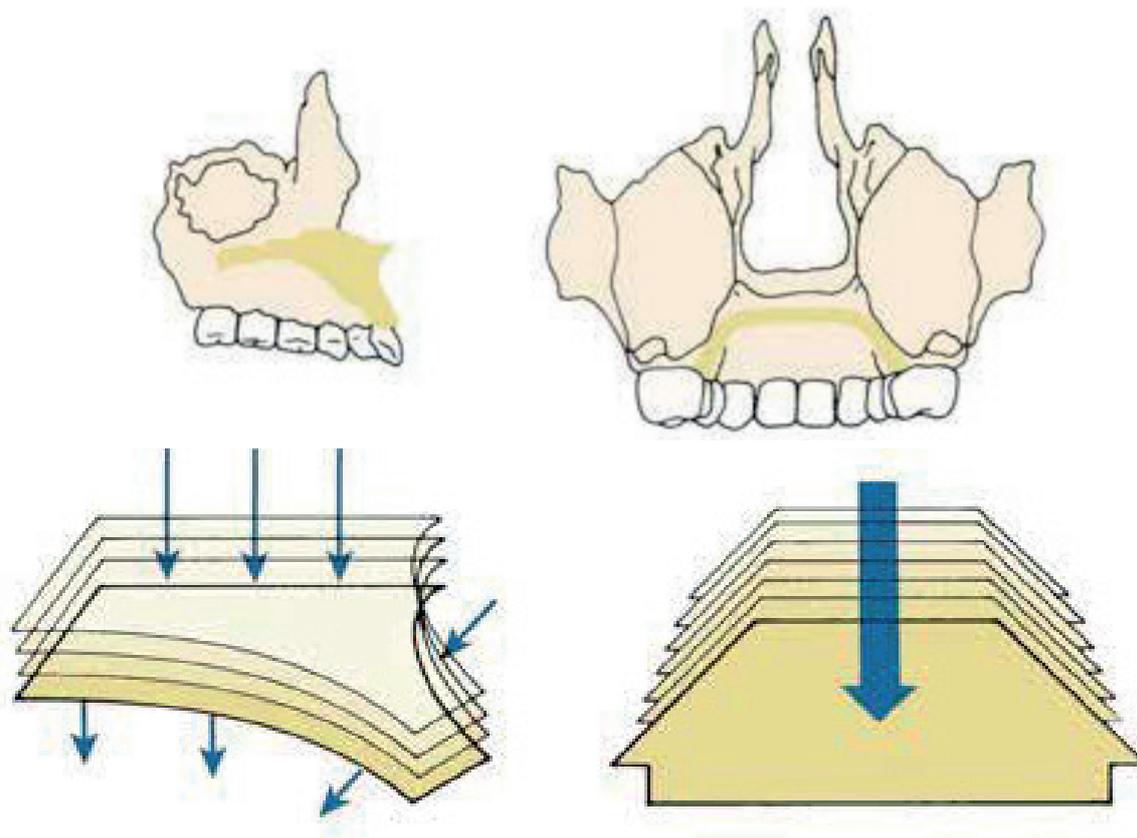


Figure 3. Bone apposition on the surface of the palate highlighted in yellow⁷

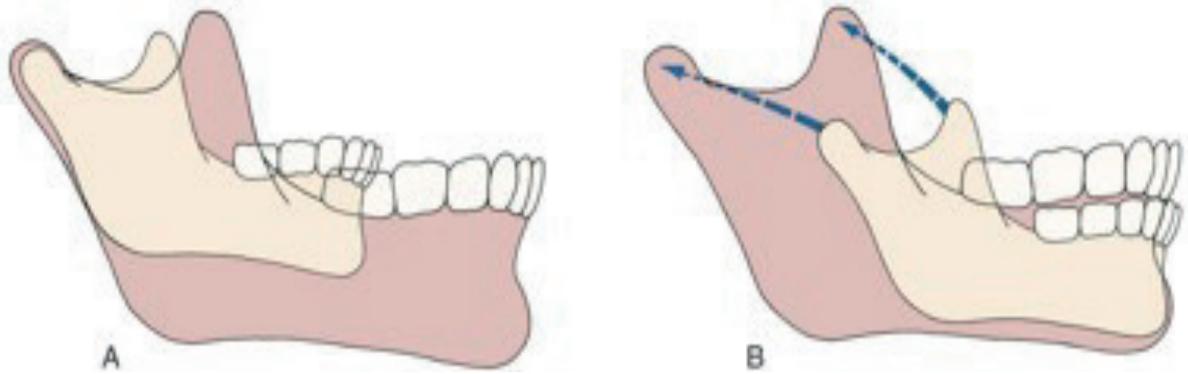


Figure 4. Bone growth in relation to the cranial base (A), and as assessed using Alzarin Red S dye (B)⁷

the child's OHQoL⁶. In recent years, more clinicians have begun to consider using fixed tooth supported restorations or osseointegrated implant-retained prostheses in children with congenital dental defects. These options may improve self-confidence, perceived quality of life, psychosocial health and alleged social acceptability^{6,17}. Careful consideration of the feasibility, timing of implant placement, future growth and potential restorative or implant failures should be made prior to embarking on any fixed or implant-supported prostheses in children with congenitally dental anomalies.

Treatment considerations

Almost all children with congenital tooth anomalies or absence will need some form of prosthodontic intervention, as well as any number of other treatment modalities. It stands to reason then that the overall management of each child should be coordinated by the treating dentist/prosthodontist, as part of a multidisciplinary team. The objective of this team approach is to “bring the child to a point where they do not differ significantly from their peers in terms of health, education or ability to interact socially”¹⁴. Good communication between the different specialities is essential to ensure the patient gets the appropriate treatment at the correct time to achieve the best possible outcomes in terms of speech, language and hearing, facial appearance, dento-occlusal development and oral function. Each phase of treatment and treatment modality impacts on the others, and thus requires careful co-ordination. For example, in cleft palate patients if timing of surgery is not correctly planned, too early closure of the palatal defect could impede dento-occlusal development and orthognathic growth¹⁴. Similarly, dental prostheses may address aesthetics and masticatory concerns but could affect speech and articulation at a crucial time in the child's social development. Thus, all aspects of the treatment regime need to be pre-planned and integrated rather than individually administered. Figure 5 is a diagrammatic representation proposed by the authors of how the various role players may interact. The vertical pillars represent the family; the prosthodontist/restorative dentist and technician; and various crucial allied disciplines including social workers, psychologists, geneticists, speech and hearing therapists, surgeons and nurse aids. The horizontal arms illustrate key dental disciplines that may be needed individually or in combination with each other.

1. Assessment and planning phase

This stage requires cephalometric, panoramic and hand wrist radiographs as well as articulated study casts as diagnostic aids³. During this phase of treatment, the clinician should

assess the age and developmental stage of the child, the anatomy of the hard and soft tissue, the number and location of missing teeth, presence of permanent successors, arch shape and the condition the child is suffering from^{3,18}. The quality and quantity of bone available in edentulous areas should also be evaluated as some areas may need bone augmentation to help support a prosthesis or to facilitate implant placement and integration¹⁹.

Any previous or currently worn prosthesis should also be examined to visualise arch relations and facial dimensions, and to identify any shortcomings with the hopes of improving these in the future. The assessment phase also includes planning to blueprint a phased approach that will address both functional and aesthetic needs. This will entail use of above-mentioned radiographs and diagnostic wax ups on articulated study casts. These help clinicians explore the various possible treatment options and facilitate communication between patient and clinician, and between members of the treatment team⁹.

2. Orthodontic phase

Malocclusion, rotated teeth, tilted teeth, microdontia and multiple diastemas are a few common traits seen in patients with oligodontia. These patients may require initial active orthodontic treatment¹², and often need prolonged use of retainers⁴. Orthodontics can help create or maintain space in the arches and correct adverse tooth relationships. Orthognathic surgery may also be needed to correct the jaw relationship⁶. It is imperative to remember that oral rehabilitation in growing patients must not only focus on immediate restoration of facial dimensions but must also facilitate craniofacial growth to obtain the ultimate ideal jaw relationship – if possible – as this will result in more optimal treatment in the adult patient. Jaw relationships may be improved using maxillary dentures with expansion screws to try to promote sutural growth¹³.

3. Surgical phase

The goal of this phase is to preserve bone and provide treatment that will benefit the patient immediately and in the future. The most crucial aspect is to try to preserve bone by retaining primary teeth for as long as possible²⁰. This may also be achieved by autotransplantation of teeth when possible. In children this procedure can be successful if the tooth apices are still open as this allows for healing with a functional periodontium. This ligamentous attachment enables the tooth to participate in growth of the alveolar ridge and allows for orthodontic tooth movement²¹. While auto transplants are only successful in children and adolescents,

deciduous teeth may, at times, be retained well into adulthood²¹. Although implants have not been widely used in children with congenitally missing teeth, Terheyden and Wüsthoff (2015) noted that implant supported prosthesis had a better outcome and higher survival rate than tooth autotransplants. Thus, the possible use of osseointegrated implant therapy warrants further debate²¹.

4. Prosthetic phase

This phase is important because of the dynamic oral environment, where there are many factors to consider. The first is the arch length. Bu et al (2008) found that in children with oligodontia the maxilla was on average 4.40mm shorter than its dentonormative counterpart, while the mandible was approximately 2.80mm shorter. The next factors are those of prosthesis retention, support, bone loading and follow-up treatment or maintenance. Kearns et al (1999) noted that loading of the basal bone at an early age leads to gradual resorption of the basal bone. Thus, any teeth that could viably be used to retain and support a prosthesis should be considered. Even small, malformed or malaligned teeth may be prepared for telescopic crowns and used to help support an overdenture. In the mandible, these are particularly useful to inhibit tilting of the mandibular denture and make cleaning easier than a fully fixed prosthesis¹⁷. Follow up should be every 3-6 months until growth is complete as new dentures may be needed to accommodate the growing jaw²². These appointments should monitor crown discolouration, gingival impingement, occlusal interferences and prosthesis stability¹⁶. In addition, radiographs should be taken every 2-3 years, with adjustment of restorations being made when needed, until growth is complete^{3,4}. (Note: The same principles for overdenture abutments will apply with regard to growth, monitoring, adjustment and maintenance when osseointegrated implant retained restorations are to be considered.)

In children with ectodermal dysplasia salivary gland hypoplasia is common leading to xerostomia and difficult adaptation and retention of removable dentures^{6,21}. Conventional treatment poses challenges due to previously mentioned absence of teeth, conical shape of existing teeth, knife-edged alveolar ridges and compounding xerostomia. This all results in poor denture retention, instability, pain on the ridges and mucosa, speech and masticatory difficulty and poor aesthetics²³. In these children one may thus begin to explore the possibility of placing endosseous implants. However, Terheyden and Wüsthoff (2015) expressed caution when placing implants in children with ectodermal dysplasia, as they often have delayed development in comparison to their peers and this could lead to an unfavourable final position of the implants.

4.1. Considerations for the use of osseointegrated implants in children with congenital dental anomalies

Implant treatment in children has historically only been considered if all other options have been exhausted and have failed^{24,25}. However, with the emergence of many new implant systems, mini-implants and possibility of custom-made implants, this is an area of dentistry that warrants more research and deliberation. Implant treatment planning needs to consider factors such as gender and age of the patient, skeletal maturation, available supporting and retentive structures, proposed implant location and the current and future needs of the patient²⁴. In the maxilla, growth may cause implants to develop diastema between them, to become infra-occluded, to end up in the sinus or to lose stability due to loss of buccal bone²⁶. It has been advised that 10 years is the minimum age that implants be placed in the anterior maxilla and only after the age of 15 in girls and 17 in boys on the posterior maxilla to help avoid later growth-related implant complications^{3,24}. In the

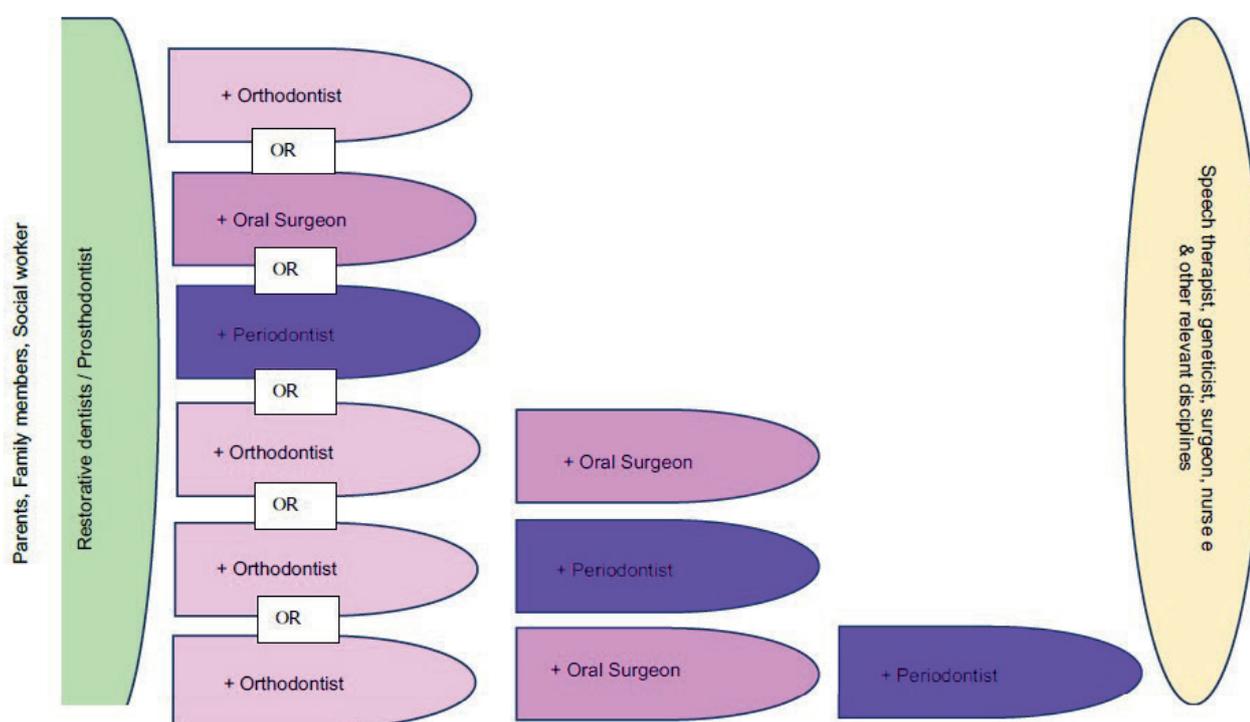


Figure 5. Diagrammatic representation of multidisciplinary team interactions (Proposed by LM Sykes and LV Mkhonza)



Figure 6. The Onplant implant.

maxilla placement of implants more coronally may help prevent infra-occlusion of implant crowns at a later stage, but could complicate the occlusal and aesthetic needs of the immediate restorations. In patients where the maxilla is unsuitable for implant placement, zygomatic implant placement may even be considered¹⁹.

In the mandible, the interforaminal region is the best site for implant placement, as there is little growth in this area after 6 years of age in the dentate mandible and after 3 years in a mandible with an edentulous interforaminal region^{3,17,19,24}. Posterior mandibular implant placement should be avoided until completion of skeletal maturation. This is because of the unpredictable nature of the anteroposterior dimensions of the mandible²⁴. It must also be noted that a high number of implants in children are lost in the healing phase²¹.

4.2. Contraindications to implant placement

Contraindications include use of implants in children with systemic conditions such as uncontrolled diabetes, vascular conditions, active chemo/radiation therapy and psychiatric disorders; those with metabolic disorders related to wound or bone healing; arches with insufficient bone height or width for implant placement; children with uncontrolled parafunctional habits (for example bruxism, lip or nail biting); uncooperative patients and those who fail to follow and maintain proper oral hygiene practices²².

4.3. Advantages of implant therapy

The main advantage is the perceived improvement in OHQoL due to implant's potential to provide more successful treatment in patients who have had difficulties with conventional treatment^{1,19}.

4.4. Disadvantages of implants in children

In children with congenital dental anomalies the main disadvantage is that implant survival is lower in augmented areas. Vertically augmented bone is particularly susceptible to resorption, development of peri implant pockets and soft tissue recession within the first year after implant placement¹⁹. In addition, the survival rate of implants in children is lower than that reported for adults and geriatrics. Furthermore, growth in children can lead to changes in implant position as already mentioned⁹.

4.5. Possible implant types for use in children

Based on the available space, ridge volume and the age of commencement of treatment, different implant systems can be used. Mini implants have been used in orthodontics to help anchor and support active appliances. Their diameters range from 1.8mm to 2.7mm and were designed to be used in areas where there was limited bone²². Mini implants have a smaller surface area and roughness, and this decreases the likelihood of osseointegration and long-term survival. Their main advantage is that they may be loaded immediately if primary stability is achieved or after 6 months if not initially stable¹⁶. These implants should be large enough to provide retention and stability, but small enough to allow bone growth. Literature suggests that mini-implant supported prostheses can be functionally stable for up to 8 years¹⁶, but that they should be replaced with standard implants once bone growth is complete²⁷. Further advantages are that due to their small diameter they are easier to insert than standard implants, are cheaper, do not need submerged healing, and can often be immediately loaded¹³. Some authors also believe that they could preserve alveolar bone volume and may even stimulate remodelling of bone.

Standard implants maybe used for in children if their bone volume is sufficient or if augmentation is possible. Kearns et al (1999) reported high success rates in a series of patients where a total of 36 Titanium plasma-sprayed, press-fit cylindrical implants (3I Implant Innovations) and 5 titanium screw-type implants (Nobelpharma) were placed in the maxillae and mandibles of 6 children²³. Worsaae et al (2007) placed 283 Brånemark (Nobel Biocare) and Astra (Astra Tech) implants in 46 children, and also showed high success rates (98%)¹². Filius et al (2014) successfully placed 8 Strauman SLA implants size 10-14mm in the mandibles of children with congenital defects. All these studies seem to suggest a high survival rate for standard implants in children; however, success and survival criteria were not clearly defined and long-term follow-up results not reported on²⁸.

Another rather unconventional type of implant to consider is the Onplant from Nobel Biocare (Fig 6)¹⁷. It has a disc-like design that can help overcome bone deficiency in the maxilla. Heuberer et al (2011) used it successfully for anchorage of an upper overdenture¹⁷. In 2019, Kamatham et al stated that

there was insufficient evidence on the use of implants in children to establish any definitive guidelines²⁹. To date there is still a paucity of literature and long-term follow-up studies reporting on the use of implants in children, most especially those with congenital dental anomalies.

Conclusion

The type and severity of congenital dental defects can influence both the psychosocial development and oral rehabilitation in children. If conventional treatment has been unsuccessful, it may be prudent to consider implant therapy. However, the timing, placement, monitoring and adjustments, and anticipated future needs must all be carefully considered and planned for by a multidisciplinary team. At present there is little literature regarding recommended implant protocols. Neither are there many long-term follow-up studies of survival and success rates, or the psychological impact and benefits that may be derived from their use. There is also very little data on failed implant treatment in children and how these could be addressed. The aim of all dental and restorative treatment in children with congenital dental manifestations should be to restore function and aesthetics and to “bring the child to a point where they do not differ significantly from their peers in terms of health, education or ability to interact socially” – Bozch 1997¹⁴

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CPD questionnaire on page 372

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.



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

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1. Stress levels of a group of dentists while providing dental care under clinical, deep sedation, and general anaesthesia

Stress, according to the World Health Organization, can be defined as a state of worry or mental tension caused by a difficult situation. Stress is a natural human response that prompts us to address challenges and threats in our lives. Everyone experiences stress to some degree. The way we respond to stress, however, makes a big difference to our overall well-being. Occupational stress, defined as when the resources of an individual are not sufficient to cope with the needs of a situation, is a leading modern health and safety challenge¹.

Health sector professionals have higher stress than other professionals, and it is usually caused by workload and patient-doctor relationships.¹ Dentistry is one of the most stressful professions and paediatric dentistry with its behaviour management issues in children, parental expectations, and parental behaviours can be even more stressful and exhausting in practice.

A child's level of cooperation and general behaviour is critical for a dentist to choose the most suitable behavioural management approaches, such as tell-show-do, sedation, and general anaesthesia.¹ There are some treatment complications with both deep sedation and general anaesthesia. Ensuring and maintaining airway patency is vital in the application of sedation. In the application of anaesthesia, deep sedation is challenging in dental procedures due to the anatomical proximity of the surgical area to the airway and the risk of micro-aspiration of water, blood, saliva, and small particles of filling material when working in the open mouth¹. Dental treatment with general anaesthesia is seen as a stressful situation for practitioners since some complications, such as neurological damage, cardiac and respiratory arrest, and even death, may occur.

In response to any stress factors in humans, two biological systems are activated: the sympathetic nervous system in the period immediately after exposure to the factor and then the hypothalamic-pituitary-adrenal system¹. In healthy individuals, stimulation of the sympathetic nervous system at the beginning of the stress response begins with the secretion of epinephrine and norepinephrine from the adrenal medulla. These catecholamines cause the characteristic features of sympathetic nervous system activity, such as an increase in heart rate, mydriasis in the pupils, and acceleration of breathing. For this reason, sympathetic activity is measured by various evaluation methods, such as heart rate, blood pressure, and O₂ saturation¹. Similarly, salivary cortisol has been accepted as a reliable biomarker of the hypothalamus-pituitary-adrenal system as a delayed stress response¹.

A literature review showed that very few studies have investigated occupational stress related to paediatric dentistry¹. Esra Kızılcı and colleagues (2023)¹ evaluated the stress experienced by dentists while treating children in all three treatment protocols (clinical sedation, deep sedation, general anaesthesia) by using objective and subjective (Dentists' Stress Questionnaire) tools. The null hypothesis (H₀) of this study was that there is no statistically significant difference between the stress levels of dentists while treating children with the different treatment protocols.

Methodology

The unit of interest in this study was the dentist rather than their patients. Each dentist treated 27 patients with 3 different treatment approaches, and the study resulted in a total of 108 patients.

There was standardisation of the dentists who treated the patients (all were women between the ages 30-33 with similar weight and experience) and patients. Children with positive or definitely positive behaviour score of 3 or 4 according to the Frankl Scale, were included in the clinical treatment group. According to the clinical examination of these patients, 36 healthy children aged 5-6 years who did not require pulpal treatment and whose caries level was 1-4 according to the ICDAS (International Caries Detection and Assessment System) were selected. The type of treatment was determined as compomer fillings applied to 2 primary molars after local anaesthesia, and the duration of the treatment was limited to 30-60 min.

Children aged 48-72 months and children with negative or absolutely negative behaviour (Frankl 1, 2) according to the Frankl Scale were provided treatment under deep sedation. To provide standardization among patients suitable for sedation, 36 children whose dmft (decayed, missing, filled teeth index) score was less than their age and for whom the duration of the procedure was limited to between 30 and 40 min were included in the study. For general anaesthesia, 36 healthy children whose dmft score was equal to or higher than their age were included. In addition, patients whose treatment time was limited to 30-60 min were included.

The patients were randomly assigned to the dentists, and their treatment was carried out. The study did not include children with general health problems or children whose parents refused treatment with general anaesthesia/sedation.

For the general anaesthesia and deep sedation group, after a minimum of 6 h of fasting, all patients were given midazolam for premedication before they were taken to the operating room. In the operating room, non-invasive standard

monitoring was performed for all patients, including heart rate, non-invasive MAP, electrocardiogram, and SpO₂.

For the general anaesthesia group, 2.5mg/kg propofol, 0.6mg/kg rocuronium, and 1µg/kg fentanyl were used to induce the anaesthesia. The most appropriate cuffed endotracheal tube was used for the intubation procedure. Sevoflurane (1 MAC) and a 50% oxygen-air mixture were applied to maintain general anaesthesia.

In the deep sedation group, anaesthesia was initiated with propofol at a dose of 2mg/kg. A nasal mask was applied to all patients in this group. The pressure ventilator was used for non-invasive ventilation during the deep sedation procedure. Additional intermittent propofol was used to achieve the appropriate sedation depth at which the dental treatment and ventilation could be performed comfortably.

Non-invasive mean arterial blood pressure (MAP) and peripheral oxygen saturation (SpO₂) were measured and recorded 10 min before the dental treatment, at the 25th min of the treatment, and 30 min after the treatment for all three treatment approaches. Also, saliva samples were taken from 4 dentists in the same time intervals for the study. The dentists' measurement scores compared to each other.

The Saliva Swab Sample Collection (SpeciMAX™) kit was used to collect saliva samples. The swab was placed under the tongue for 2 min, and it was ensured that the swab absorbed the saliva. Afterward, the swab was centrifuged and placed in saliva storage tubes with a perforated chamber for separating saliva and the remaining dry swab. Samples were centrifuged at 3000rpm for 15 min; the saliva was cleared of debris and then poured into the bottom of the storage tube. Then, the saliva in the plastic saliva storage tube was stored at -80°C in an upright position until measurements were made. After the saliva samples were thawed at room temperature on the day of the measurements, they were taken to the Biochemistry Laboratory for analysis.

Salivary cortisol was measured by the electrochemiluminescence (ECLIA) method using the Cobas Cortisol II kit.

At the end of each patient's treatment, after the samples were taken and the measurements were made, the dentists were asked to fill out the "Dentist Job Stress Questionnaire," consisting of 6 questions reflecting their current stress. In the questionnaire, questions were asked to measure the physician's current degree of work stress, and they were asked to choose the most suitable option for them.

Results

When the findings were evaluated according to the measurement times, systolic and diastolic blood pressure measurements for all dentists before the procedure were similar in the clinical, general anaesthesia, and deep sedation groups ($P>0.05$). Both systolic and diastolic blood pressure measurements were found to be higher in the deep sedation group ($P<0.05$). It was determined that the systolic blood pressure measurements after treatment did not differ among the clinical, general anaesthesia, or deep sedation groups ($P>0.05$), but the diastolic blood

pressure measurements did. The measurements of the deep sedation group were higher than those of the clinical sedation and general anaesthesia groups ($P<0.05$). Heart rate and oxygen saturation measurements before, during, and after the treatment did not differ among the clinical sedation, general anaesthesia, and deep sedation groups ($P>0.05$). It was observed that cortisol measurements before and during treatment were not at different levels among the clinical sedation, general anaesthesia, and deep sedation groups ($P>0.05$). After treatment, the cortisol measurements in the deep sedation group were higher than those in the clinical and general anaesthesia groups ($P<0.05$).

When the systolic and diastolic blood pressure measurements were examined according to the procedure times, it was observed that the systolic and diastolic blood pressure measurements were similar before, during, and after treatment in the clinical and general anaesthesia groups ($P>0.05$). In the deep sedation group, systolic and diastolic blood pressures measured during the procedure were shown to be high.

The heart rate measurements were at similar levels before, during, and after treatment in the clinical and general anaesthesia groups ($P>0.05$). In the deep sedation group, it was determined that the heart rate measurements during the procedure were higher than those before and after the procedure ($P<0.05$).

When the authors evaluated the oxygen saturation measurements, the oxygen saturation value during the procedure was lower than that before and after the procedure ($P<0.05$).

Cortisol measurements were found to be at different levels according to the processing times.

It was determined that the stress levels obtained by using the applied questionnaire differed among the clinical sedation, general anaesthesia, and deep sedation groups. It was observed that the stress level of the dentists in the deep sedation group was higher than that of dentists in the clinical sedation and general anaesthesia groups ($P<0.05$).

In this study, there was a correlation between the stress level and systolic blood pressure values of the dentists in the clinical sedation, general anaesthesia, and deep sedation groups before and after the procedure ($P<0.05$). According to the survey results, the preprocedural systolic blood pressures of the dentists reporting high stress levels were higher.

It was determined that the stress level of dentists during the protocols and the systolic blood pressure and heart rate measurements were moderately strong and positively correlated ($P<0.05$).

The study showed that systolic and diastolic blood pressure values and heart rate measurements differed among dentists before, during, and after treatment. It was observed that the difference was because dentist-1 had higher systolic and diastolic blood pressure values and heart rate measurements than all the other dentists ($P<0.05$). Oxygen saturation and salivary cortisol measurements before,

during, and after treatment were found to be at similar levels in all dentists ($P > 0.05$)

Conclusion

The researchers found that dentists who care for paediatric patients are more stressed when applying treatment under deep sedation.

Implications for practice

The results suggest the need for more training and practice to strengthen the education given on general anaesthesia/sedation in paediatric dentistry training.

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2. Is Leukocyte- and Platelet-Rich Fibrin (L-PRF) an effective haemostatic agent in single tooth extractions? A cohort study on vitamin K antagonist (VKA) and direct oral anticoagulants (DOAC) patients

Many cardiovascular pathological conditions, such as non-valvular atrial fibrillation, valvular pathologies, myocardial infarction, stroke, pulmonary embolism, and deep vein thrombosis, require oral anticoagulant therapy as prophylaxis or life-saving pharmacological treatment¹. The purpose of anticoagulation therapy is to reduce blood clotting capacity in order to reduce the risk of thromboembolic complications in clinical conditions such as atrial fibrillation, mechanical heart valves, deep vein thrombosis and pulmonary embolism, and stroke.

Although traditional, oral anticoagulant therapy with vitamin K antagonists (VKAs), warfarin and acenocoumarin, has represented the gold standard for decades; nowadays, this drug category has been largely supplanted by direct oral anticoagulants, briefly named DOACs.

The introduction and development of DOACs was dictated by the need to overcome the several disadvantages associated with traditional oral anticoagulant therapy, such as the interactions with food and other medicaments, the long half-life, the need of individual dosages, and the mandatory regular monitoring.

DOACs include dabigatran etexilate (Pradaxa) which acts as a direct inhibitor of thrombin or factor IIa, rivaroxaban (Xarelto), apixaban (Eliquis), and edoxaban (Lixiana) which blocks blood clotting factor Xa¹.

The rationale for choosing L-PRF as a haemostatic agent lies in its intrinsic property of facilitating blood clot formation through a rapid activation of the coagulation cascade.

Berton and colleagues (2023)¹ reported on a clinical observational study that sought to assess the efficacy of L-PRF as a haemostatic agent, comparing post-operative bleeding after single simple tooth extraction in patients under treatment with vitamin K antagonists (VKAs) or direct oral anticoagulants (DOACs).

Methodology

This was an Italian study that included patients under oral anticoagulant therapy (VKA or DOACs) who needed a single

tooth extraction. Patients ≥ 20 years; Healthy patients (\leq ASA 3); those with at least two months of DOAC therapy with dabigatran (PRADAXA) or rivaroxaban (XARELTO) or apixaban (ELIQUIS) or edoxaban (LIXIANA) OR at least three months of OAT therapy with warfarin (COUMADIN) or acenocumarol (SINTROM) for VKA group; platelet count $> 50,000/\text{dl}$ and INR between 2.0 and 3.0 (VKA group) were included in the trial. Smokers, those with impaired renal function or who had previous head and neck radiotherapy or had the extraction that lasted longer than 15 min or had a complicated extraction were excluded.

Intraoral radiographs and/or pans were used to plan extractive therapy. When multiple extractions were indicated, priority was given to the symptomatic teeth. In asymptomatic patients, the most distal tooth programmed for extraction was selected. Each patient underwent professional oral hygiene one week before the extractive procedure

Blood pressure was recorded for both groups before tooth extraction; International Normal Ratio (INR) was registered for VKA group. Antibiotic prophylaxis was orally administered one hour before the extraction (Amoxicillin 2gr or Clarithromycin 500 mg for allergic patients).

Subsequently, following cutaneous disinfection, blood withdrawal from cubital or cephalic vein of the non-dominant arm was performed using 9ml blood collection tubes. The tube was immediately placed into a centrifuge and operated for 18 min at 2700rpm.

The patient was asked to perform a one-minute mouth rinse with 0.2% chlorhexidine mouthwash before starting the surgical procedure (extraction). The time at which the procedure took place was recorded.

All the surgeries were performed by a single operator and only simple extractions were included, i.e., carried out without elevation of mucoperiosteal flaps and osteotomies, in a maximum of 15 min (from periotomy to complete tooth extraction).

Local anaesthesia (mepivacaine 20mg/ml + adrenaline 1:100,000) was performed, and teeth were luxated and extracted with elevators and forceps. Following an accurate alveolar curettage, L-PRF plug was positioned and compacted inside the alveolus using appropriate tools and finally secured with non-absorbable 3/0 braided silk sutures. After aspirating the excess of saliva, a cotton roll was gently compressed over the surgical site for 20s. The weight in grams of the cotton before and after imbibition was obtained with an analytical balance. All the intra-operative variables were collected.

Within 30 min after surgery, patients began topical ice application keeping a gauze in compression. Patients were prescribed with chlorhexidine 0.2% 3 rinses/day (except for the first day) and paracetamol 1000mg in case of pain, excluding any other NSAID. Once hemostasis was reached, the patient was discharged with a form to be filled with data related to pain-VAS (score 0 to 10), paracetamol intake, any bleeding event and its management.

The seventh day sutures were removed and any biological complication (ecchymosis, hematoma, swelling, infection, nerve injury) was recorded, as well as the presence of

phlebitis, bruising, or hematomas at the sampling site on the arm. A bleeding score of 3 or greater was considered clinically significant and classified as a relevant post-operative bleeding complication. In addition, the onset, course, and severity of complications, as well as the procedures undertaken by the patient or the operator to solve them, were registered.

Results

A total of 112 patients under oral anticoagulation therapy (59 patients for DOAC and 53 for VKA group) needing tooth extraction were enrolled in this study.

Pre-operatively, the two groups were homogeneous for all parameters, and evenly distributed by gender ($P = 0.93$) and age ($P = 0.79$), with a mean of 76.6 ± 9.2 years for VKA and 76.8 ± 10.4 for DOAC, as well as by pathology for which they were under anticoagulant therapy.

In the DOAC group, 15 patients (25.4%) took dabigatran, 17 (27.1%) rivaroxaban, 17 (28.8%) apixaban, and 11 (18.6%) edoxaban, while in the VKA group 51 (96.2%) took warfarin and the remaining 2 (3.8%) acenocoumarol. The most frequent indication both for DOACs and VKA was atrial fibrillation, with 39 (73.6%) and 39 (66.1%) cases, respectively.

Patients were also equally distributed with regard to the time elapse from the last dental. For patients receiving VKA or DOAC, the bleeding scores were similar with no significant difference. Hematologic parameters (sampled within 30 days before intervention) were found in the normal range in all patient in both groups.

Blood pressure and INR were measured in all subjects just before proceeding with the extractions. Mean systolic and diastolic readings were similar in both groups and the Indication for extraction and type of dental element were equally distributed in the groups. The most frequent indication for tooth extraction was endodontic/conservative [31 (52.5%) and 28 (53%) patients for DOAC and VKA groups, respectively], with no significantly different distribution along with the other indications.

There were no significant differences between the two groups regarding gingival inflammation of the surgical site ($P=0.08$) and amount of granulation tissue of the post-extraction socket ($P=0.90$)

Most of the patients achieved complete hemostasis immediately after extraction, with an average cotton roll imbibition rate of 0.03 ± 0.02 g and 0.04 ± 0.04 g for VKA and DOAC, respectively. No significant differences between the

two groups were demonstrated for this item ($P=0.65$).

Post-operative bleeding was recorded in nine patients (17%) for VKA group and nine patients (15.3%) for DOACs group. No significant difference has been registered ($P=0.31$).

In particular, bleeding was distributed as follows in VKA patients: bleeding was managed with simple compression (once or twice a week) in seven patients (13.2%), while in two patients (3.8%) bleeding was stopped with simple compression (more than twice a week).

In DOAC group, all the nine patients reported bleeding stopped with simple compression (once or twice a week). None of the patients of the two groups needed a medical support for managing of bleeding (score 4 according to the classification used).

Seven days after surgery, no cases of post-extractive complications, such as ecchymoses, hematoma, swelling, neurological lesions, and or surgical site infections requiring antibiotic therapy occurred in both groups.

The sensation of blood taste during the seven post-operative days was significantly more frequent in VKA group ($P = 0.018$). No differences between the two groups emerged with respect to the intake (yes/no) of paracetamol in the 7-day post-operative period ($P = 0.5$). No differences in the amount of paracetamol (mg) were observed between groups at each time-point.

Similarly, no differences in pain-VAS values were observed between the two groups on post-operative days ($P=0.409$). Twenty patients (7 VKA and 13 DOAC) reported ecchymoses in the site of blood sampling (forearm).

Multivariate regression analysis failed to highlight any correlation to the examined variables.

Conclusions

The researchers concluded that the use of L-PRF resulted in limited mild late post-operative bleedings without the need of medical intervention.

Implications for practice: The results of this trial suggest that the use of L-PRF can be adopted for an uneventful post-operative episode in anticoagulated patients without adjusting their therapy for single tooth extraction.

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CPD questionnaire on page 372

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The moral claim for obligatory dissemination of study results: part one

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DP Motloba¹, PD Moipolai²

INTRODUCTION

The process of taking data from a person or community when doing research, and then publishing such data and one's academic interpretation thereof in an academic journal, is usually well protected and scrutinised by several ethical checks and balances. However, to disseminate research findings back to the community in which the research was conducted is seen as a fundamental principle in ethical research practice that seldom materialises into reality. When researchers appropriately respect their obligation to do this, it is often filled with nuanced challenges.

Researchers must consider how to convey complex findings in a way that is understandable and actionable for the community. Different communities have different views on norms, values and communication preferences. Researchers must be culturally sensitive in how they share findings to ensure relevance and respect. Dissemination may require resources such as translation services, community meetings or educational materials. It's essential to share not only positive results but also negative or inconclusive findings. This avoids bias and helps the community make informed decisions.

Case study

A funded study was approved by the Ethics and Review Committee of a school of oral health sciences in South Africa. The objective of the research was to estimate the incidence of ameloblastoma and determine the predictors of poor clinical outcomes related to this condition. The study was undertaken in Limpopo province as this region is purported to have the highest prevalence of ameloblastoma in the country. The research team was aware of the entrenched chieftainship system, language and cultural diversity in the province. The study stipulated clearly how the dynamic of the individuals and the local traditional authorities would be handled in this governance system. Additionally, the research team indicated that "... the results of the study will be disseminated ..." and that the findings will "provide valuable insights to the clinicians and communities in improving the clinical outcomes of ameloblastomas". Data was collected using community-

based research assistants who were fluent in local languages, culture and practices.

Three years after the completion of the study, one of the chiefs complained that research results had not been shared with communities, yet two papers were published in high impact accredited journals. Similarly local clinicians and other stakeholders were in the dark about the implications of the study findings. The research participants and stakeholders viewed this research project as a betrayal of trust. As a response to these queries, the research team indicated that they lacked funding to host feedback sessions. Furthermore, the team could not circulate the journal reprints to stakeholders due to possible violation of intellectual property held by the journal.

It has been five years and the research results are yet to be disseminated to the participants and stakeholders. This paper seeks to argue that researchers indeed have a moral duty to inform participants and disseminate research findings to the participants and any affected groups. In this, part one, we address the questions below, while the remaining questions are discussed in part two of the series.

Questions

Do researchers owe participants and communities restitution and information about the study findings? In other words, is the moral claim for obligatory dissemination of study results defensible? If so, are there limitations to this moral claim? What are the limitations of the moral claim to disseminate research findings? What is the extent or scope of the information that is owed? Is there moral justification for withholding study findings from participants? Who should determine the target audience for the dissemination? What constitutes the most appropriate channels of dissemination?

DISCUSSION

The moral obligation for researchers to inform participants and communities.

While it is generally accepted that information sharing is a critical part of the scientific research process, study results are seldom disseminated to study participants. Failure to inform participants about the research findings is particularly prevalent, especially at the terminal stages of the studies, because "patients are not needed anymore", and the researchers "got what they wanted". We argue in this paper that researchers indeed owe participants sufficient information, and throughout the entire research process. In other words, researchers have a moral obligation to disseminate research findings to communities. Our defence of the thesis above is based on the ethical principles: (i) autonomy (respect for persons) (ii) beneficence and non-maleficence (favourable risk-benefit ratio) and (iii) justice. It is hence our contention that it is morally unjustifiable for

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researchers to withhold any information or fail to disseminate research findings to participants and communities.

1. Respect for persons – a sufficient moral foundation of research in humans

The philosophical concept of respect for persons is well described in Immanuel Kant's classical statement "Act so that you treat humanity, whether in your own person or that of another, always as an end and never as a means only".³ Kant also claims that "Respect ... is the acknowledgment of the dignity of another man, ie a worth which has no price, no equivalent for which the object of evaluation could be exchanged".⁴ Kant asserted that persons have a special moral status which obligates others, including researchers, to acknowledge their agency and respect their rights and choices. Special protection should therefore be ensured, especially in cases of limited self-determination and incapacity. This means that the wants, desires and interests of others, especially the vulnerable, should always be a primary consideration, especially in research.

This Kantian explication of respects for others is widely referenced and cited for its general applicability. However, the Kantian conceptualisation of respect for persons as applicable to this case lacks specificity and appropriateness in two ways. First, "respect" is not specific or distinguished from other forms of admiration, reverence, awe or fear. Second, the notion of "respect" does not place any tangible worth, value or restrictions on the attribute to be respected. In other words, Kant does not place conditions for respect for persons. Instead, Kant bestows special moral status and consequent respect of persons without any cause. To mitigate the deficiencies in the conceptualisation of respect for persons, the Cranor model⁴ for respect-for-persons offers an alternative explanation. This model is based on conditions that are necessary and jointly sufficient to evaluate a person with attributes, traits and abilities worth respecting. Ultimately, the "respect for persons" should be premised on the notion that one cannot respect a person without any reason at all. Hence the assertion by Cranor that three (3) conditions must be satisfied for respect to be earned and afforded.

Cranor's respect-for-persons model unpacked

1. There should be an attribute (A) to be respected.

The respector (R) ought to believe that the person (P) has a good attribute (A). The evaluation of the attribute as "good" or "bad" may be based on its inherent moral, non-moral, aesthetic, practical characteristics. This phase of the model does not require concrete evidence about the attribute. The mere inclination about the goodness of the attribute (A) is sufficient.

2. There should be reasonable knowledge and appreciation of the nature of the attribute (A) to be respected.

The respector (R) must demonstrate knowledge and appreciation of the nature of the attribute (A). This evaluation goes beyond mere admiration, awe or fear of the person (P) with the attribute (A). There should be sufficient knowledge that the possession of the attribute (A) could enable the person (P) to do good or achieve the expected outcomes. As a condition for respect for persons, the respector (R) must gather evidence about the goodness of the attribute (A) and be convinced that having the attribute (A) could result in some good worthy of respect.

3. The respector (R) is predisposed to rely on the person (P) with the attribute (A) to discharge their duties accordingly and achieve the desired outcomes.

The respector (R) is inclined to confide in the person (P) to do good given that they possess the attribute (A). Consequently, the respector (R) may show commitment to, and place their welfare and wellbeing with, the person (P). This step marks the intentional genesis of the doctor-patient relationship or researcher-participants mutual engagement.

The formula for respect-of-person by Cranor can be summarised as follows: The conditions should be conducive for the individual (R) to trust, believe and confide in the person (P) endowed with a good attribute (A). By acknowledging and recognising the good disposition of the person (P), the respector (R) could (a) emulate the actions of the respected person; (b) heed their desires, wishes and commands; and (c) honour the respected person in various ways, such as titles and mannerisms.

What does participation in research really mean?

By "consenting" to participate in a study, the research participant assumes a vulnerable position, relinquishes their agency and surrenders their personhood, literally. According to the respect-for-persons model by Cranor, the research participant goes through several agonising steps: First, the research participants must believe that the researcher (Re) has the requisite disposition and traits to undertake the study. Second, the research participants must contend with evidence (or lack thereof) regarding the ability of the researcher (Re) to execute the study; prevent or minimise harm; and confer benefits to the participants. In most cases, indigent and vulnerable research participants lack the agency to satisfy themselves with the research processes. Third, the participants must trust that the researcher (Re) possesses the requisite attributes and has the intention to achieve the desired outcomes of the study. Unfortunately, the credentials of researchers (Re) are not readily available, and could be cryptic to decipher and comprehend by lay persons. Fourth, the majority of clinical trials require clinical equipoise in order to meet the ethical master.⁵ This means the researcher (Re) must be in a state of genuine uncertainty "... regarding the comparative therapeutic merits of each arm in a trial". Therefore, the researcher (Re) will have no preference, no evidence and no offer of benefit but uncertainty about a trial. Clinical equipoise does not offer research participants any objective level of beneficence, except equality of interventions. Yet there is an expectation of these subjects to leap in faith and trust, and thus subject themselves to the research process. It is hence critical to reciprocate participants' selfless acts through investment in beneficial research activities. Therefore, every step of the research process must reflect the sacrifice of the research participants including once the project is completed. The potential risks incurred by study participants should be balanced by the benefit of contributing to publicly available knowledge.⁶

2. Beneficence – the essence of human research

The principle of beneficence is embodied in the three major normative moralities namely consequentialism, deontology and virtue ethics.⁷ The consequentialist beneficence promotes social good, hence the expectation for research endeavours to increase utility. A benefit act is altruistic or utilitarian, to the extent that it promotes the "greatest

benefit for the greatest number.”^{8,9} This Bentham morality compels research processes to ensure (i) the prevention of harm or evil; (ii) elimination of harm or evil; (iii) doing and advocating for good.^{10,11} Therefore, the conduct of research should be underpinned by clear and explicit enumeration and articulation of risks and benefits. Research participants should be aware and well informed of how the benefits will be maximised and risks minimised. The vulnerability of research subjects justifies the obligation of the researcher to optimise the benefits for participants. This includes dissemination of critical information to participants and communities.¹²

Benevolence can also be viewed from a deontological perspective. Kantian benevolence, as described by Korsgaard and Cumiskey^{13,14}, offers an alternative view of the consequentialist normative morality. According to these authors, humanity has a duty “to offer other’s ends, the same status as one’s own”. This means the best outcomes that we wish for ourselves should be extended to others, thereby equalising the “ends” through the similar “means”.¹⁵ In applying Kantian benevolence to research, it would be expected that researchers, as custodians of knowledge, share information with the participants and stakeholders. In so doing, they would be treating the participants’ “ends” the same as their own, and not as “mere means to an end”. Therefore, researchers must provide information to research participants in a manner that they would themselves expect, had they been in the participants’ shoes.

3. Virtue – the undisputable disposition for benevolence

Virtue ethics emphasises character and traits of the possessors as foundational for this moral theory. This philosophical approach differs from deontology, which recognises virtues as traits of those who follow rules and for consequentialism for those who maximise good. Virtue is a disposition or moral excellence that “goes all the way down”. As Aristotle said: “... virtuous actions, those that express a virtuous trait, must be chosen for their own sakes”. Virtues are more than habits, but a way of life, how one conducts oneself, what one values, feels, desires and chooses. Benevolence represents virtues such as kindness, generosity, sympathy, compassion, empathy, loyalty and integrity.¹⁶ These virtues are recognised as critical, especially for health professionals including researchers. The virtue of benevolence is concerned with conduct in relationships, and how behaviour contributes to others’ welfare. A question can be asked: what virtues should researchers have to act right? Some attributes increase the propensity to act right and some wrong. Based on this moral theory, researchers must possess and exercise both intellectual and moral virtues. These include the virtues of critical thinking, perseverance, curiosity and open-mindedness. Similarly, researchers must be honest, just, fair, truthful and kind.

4. Justice – foul is not fair

The principle of justice as embodied in the Belmont Report refers to (i) distributive justice (ii) procedural justice and (iii) compensatory (retributive) justice. The most widely applicable concept of justice in research is distributive justice, which entails fair allocation of benefits and burdens emanating from research. Fair distribution could mean equitable or equal distribution of risks depending on the

context. Therefore, the conduct of research should be devoid of discrimination and exclusion of groups with potential to benefit from research interventions. Justice demands not to unduly subject certain individuals and groups to disproportionate risks, or enrolling participants unlikely to benefit from the research. Similarly, individuals and groups may not be systematically recruited into studies because of their vulnerability, manipulability and or accessibility.

The principle of procedural justice demands for researchers to engage potential participants and communities in a meaningful participatory process. This process should be just and fair, including timely and sustained involvement of participants. It is hence imperative for researchers to find mechanisms that foster early and sustained dissemination of information without prejudice.¹⁷ The principle of retributive justice entails compensation of participants for enrolling in the research. The manner and nature of compensation of research participants should be commensurate with the inherent risks of the study. The dissemination of research findings can serve as a form of compensation for risks and disproportionate sacrifices during the research process. Given that research is a public good, the dissemination of study findings goes beyond the research participants to involve future and prospective beneficiaries. These parties are morally entitled to receive some form of restitution.

CONCLUSION

Scientific discoveries have limited benefit or no utility if they remain unpublished or masqueraded as jargon in professional journals. Rapid translation or conversion of science into practice is highly desirable and can benefit participants and society. In this paper we have argued based on principles why it morally unjustifiable to withhold information from study participants and communities. It is advisable, if not mandatory, for research proposals to have very clear mechanisms for dissemination of study results. Research and ethics review boards should be held accountable for approving research proposals which are deficient in how they plan to disseminate study findings.

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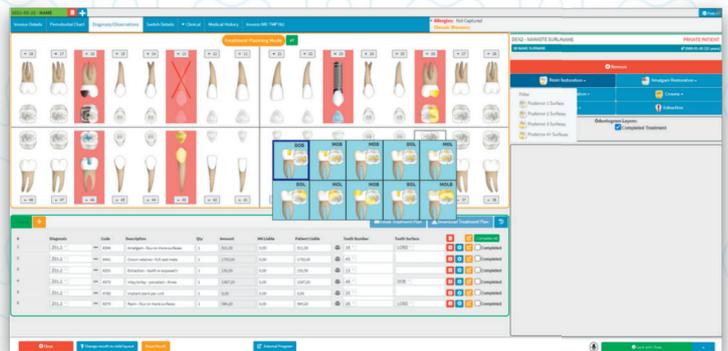


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MAXILLOFACIAL RADIOLOGY

Nevoid Basal Cell Carcinoma Syndrome

L Merbold¹ Z Yakoob²

SADJ August 2023, Vol. 78 No.7 p370-371

CASE

An 18-year-old male patient presented at our dental clinic in 2009 for a dental assessment. A panoramic radiograph was taken to evaluate dental crowning (Figure 1). An incidental finding was noted in the right maxilla, presenting as a well-demarcated, round, unilocular, radiolucent lesion with a corticated rim extending from the right maxillary tuberosity area to distal of the 16 causing impaction of the 18. A biopsy was taken and diagnosed as an odontogenic keratocyst (OKC) that was subsequently enucleated. In 2021 the patient returned and another panoramic radiograph (Figure 2) and a Waters view was taken where calcification of the falx cerebri was seen (Figure 3). On the panoramic radiograph an additional mandibular lesion was visible that presented as a well-demarcated, round, unilocular, radiolucent lesion with a corticated rim extending from distal of the 46 into the missing 47, 48 area. A CBCT was then taken to further analyse the lesions (Figure 4). A biopsy was taken in the right posterior mandible and diagnosed as an OKC. In 2023 the patient returned and a CBCT was taken. The right maxilla showed increased bone density adjacent to the enucleated lesion (Figure 5).

A diagnosis of Nevoid Basal Cell Carcinoma Syndrome (NBCCS) was made due to the multiple OKCs and calcification of the falx cerebri.

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2. Zarah Yakoob (secondary author) – 50%



Figure 1. A panoramic radiograph showing a maxillary lesion in quadrant 1 in 2009 (blue stippled line).



Figure 2. Panoramic radiograph in 2021 shows an additional lesion in the right posterior mandible (green stippled line).



Figure 3. Waters radiograph showing calcification of the falx cerebri (orange arrow).

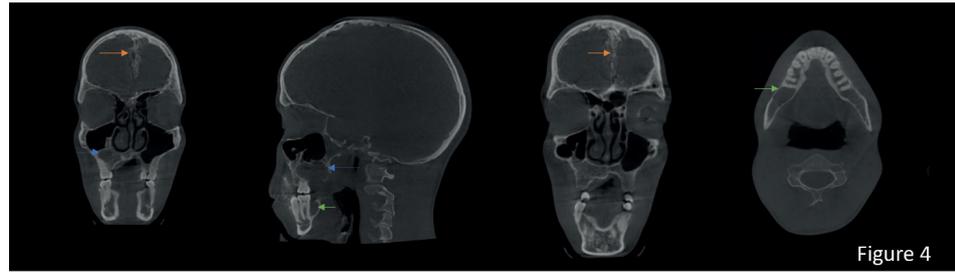


Figure 4. CBCT in 2021 indicating calcification of the falx cerebri (orange arrow), maxillary (blue arrow) and mandibular cystic lesions (green arrow).

INTERPRETATION

Nevoid Basal Cell Carcinoma Syndrome (NBCCS), also known as Gorlin syndrome, is an autosomal dominant inherited condition¹ with an equal gender distribution² and a prevalence of 1 in 60,000.³ It is more common in the white population when compared to the black population, arising in the first to third decades of life³. It is caused due to a mutation in the patched (PTCH1) tumour suppressor gene on chromosome 9q22.3-q314, a component of the Hedgehog (Hh) pathway.⁵

The major diagnostic criteria for NBCCS are:³

- Multiple basal cell carcinomas (BCCs) of the skin
- Multiple odontogenic keratocysts of the jaws
- Calcification of the falx cerebri
- Bifid rib
- Palmar/plantar pitting

The minor diagnostic criteria of NBCCS are:²

- Frontal and temporoparietal bossing
- Hypertelorism
- Mandibular prognathism
- Ovarian fibroma
- Medulloblastoma

A clinical diagnosis relies on specific criteria. NBCCS can be suspected with the presence of major and/or minor criteria, while a gene mutation analysis will confirm the diagnosis.²

The OKCs in patients with NBCCS differ from those in patients with isolated OKCs.⁴ The age when the first cyst presents is younger in the syndromic group. On radiographic examination, the OKCs in both groups have a similar presentation. The OKCs in patients with NBCCS are commonly associated with the crowns of impacted teeth and can be mistaken for dentigerous cysts.¹

The OKCs in NBCCS usually present as uni- or multilocular radiolucencies and can be uni- or bilateral. In younger patients, the OKCs may be associated with an impacted tooth, leading to the displacement of teeth or less commonly

causing root resorption. OKCs are usually locally destructive and can spread within the bone, rarely causing expansion.³ OKCs can be differentiated from other odontogenic cysts due to their non-expansive/minimal-expansive nature. Most benign odontogenic lesions expand the cortical borders of the jaws where OKCs extend along the long-axis or antero-posterior region of the jaws.⁶

The patient presented above did not have any of the other clinical features of NBCCS. However, if Basal Cell Carcinomas are present the treatment and prognosis depend on the behaviour of the skin lesions. The manifestations of NBCCS are generally not life-threatening; however, early diagnosis is important. Patients should take precautions to avoid ultraviolet sun exposure and radiation therapy. In rare instances, the skin lesions can cause tumour invasion into the brain and be fatal.¹ The jaw cysts can be treated conservatively by enucleation. Removal of the cysts can lead to facial deformity and infection.¹ The OKCs in patients with NBCCS have a higher recurrence rate and need more aggressive treatment.⁶ To detect early recurrences, the patient must be followed up with regular radiographs. Genetic counselling should be done for all patients with NBCCS.¹ Early diagnosis and regular follow-up visits by a multidisciplinary team are important.³

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. 381/2023). All procedures followed the ethical standards of the Helsinki Declaration of 1975, as revised in 2008.

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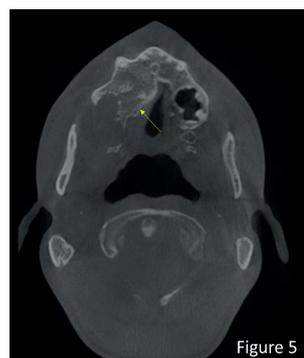


Figure 5. CBCT in 2023 showing the bony changes in the right maxilla (yellow arrow).

CPD questionnaire

Restorative considerations in children with congenital dental anomalies

- Select the CORRECT answer. Child Perception questionnaires are sectioned into**
 - Oral symptoms, functional limitations, emotional well-being and social well-being
 - Oral symptoms, functional well-being, emotional limitations and social limitations
 - Physical well-being, functional management, emotional symptoms and social symptoms
 - Oral well-being, parafunctional habits, emotional limitations and social limitations
 - Oral symptoms, parafunctional habits, emotional limitations and social well-being
- Choose the CORRECT answer. Growth of the maxilla**
 - Is due to endochondral ossification and surface remodelling
 - Is described in relation to the zygomatic arches
 - Is due to sutural growth and surface remodelling
 - Causes it to move forwards and upwards
 - Ceases after the age of 7 in the sutural areas
- Select the CORRECT answer. Contraindications for implant placement in children include**
 - Patients with systemic conditions
 - Naughty patients
 - Patients with parafunctional habits
 - All of the above
 - Only A and C above

Dental therapist job satisfaction and intention to leave: A cross-sectional study

- Select the CORRECT answer. What percentage of participants had intention to leave**
 - 51.5%
 - 69.5%
 - 74.5%
 - 80%
- Choose the CORRECT answer. What percentage of participants were dissatisfied with their jobs**
 - 57.2%
 - 60%
 - 69.5%
 - 40%

Embracing technology for improving dental records and record-keeping in the Republic of South Africa. A review.

- Select the INCORRECT option. Which of the following is NOT considered a technological modality that can be utilised for forensic dentistry investigations?**
 - Flourescence imaging
 - 3-Dimensional facial imaging
 - Nano-radiography
 - Digitally guided implant surgery

- Which of the following is INCORRECT. Identify a strategy that was NOT implemented as reported by dental schools during the Covid-19 pandemic, to facilitate teaching and learning**
 - Web-based knowledge systems
 - 2-Dimensional dental simulation and surface mapping
 - Virtual reality systems
 - 24/7 facilities
- Select the INCORRECT option. Which of these is NOT a barrier to the development of a national electronic health record in South Africa?**
 - Corruption
 - Collusion amongst electronic platform developers
 - Poor interoperability of software systems
 - Lack of legislation and policy framework
- Choose the CORRECT answer. According to the article, which of these is the least recorded in dental records**
 - Implants
 - Denture markings
 - Erosion/abrasion/attrition
 - Dental caries

Bacterial contamination of curing light guides: prevalence and students' knowledge and awareness of measures to maintain sterility

- Select the CORRECT option. In dental settings, infections may be acquired indirectly through contact with**
 - Contaminated instruments
 - Operating equipment
 - Environmental surfaces
 - All of the above
- Choose the CORRECT answer. The two most commonly used light-curing units are**
 - Tungsten-halogen (QTH) and light-emitting diode (LED)
 - Tungsten-halogen (QTH) and plasma arc curing (PAC)
 - Tungsten-halogen (QTH) and Argon laser units
 - None of the above
- Which option is CORRECT? In the Spaulding classification scheme of patient-care items, light-curing units are categorized as**
 - Critical
 - Semicritical
 - Noncritical
 - None of the above

- Select the CORRECT answer. Recent evidence suggests correctly applied plastic barriers reduced the light output by**
 - 0%
 - 5–8%
 - 10–13%
 - 14–26%

Radiology corner

14. What is the inherited pattern of NBCCS?

- A. Autosomal recessive
- B. Autosomal dominant
- C. X-linked dominant
- D. X-linked recessive

15. Which one of the following is not part of the major diagnostic criteria for NBCCS?

- A. Calcification of the falx cerebri.
- B. Bifid rib.
- C. Palmar/plantar pitting.
- D. Hypertelorism.

16. What can an OKC in patients with NBCCS be mistaken for?

- A. Unicystic ameloblastoma
- B. Dentigerous cyst
- C. Adenomatoid odontogenic tumour
- D. Glandular odontogenic cyst

17. How is the OKCs treated?

- A. Enucleation
- B. Resection
- C. Marsupialization
- D. Cryotherapy

Evidence-based Dentistry

18. Select the CORRECT answer. In the Kızılcı et al study, both systolic and diastolic blood pressure measurements were found to be higher in which of the following group?

- A. general anaesthesia group
- B. clinical treatment group
- C. deep sedation group
- D. general anaesthesia and deep sedation group

19. Choose the CORRECT option. The Dentist Job Stress Questionnaire used in the Kızılcı et al study is an example of what type of measure?

- A. Objective measure
- B. Subjective measure
- C. Independent measure
- D. Linear measure

20. Which option is INCORRECT? In the Berton et al study, there was no significant difference in the measures between the groups except for which one of the following variables

- A. Paracetamol intake
- B. Post-operative bleeding
- C. Mean systolic and diastolic readings
- D. The sensation of blood taste during the seven post-operative days

Ethics CPD questions: The moral claim for obligatory dissemination of study results: Part One

21. Which of these options is CORRECT. The principle of beneficence can also be explained by the following normative moral theories:

- A. Consequentialism
- B. Deontology
- C. Primum no cere
- D. 1 and 2
- E. 1, 2 and 3

22. Choose the CORRECT answer. The following describes the virtues of the researchers.

- A. Should include both intellectual and moral virtues.
- B. Virtue is a disposition or moral excellence that "goes all the way down"
- C. Virtues are habits.
- D. 1 and 2
- E. 1, 2 and 3

23. Which of the following options is CORRECT. The most widely applicable concept of justice in research

- A. Distributive justice
- B. Retributive justice
- C. Procedural justice
- D. All of the above

24. Select the CORRECT statement. Beneficence can also be viewed from a deontological perspective as follows

- A. Offer "other's ends", the same status as "one's own".
- B. Equalise the "ends" through the similar "means".
- C. Promote "greatest benefit for the greatest number."
- D. 1 and 2
- E. 1,2 and 3

25. Select the INCORRECT option. The following is NOT a principle of ethics

- A. Informed consent
- B. Beneficence
- C. Justice
- D. Autonomy
- E. None of the above

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