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THE SOUTH AFRICAN
DENTAL ASSOCIATION

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The Cederberg Mountains lie about 300 kilometres north of Cape Town in the Western Cape. The range is known for dramatic sandstone formations shaped by wind and water over millions of years. Iconic sites such as Wolfberg Arch and Maltese Cross attract hikers and climbers. The area supports unique fynbos vegetation and rare wildlife. It also preserves ancient San rock art, offering visitors both striking scenery and deep cultural heritage.

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References: 1. Li M, Sun Z, Zhang H, *et al.* Recent advances on polaprezinc for medical use (Review). *Experimental & Therapeutic Medicine* 2021;22:1445. **2.** Hepilor® Capsules for oral use. Product Information. Sept 2019. **3.** Hepilor® Liquid Suspension for oral use. Product Information. May 2019. **4.** Hepilor® Liquid Suspension for oral use in single-dose stick packs. Product Information. May 2019. **5.** Hepilor® Mouthwash. Product Information. April 2021.

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The exhausted profession: burnout, moral injury, and the sustainability of dentistry

SADJ APRIL 2026, Vol. 81 No.3 P129-P135

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

There are certain forms of exhaustion that professions learn to hide well.

They do not announce themselves dramatically, nor do they always interrupt performance. Clinics continue to function. Lectures are delivered. Patients are treated. Research outputs are submitted. Waiting rooms remain full, and treatment lists continue moving forward with outward efficiency. From the outside, the profession appears productive, disciplined, and composed.

And yet, beneath this surface, something quieter has been accumulating.

Across healthcare, growing attention is being directed toward burnout, emotional exhaustion, and workforce sustainability. Dentistry is increasingly part of that conversation. International literature now points to concerning levels of psychological strain among oral health professionals, students, and educators, while healthcare systems globally continue to grapple with workforce attrition, emotional fatigue, and declining professional wellbeing. But beyond the statistics lies a more difficult question, one that professions often struggle to ask honestly of themselves: what happens when the culture of a profession becomes sustained by chronic exhaustion?

This question matters because dentistry has historically prized endurance. The profession values precision under pressure, emotional control, consistency, productivity, and resilience. These qualities remain important. But over time, cultures built strongly around performance and responsibility may also become environments in which fatigue is normalised, vulnerability is concealed, and personal depletion is quietly absorbed into the routine expectations of professional life.

The consequences are not always immediately visible. Exhaustion rarely begins as collapse. More often, it emerges gradually, in cynicism replacing curiosity, detachment replacing empathy, routine replacing meaning, and survival replacing fulfilment. Clinicians may continue functioning at high levels while becoming progressively disconnected from the aspects of the profession that once gave it purpose.

Importantly, the growing discussion around burnout in dentistry cannot be reduced simply to individual wellbeing. Increasingly, healthcare literature suggests that exhaustion is shaped not only by personal coping capacity, but by the systems, cultures, and institutional expectations within which professionals work. In this sense, burnout may reveal something larger than stress alone. It may reflect a profession attempting to sustain increasingly complex demands within structures that are themselves becoming difficult to sustain.

This editorial does not seek to pathologise dentistry, nor to diminish the privilege and meaning that many clinicians continue to find in their work. Rather, it aims to reflect honestly on a growing reality within the profession: that beneath the appearance of competence and composure, many clinicians, educators, and trainees are profoundly tired, and that the sustainability of dentistry may ultimately depend on the profession's willingness to confront that reality with seriousness, humanity, and intellectual honesty.

The quiet fatigue beneath the profession

Dentistry has long projected an image of composure. The profession is associated with precision, discipline, technical mastery, and resilience under pressure. Patients encounter clinicians who appear calm, meticulous, and in control, often performing complex procedures within confined spaces and under relentless time constraints. To the outside world, dentistry can seem orderly and exacting, a profession of steady hands and measured confidence.

Yet beneath this polished exterior, a quieter reality often exists.

Across healthcare professions, there is growing recognition that clinical work carries a substantial emotional burden, and dentistry is no exception. International literature increasingly reports high levels of emotional exhaustion, psychological distress, de-personalisation, and professional fatigue among dental practitioners and trainees. While burnout is now widely discussed in medicine and nursing, dentistry has historically engaged with the subject more cautiously, perhaps because the culture of the profession has traditionally valued endurance, self-sufficiency, and uninterrupted performance.

The fatigue experienced within dentistry is rarely dramatic. More often, it accumulates slowly and silently. It is found in the practitioner who moves from patient to patient without pause, the academic balancing teaching with clinical service and research expectations, the postgraduate registrar navigating relentless assessment pressures, and the clinician who continues to function outwardly while internally disengaging from the work that once carried meaning and satisfaction.

Part of what makes this exhaustion difficult to recognise is that dentistry often rewards the appearance of coping. Productivity, efficiency, and procedural throughput remain deeply embedded indicators of professional success. Clinicians become highly skilled at maintaining performance even when emotionally depleted. In this environment, fatigue may not initially present as collapse, but rather as something quieter: cynicism, detachment, diminished empathy,

irritability, loss of professional fulfilment, or the gradual narrowing of work into mere functional routine.

The COVID-19 pandemic intensified many of these pressures, but it did not create them. Rather, it exposed vulnerabilities that had existed within healthcare systems and professional cultures long before the pandemic emerged. Studies conducted internationally in the post-pandemic period continue to demonstrate concerning levels of burnout and psychological strain among oral health professionals, particularly in environments characterised by workforce shortages, administrative overload, financial pressure, and growing patient demands.

Importantly, the discussion around burnout has evolved. Increasingly, researchers and professional organisations caution against viewing exhaustion solely as an individual failure of resilience or coping capacity. The emerging literature instead points toward a more complex interaction between clinicians and the systems within which they work. In other words, the problem may not simply be that professionals are struggling to withstand the pressures of dentistry, but that aspects of modern professional life have themselves become increasingly difficult to sustain.

This distinction matters. Because before dentistry can meaningfully address exhaustion within the profession, it must first be willing to acknowledge that beneath its culture of competence and composure, many clinicians are simply tired. Not temporarily tired, but profoundly and persistently so.

Burnout Is not simply "Stress"

The language used to describe exhaustion within healthcare is often imprecise. Terms such as stress, burnout, fatigue, and mental strain are frequently used interchangeably, yet they do not describe the same phenomenon. This distinction is important, because how a profession defines a problem often determines how it attempts to solve it.

Stress, in itself, is not inherently pathological. Dentistry has always been demanding. Clinical complexity, time pressure, technical precision, difficult interpersonal interactions, and high levels of responsibility are intrinsic to the profession. Many clinicians function effectively under significant pressure and may even derive professional fulfilment from demanding work. Stress becomes problematic, however, when it is chronic, unmanaged, and structurally embedded within the daily realities of practice.

Burnout represents something deeper and more enduring. The most widely accepted conceptualisation, developed by Maslach and colleagues, describes burnout through three interrelated dimensions: emotional exhaustion, depersonalisation, and a diminished sense of personal accomplishment. Emotional exhaustion reflects the depletion of psychological and emotional resources. Depersonalisation manifests as emotional distancing, cynicism, or detachment from patients and colleagues. Reduced professional accomplishment reflects the growing perception that one's work has lost effectiveness, meaning, or value.

Importantly, burnout does not always appear as visible dysfunction. Many clinicians continue to work, teach, supervise, publish, and maintain outward professional performance while experiencing profound internal depletion. This is partly why burnout can remain hidden within dentistry for long periods before it is openly acknowledged.

More recently, another concept has entered healthcare discourse with increasing force: moral injury. Unlike burnout, which is often framed as an occupational syndrome, moral injury arises when clinicians are repeatedly placed in situations where they are unable to provide care aligned with their professional or ethical values. It emerges when practitioners know what good care requires, but are constrained by systems, policies, resource limitations, administrative demands, or institutional pressures that prevent them from delivering it.

This distinction is particularly relevant within contemporary healthcare systems. A clinician working in an understaffed public clinic, an academic unable to provide adequate supervision because of overwhelming service obligations, or a practitioner pressured toward productivity targets at the expense of meaningful patient interaction may experience more than fatigue alone. They may experience the distress associated with practising in ways that conflict with their professional ideals.

The World Health Organization now recognises burnout as an occupational phenomenon associated with chronic workplace stress that has not been successfully managed. Notably, however, the WHO does not classify burnout as a medical condition, reflecting the growing understanding that the phenomenon cannot be explained solely at the level of the individual. Increasingly, the literature points toward organisational culture, system design, workload structures, and professional expectations as central contributors.

This shift in understanding is important because it reframes the conversation. If burnout is viewed only as an individual inability to cope, the proposed solutions tend to focus narrowly on resilience training, wellness initiatives, or self-care interventions. While such measures may offer value, they risk obscuring a more uncomfortable reality: that exhausted professionals may, in some cases, be responding normally to environments that have themselves become unsustainable.

In this sense, the growing discussion around burnout in dentistry is not merely about wellbeing. It is about the conditions under which professional care is expected to occur, and whether those conditions remain compatible with the kind of dentistry the profession claims to value.

Why dentistry is particularly vulnerable

Although burnout is increasingly recognised across healthcare professions, dentistry occupies a uniquely vulnerable position. The profession combines many of the pressures seen elsewhere in healthcare with additional structural, psychological, and economic demands that are often underestimated by those outside the field. Dentistry is not only clinically intensive; it is also physically exacting, emotionally performative, financially exposed, and frequently isolated.

Unlike many areas of medicine, large portions of dental practice occur within relatively small clinical environments where practitioners work in close proximity to patients for prolonged periods, often with limited opportunities for collegial interaction or emotional decompression. The work

demands sustained concentration, fine motor precision, and continuous interpersonal engagement, all while functioning within tightly scheduled timeframes. Small delays accumulate quickly. A single difficult procedure or emotionally charged patient interaction may alter the rhythm of an entire day.

There is also a psychological dimension unique to dentistry. Dental practitioners routinely manage fear, anxiety, pain anticipation, and patient mistrust in ways that are rarely acknowledged explicitly within professional discourse. Much of dentistry involves working on conscious patients who may already be distressed before treatment begins. Over time, the repeated absorption and management of patient anxiety becomes a form of emotional labour that is cognitively and psychologically demanding.

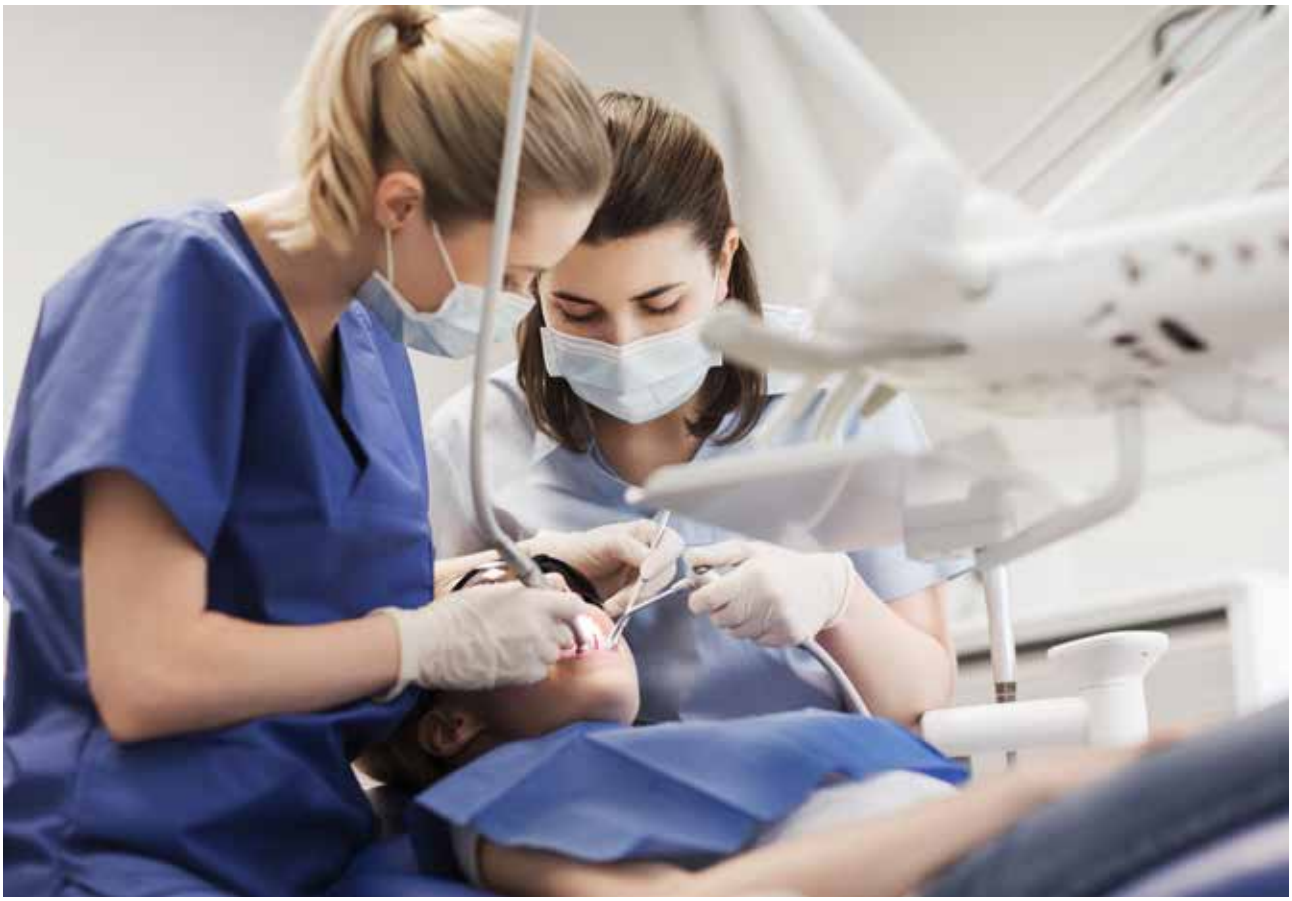
At the same time, the profession remains deeply tied to performance metrics. Productivity, procedural output, efficiency, financial viability, publication expectations, and academic advancement all exert pressure across different sectors of practice. In private practice, clinicians may face the competing demands of patient care, business sustainability, staffing concerns, and increasing operational costs. Within academic institutions, educators are often expected to balance clinical supervision, service delivery, teaching, research productivity, postgraduate training, administration, and institutional compliance simultaneously. In the public sector, workforce shortages and resource constraints frequently intensify these pressures further.

These dynamics are particularly relevant in South Africa, where oral healthcare inequalities remain substantial. Significant disparities persist between urban and rural access to care, between private and public sector resources, and between workforce availability and population need. In many settings, clinicians are expected to deliver high volumes of care under difficult circumstances, often with insufficient staffing, constrained infrastructure, or limited material resources. The cumulative effect is not merely workload, but chronic professional strain.

There is also increasing concern regarding workforce sustainability. Internationally, healthcare systems are grappling with migration, early career attrition, recruitment difficulties, and growing reluctance among younger professionals to accept working conditions that previous generations may have normalised. Dentistry is not insulated from these trends. Younger practitioners increasingly speak of work-life imbalance, emotional exhaustion, and uncertainty regarding long-term career sustainability. Meanwhile, experienced clinicians and academics often continue working within systems that rely heavily on their endurance while offering limited structural relief.

Importantly, these pressures rarely occur in isolation. Financial stress intersects with clinical responsibility. Administrative burden intersects with emotional fatigue. Academic expectations intersect with service delivery demands. Over time, the cumulative effect may not simply be exhaustion, but the gradual erosion of professional meaning itself.

This is perhaps one of the more uncomfortable realities confronting dentistry today: the profession has become extraordinarily skilled at sustaining performance under pressure, but far less skilled at recognising the long-term human cost of doing so.



The culture of silence in dentistry

One of the more difficult aspects of exhaustion within dentistry is not simply its prevalence, but the culture that surrounds it. Despite growing awareness of burnout across healthcare, many clinicians continue to experience psychological strain in relative silence. Within dentistry, there remains a deeply embedded professional expectation that competence should appear effortless, composure should remain uninterrupted, and personal difficulty should be managed privately.

From the earliest stages of training, dentists are often socialised into cultures that reward endurance. Long hours, emotional restraint, perfectionism, and relentless productivity are frequently normalised, sometimes even admired. The ability to continue functioning despite exhaustion becomes interpreted as professionalism. Over time, this creates an environment in which vulnerability may be perceived, explicitly or implicitly, as weakness, fragility, or lack of suitability for the profession.

The consequences of this culture are subtle but significant. Clinicians may become increasingly reluctant to acknowledge emotional fatigue, seek support, or disclose psychological distress to colleagues for fear of judgement, reputational harm, or perceived professional inadequacy. Academics and senior clinicians, in particular, may feel pressure to maintain an image of stability and capability, even when personally depleted. In this sense, the profession often becomes highly effective at concealing distress while remaining functionally productive.

There is also a growing tension between the public image of dentistry and the lived experience of many practitioners. Contemporary professional culture increasingly emphasises visibility, achievement, and performative success. Social media platforms, professional branding, and digitally curated portrayals of clinical excellence can create the impression that modern dentistry is characterised primarily by innovation, aesthetic precision, entrepreneurial growth, and constant advancement. While these developments reflect genuine aspects of the profession, they may simultaneously obscure the emotional realities that accompany daily clinical practice.

This disconnect can be particularly isolating for younger practitioners and students. Individuals entering the profession may encounter an implicit message that successful clinicians are perpetually productive, emotionally resilient, and continuously thriving. When their own experiences fail to align with this narrative, exhaustion may become internalised as personal failure rather than recognised as part of a broader systemic issue.

The profession must therefore confront an uncomfortable possibility: that aspects of its own culture may inadvertently perpetuate the very exhaustion it struggles to address. A culture that prizes stoicism above reflection, performance above sustainability, and endurance above wellbeing may ultimately produce clinicians who continue to function professionally while becoming progressively disconnected from the meaning, empathy, and fulfilment that drew them to the profession in the first place.

Importantly, acknowledging this reality does not diminish professionalism. If anything, it strengthens it. Mature professions are not defined by the absence of vulnerability, but by their capacity to recognise human limitation honestly and respond to it constructively. Dentistry's challenge may therefore not simply be reducing burnout, but creating a professional culture in which conversations about exhaustion, sustainability, and psychological wellbeing can occur without shame, defensiveness, or fear.

When the system itself exhausts the clinician

There is a tendency within professional discourse to locate exhaustion primarily within the individual clinician, as though burnout emerges from insufficient resilience, poor coping strategies, or an inability to adapt to the demands of practice. Yet increasingly, healthcare literature challenges this assumption. In many cases, clinicians are not failing because they are weak; they are struggling because the systems within which they work have become progressively more difficult to sustain.

This distinction is critical. It shifts the conversation away from individual pathology and toward organisational responsibility.

Modern dentistry operates within environments of intensifying complexity. Clinical care is now accompanied by expanding administrative obligations, regulatory compliance requirements, documentation burdens, medico-legal anxieties, technological adaptation, continuing professional development demands, and growing expectations for measurable productivity. Across both public and private sectors, the profession is increasingly shaped by metrics: patient numbers, procedural throughput, publication outputs, financial targets, clinical quotas, performance indicators, accreditation requirements, and institutional deliverables.

The cumulative effect is subtle but profound. Work that once centred primarily on patient care becomes increasingly fragmented by competing demands that consume cognitive and emotional energy. Clinicians may spend substantial portions of their day navigating systems rather than practising the aspects of dentistry they find professionally meaningful. Over time, this fragmentation contributes not only to fatigue, but to a gradual sense of professional dislocation.

Within academic environments, these pressures are particularly pronounced. Dental educators are frequently expected to function simultaneously as clinicians, supervisors, researchers, administrators, mentors, curriculum developers, assessors, and institutional representatives. The expansion of higher education accountability structures has introduced additional layers of reporting, compliance, quality assurance, and performance measurement, many of which are necessary, but collectively burdensome. In some environments, the cumulative administrative load begins to compete directly with the time and psychological space required for thoughtful teaching, scholarly reflection, and meaningful mentorship.

Similarly, clinicians within overstretched public health systems may find themselves working under conditions where the demand for care consistently exceeds available capacity. Understaffing, resource limitations, infrastructure challenges, and overwhelming patient volumes create environments in which practitioners are forced to prioritise throughput and crisis management over the kind of comprehensive, reflective care they were trained to provide. The emotional consequences of repeatedly working under such constraints are substantial, particularly when clinicians feel unable to meet the standards of care they believe patients deserve.

Importantly, systems often adapt to chronic strain by normalising it. What begins as temporary overload gradually becomes institutional culture. Long hours become expected. Emotional depletion becomes routine. Exhaustion becomes interpreted as evidence of dedication rather than a warning sign of dysfunction. In such environments, the profession risks confusing endurance with sustainability.

There is also a growing concern that healthcare systems increasingly rely upon the goodwill of clinicians to compensate for structural inadequacies. Professionals continue to absorb additional responsibilities, extend themselves beyond reasonable limits, and maintain services despite insufficient support because of their commitment to patients, students, and colleagues. While admirable, this dynamic can unintentionally mask systemic fragility. A system sustained primarily by personal sacrifice eventually places both practitioners and patient care at risk.

This is why burnout cannot be resolved solely through individual wellness interventions. Mindfulness workshops, resilience training, and self-care initiatives may offer benefit at a personal level, but they cannot fully counteract environments characterised by chronic understaffing, unrealistic expectations, moral strain, or unsustainable workload structures. The profession must therefore confront a more difficult question: not simply how to help clinicians cope better within exhausting systems, but whether aspects of those systems themselves require redesign.

Because ultimately, no profession can remain healthy if the conditions required to sustain it are themselves exhausting the very people expected to uphold it.

Students, young dentists, and the inheritance of exhaustion

Perhaps one of the more concerning aspects of professional burnout is that it may no longer be confined to established practitioners. Increasingly, signs of exhaustion are emerging early—during undergraduate training, internship, community service, and the first years of independent practice. In many respects, younger members of the profession are not entering stable systems and gradually becoming fatigued by them; they are entering environments where exhaustion has already become structurally embedded.

Dental education has always been demanding. The acquisition of clinical competence necessarily involves high levels of responsibility, technical precision, assessment pressure, and emotional adaptation. Yet there is a growing concern internationally that health professions education may, at times, unintentionally normalise chronic stress as an expected feature of professional identity formation. Students quickly learn that long hours, sleep deprivation, emotional suppression, and constant performance evaluation are not temporary exceptions, but recurring features of professional life.

This process is often reinforced through what educational theorists describe as the hidden curriculum: the unspoken values, behaviours, and norms communicated indirectly through institutional culture and professional behaviour. Students observe not only what educators teach formally, but how clinicians behave under pressure, how exhaustion is discussed, or avoided, and how vulnerability is received within professional environments. When fatigue becomes normalised among educators and clinicians, students may internalise the belief that sustainable practice is secondary to endurance.

The consequences are significant. Studies across health professions education increasingly report high levels of psychological distress, anxiety, burnout symptoms, and emotional exhaustion among students and trainees. In dentistry, these pressures are compounded by uniquely intensive clinical requirements, manual performance expectations, close supervision, and concerns regarding

competence and patient safety. For some learners, the transition from idealism to professional fatigue occurs remarkably early.

Young practitioners entering the workforce often encounter additional pressures. Educational debt, uncertain career trajectories, competitive professional environments, financial instability, and rapidly evolving technologies contribute to a sense that they must continuously accelerate simply to remain professionally viable. At the same time, they inherit systems already strained by workforce shortages, institutional pressures, and shifting healthcare expectations. The result is that many early-career clinicians begin professional life already carrying substantial emotional and psychological burden.

Importantly, this raises questions not only about wellbeing, but about the future sustainability of the profession itself. A generation that associates dentistry primarily with exhaustion, imbalance, and chronic pressure may engage differently with long-term career planning, academic leadership, public service, and professional commitment. Internationally, healthcare systems are already observing changing attitudes toward work-life integration, professional boundaries, and career sustainability among younger practitioners. Dentistry is unlikely to remain exempt from these broader generational shifts.

This is not necessarily a sign of declining resilience. In some respects, younger professionals may simply be less willing to accept conditions that previous generations endured without question. That distinction matters. It suggests that the profession may be confronting not merely a workforce issue, but a deeper reassessment of what constitutes acceptable professional culture.

The challenge for dentistry, therefore, is not only to support exhausted clinicians already within the system, but to consider carefully what kind of professional life it is modelling for those still entering it. Because professions do not sustain themselves through recruitment alone. They endure when successive generations believe that the work, despite its demands, remains meaningful, humane, and ultimately sustainable.

Reclaiming sustainability, meaning, and professional humanity

If dentistry is to confront exhaustion honestly, it must move beyond the language of survival. A profession cannot define success solely by how much pressure its members can endure before they fracture quietly behind closed doors. Nor can sustainability be reduced to occasional wellness initiatives layered onto systems that remain fundamentally exhausting. The question facing dentistry is no longer whether burnout exists. The question is whether the profession is willing to reconsider the conditions it has normalised in order to preserve the very people upon whom its future depends.

This requires more than resilience rhetoric. Resilience is valuable, but resilience has limits. No amount of mindfulness, productivity optimisation, or motivational discourse can indefinitely compensate for environments characterised by chronic overload, emotional isolation, workforce shortages, and institutional cultures that equate exhaustion with commitment. At some point, professions must ask whether they are helping clinicians adapt to unhealthy systems rather than addressing the systems themselves.

The challenge is especially important because dentistry remains, at its core, profoundly human work. It depends on concentration, empathy, judgement, communication, trust, and emotional presence. Exhausted clinicians may continue to function technically for long periods, but the gradual erosion of emotional engagement carries consequences that are more difficult to measure. When practitioners become chronically depleted, something essential risks being lost, not only personal wellbeing, but curiosity, patience, compassion, mentorship, and the deeper sense of meaning that sustains professional life over decades.

Reclaiming sustainability therefore demands cultural as well as structural change. Educational institutions must reflect carefully on the environments within which students are trained and socialised. Healthcare organisations must recognise that workforce wellbeing is not peripheral to quality care, but integral to it. Professional leadership must be willing to speak honestly about exhaustion without reducing it to individual weakness or temporary inconvenience. And the profession itself must reconsider the values it rewards. A culture that consistently celebrates overwork, uninterrupted availability, and relentless productivity may eventually undermine the very excellence it seeks to preserve.

There is also an ethical dimension to this conversation that cannot be ignored. Dentistry has long emphasised responsibilities to patients, communities, and professional standards. Yet professions also carry obligations toward the sustainability and humanity of their own members. Systems that rely excessively on personal sacrifice, emotional suppression, and chronic overextension are not indefinitely sustainable, no matter how dedicated the individuals within them may be.

Importantly, none of this diminishes the privilege of practising dentistry. The profession remains intellectually demanding, technically sophisticated, and deeply meaningful. For many clinicians, it continues to provide immense fulfilment, purpose, and connection. But meaningful work is not protected from exhaustion simply because it matters. In fact, professions rooted strongly in identity and service may be particularly vulnerable to self-neglect precisely because those within them care deeply about the work they do.

Perhaps this is the deeper challenge now facing dentistry: not merely preserving workforce numbers or maintaining productivity, but safeguarding the conditions that allow clinicians to remain fully human within the profession itself.

Because a profession ultimately reveals its values not only through how it treats patients, but through how it treats the people entrusted to care for them.

Conclusion

Perhaps one of the more difficult truths confronting modern dentistry is that exhaustion has become so familiar within the profession that it is increasingly mistaken for normality.

What begins as commitment gradually becomes chronic overextension. What begins as professionalism slowly becomes self-neglect. Over time, the ability to function despite exhaustion is no longer viewed as exceptional, but expected.

And because dentistry continues to perform outwardly, with clinics operating, students graduating, conferences proceeding, and practices remaining productive, the deeper human cost can remain remarkably easy to ignore.

Yet professions, like individuals, are ultimately shaped by what they choose to normalise.

If the culture of dentistry continues to equate worth primarily with endurance, productivity, and uninterrupted performance, it risks creating generations of clinicians who become technically proficient while progressively disconnected from the meaning and humanity of the work itself. A profession may survive such conditions for a time. But survival is not the same as sustainability.

Importantly, this conversation is not about fragility. Dentistry has always required resilience, discipline, and emotional strength. Nor is it about diminishing standards or avoiding responsibility. Rather, it is about recognising that the long-term health of the profession depends not only on maintaining clinical competence, but on preserving the psychological, moral, and human capacities that allow clinicians to care meaningfully for others over the course of an entire career.

There is also a broader responsibility that extends beyond the individual practitioner. Educational institutions, healthcare systems, regulatory bodies, and professional leaders all participate in shaping the conditions under which dentistry is practised. If exhaustion has become widespread within the profession, then the question cannot rest solely with how clinicians cope, but with whether the environments they inhabit remain compatible with sustainable professional life.

And perhaps this is the deeper challenge now facing dentistry: not merely how to produce more clinicians, increase efficiency, or maintain service delivery, but how to ensure that the profession itself remains liveable for the people within it.

Because a profession ultimately reveals its values through what it protects.

If dentistry protects only productivity, it may preserve output while quietly losing parts of itself that matter far more. But if it protects professional humanity alongside professional excellence, it may yet retain the qualities that have long given the profession its dignity, meaning, and trust.

The danger facing exhausted professions is rarely sudden collapse. More often, it is the gradual acceptance of depletion as ordinary. And perhaps the most important question dentistry now faces is whether it is willing to continue calling that normal.

SUGGESTED READING

1. Dean W, Talbot S, Dean A. Reframing clinician distress: moral injury not burnout. Fed Pract. 2019;36(9):400-2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6752815/
2. Divaris K, Barlow PJ, Chendea SA, et al. The academic environment: the students' perspective. Eur J Dent Educ. 2008;12(Suppl 1):120-30. doi:10.1111/j.1600-0579.2007.00494.x
3. Dyrbye LN, Shanafelt TD. A narrative review on burnout experienced by medical students and residents. Med Educ. 2016;50(1):132-49. doi:10.1111/medu.12927
4. Elani HW, Allison PJ, Kumar RA, Mancini L, Lambrou A, Bedos C. A systematic review of stress in dental students. J Dent Educ. 2014;78(2):226-42. doi:10.1002/j.0022-0337.2014.78.2.tb05673.x
5. Montgomery A, Panagopoulou E, Esmail A, Richards T, Maslach C. Burnout in healthcare: the case for organisational change. BMJ. 2019;366:l4774. doi:10.1136/bmj.l4774
6. Maslach C, Leiter MP. Understanding the burnout experience: recent research and its implications for psychiatry. World Psychiatry. 2016;15(2):103-11. doi:10.1002/wps.20311
7. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. J Intern Med. 2018;283(6):516-29. doi:10.1111/joim.12752
8. World Health Organization. Burn-out an "occupational phenomenon": International Classification of Diseases. Geneva: WHO; 2019. Available from: World Health Organization Burnout Classification.

The Data-Driven Practice: Transforming POPIA Compliance from Burden to Strategic Advantage

SADJ APRIL 2026, Vol. 81 No.3 P136-P137

Mr KC Makhubele – CEO, South African Dental Association

The Paradigm Shift: From Regulatory Burden to Trust Currency

For many dental practice owners, the Protection of Personal Information Act (POPIA) has loomed as a complex administrative headache—another box to tick in a sea of compliance. This perspective is not only limiting but financially shortsighted. In an era defined by data breaches, digital distrust and heightened consumer awareness, how an organisation handles personal information has become a primary measure of its integrity and professionalism.

We must reframe POPIA not as a back-office obligation, but as a *front-line competitive differentiator*. Your commitment to data protection is a direct signal to patients: *"We respect you, we value your privacy and we operate with the highest standards of professionalism and care."* In a competitive market, trust is the ultimate currency and POPIA compliance is your most credible trust broker.

The High Cost of Non-Compliance vs. The ROI of Trust

The risks of non-compliance are stark: potential fines of up to R10 million, reputational damage that can unravel years of community goodwill and civil claims from patients. However, the positive return on investment (ROI) for robust compliance is often overlooked:

1. **Reduced Patient Attrition:** Patients who trust you with their data are more likely to remain loyal. Transparency builds relational equity.
2. **Enhanced Referrals:** A practice known for professionalism in *all* operations, including data ethics, becomes a safer, more prestigious referral.
3. **Operational Efficiency:** Proper data mapping and classification streamlines practice management, reduces data clutter and improves record accuracy.
4. **Defensive Marketing:** In a crisis (e.g., an industry-wide breach report), your proven compliance becomes a powerful message of reassurance.

The Dental Practice POPIA Compliance Checklist: A Step-by-Step Framework

Achieving and demonstrating compliance is a structured process. Here is a tailored, actionable checklist for the South African dental practice.

Phase 1: Foundation & Assessment (Months 1-2)

- **Appoint your Information Officer (IO):** This is mandatory. The IO is ultimately responsible—typically the practice owner/CEO, though duties can be delegated to a practice manager with the requisite understanding.
- **Conduct a Data Mapping Audit:**
  - **What data do you collect?** (Name, ID number, medical history, radiographs, payment details, insurance info).
  - **Where does it live?** (Practice management software, physical files, email, cloud backups, accountant›s system, third-party labs).
  - **Who has access?** (Dentists, hygienists, reception, IT support, external service providers).
  - **Why do you have it?** Link every data point to a specific, lawful purpose (treatment, billing, medical necessity).
- **Gap Analysis:** Compare current data handling against the 8 Conditions for Lawful Processing in POPIA. Identify your vulnerabilities.

Phase 2: Policy & Process Implementation (Months 3-4)

- **Develop Core Documentation:**
  1. **Privacy Policy:** A clear, plain-language document for patients explaining what you collect, why and their rights.
  2. **PAIA Manual:** While often mandatory only for larger entities, having a basic manual showcases transparency.
  3. **Data Breach Protocol:** A step-by-step plan for identification, containment, notification and remediation.
- **Review & Secure Third-Party Contracts:** Ensure all operators (IT providers, cloud hosts, labs, accounting software) comply with POPIA via written agreements. They become responsible parties for your data.
- **Implement Technical & Physical Safeguards:**
  - **Access Controls:** Role-based logins for your practice software. No shared generic logins.
  - **Encryption:** Ensure data is encrypted *at rest* (on servers) and *in transit* (being emailed).
  - **Physical Security:** Locked filing cabinets, secure shredding for physical records.

Phase 3: Communication & Culture (Ongoing)

- **Patient Onboarding & Consent:** Redesign your new patient intake.
  - Integrate your Privacy Policy into the process.
  - Use separate, specific consent clauses for different purposes: "I consent to the use of my data for treatment." / "I consent to receiving recall reminders via SMS/WhatsApp." / "I consent to the use of anonymised before-and-after photos for professional education." Avoid blanket consent.
- **Staff Training & Empowerment:** POPIA compliance is a team sport. Train all staff annually on:
  - Identifying phishing emails (a major breach vector).
  - Secure data handling (e.g., not leaving screens unlocked).
  - Understanding patient rights and how to respond to requests.

- Create a Subject Access Request (SAR) Procedure: Patients have the right to access, correct, or delete their data. Have a clear, efficient internal process to handle these requests within the mandated timeframes.

The Marketing Advantage: Communicating Security as Superior Service

Once your compliance framework is robust, communicate it strategically to build patient confidence and differentiate your practice.

1. Secure Digital Communication as a Service Hallmark
Insecure communication is a major patient concern Transform this vulnerability into a strength.

- Adopt Secure Patient Portals: Move away from emailing sensitive treatment plans or radiographs. A portal provides a secure, HIPAA/POPIA-compliant environment for patients to view records, receive financial estimates and sign consents. This isn›t just secure—it›s *convenient and modern.*
- Professionalise Recall Systems: Shift from basic SMS to platforms that allow secure two-way communication, appointment confirmation and digital forms. The message: "We care enough about your privacy to invest in secure systems for even routine messages."
- Virtual Consultations Done Right: Use dedicated, encrypted telehealth platforms (not Zoom or WhatsApp for initial consultations) for preliminary discussions. Frame this as a "secure, private consultation from your home.

2. Transparent Practice Branding
Weave data ethics into your practice narrative.

- Website & Waiting Room Messaging: Feature a "Our Commitment to Your Privacy" section. Explain in simple terms the steps you take. This pre-empts anxiety and builds immediate trust.
- The “Privacy First” Handover: When new patients arrive, the receptionist can briefly state: "Before we begin, we want you to know that protecting your personal and medical information is a top priority for us. Our practice is fully POPIA complian and we›re happy to answer any questions." This sets a powerful tone.
- Content Marketing: Write a blog post or create a short video entitled "How We Protect Your Dental Records in the Digital Age." Educate to build trust.

3. Leveraging Compliance in Referral Networks

- Professional Partnerships: When building referral relationships with specialists, physicians, or physiotherapists, your demonstrable POPIA compliance becomes a mark of a serious, reliable partner.
- B2B Marketing: If you offer services to corporate clients, your data protection standards can be a decisive factor in tender processes or preferred provider agreements.

The Future-Proof Perspective: Data Ethics as a Core Clinical Value

Looking ahead, data will only become more central. With the rise of AI diagnostic tools, cloud-based 3D imaging and interconnected health records, the volume and sensitivity of patient data will grow exponentially. A practice that has mastered POPIA compliance today is not just avoiding risk – it is building the essential infrastructure for the next generation of digital dentistry.

Your relationship with a patient begins the moment they entrust you with their data. By handling that data with the same care, precision and respect as you would their clinical treatment, you demonstrate a holistic professionalism. You signal that every aspect of their experience – administrative, clinical and digital – is governed by integrity.

Therefore, view your POPIA compliance file not as an administrative burden, but as a foundational marketing asset. It is the documented proof of your practice’s commitment to excellence in everything you do. In a world of uncertainty, become the practice known for its certainty—the certainty that you are a trustworthy custodian of both your patients’ health and their personal information.

Master your data. Earn their trust.
Secure your future.

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DXPclave's user interface is designed with a high focus on usability. Thanks to the 4.3" capacitive touch screen display and the **intuitive menu,** cycle selection and programming are simple and instantaneous. A **user-friendly** design then facilitates the work of every professional.

PERFORMANCE

The structure of the DXPclave is designed to generate steam quickly and efficiently. Together with the tray system, designed to improve drying, and the **steam generator with stainless-steel coil** to prevent the risk of clogging, it guarantees best-in-class cycle times and long-lasting performance.

TRACEABILITY

With DXPclave, sterilisation cycle reports can be automatically saved on USB media. Traceability is optimised thanks to the integrated or external printer. The **native Ethernet connection** ensures compatibility with the web platform and secures storage and analysis of the data.

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Anthropometry of the Sphenoid sinus and its association with vertical skeletal facial growth patterns

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ABSTRACT

Introduction

The prediction of craniofacial growth plays a vital role in the establishment of accurate diagnosis and proper treatment planning among orthodontic patients. It was hypothesized that the pneumatization of the sphenoid sinus could influence the vertical skeletal growth pattern of the craniofacial complex. However, the effect of sphenoid sinus on vertical skeletal growth is scarce in the literature.

Aims and Objectives: The study was conducted to determine the association between sphenoid sinus width and height and vertical skeletal facial types.

Materials and method: Sphenoid sinus width (SSW) and height (SSH) were measured on 209 lateral cephalographs (aged 7-55 years; mean of 19.35 ± 8.81 years) recruited for the study. Frankfort mandibular plane angle (FMA) was used to categorise participants into normo-, hypo- and hyper-divergent skeletal types. Unpaired t-test was used to compare the mean SSW and SSH according to gender and One-Way ANOVA used to determine if there were significant differences in the skeletal patterns. Significance for this study was set at < 0 .05.

Results.

The SSW was significantly different among the vertical skeletal types, P=0.006, unlike the SSH (P=0.464). The mean SSW was significantly higher in hypodivergent facial types compare to normodivergent (P=0.024) and hyperdivergent (P=0.000). In addition, only SSW showed statistical significant correlation (r = - 0.164, P=0.017) with FMA.

Conclusion. Sphenoid sinus width could be an adjunctive predicting tool in determining the direction of vertical facial growth.

Key words

Sphenoid sinus, pneumatization, vertical skeletal facial growth.

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Conflict of interest:
The authors declare no conflict of interest.

INTRODUCTION

The sphenoid sinus is the most posterior of the para-nasal sinuses located in the midline of the calvarium within the body of the sphenoid bone.[1] The growth and development of the sphenoid sinus initially progresses in the anterior-posterior, transverse and inferior planes, and later superiorly at the age of seven years, reaching its full size after puberty. This process is closely associated with the development of the craniofacial complex.[2]

Sagittal, transverse and vertical growth patterns of the craniofacial complex play crucial role in the classification of occlusion, malocclusion and also on the effect of orthodontic treatment. Due to the interplay among craniofacial structures, growth in a particular region could affect the outcome of development in another location. Several studies have reported how the morphology and dimensions of the paranasal sinuses could be an etiological factor of malocclusion, affect the spatial orientation of the anterior cranial base and also be used for the determination of gender.[3-6]

Sphenoid sinus has been adjudged to be a reliable adjunctive tool in the prediction of mandibular growth.[7] Its dimensions have been reported to be significantly associated with cervical vertebrae maturation stages in predicting skeletal maturity among Indian.[8] Furthermore, studies have shown that sphenoid sinus could be a reliable tool for the gender determination.[9,10]

The influence of the paranasal sinus on the vertical and sagittal growth pattern have been reported in the literature. [11-14] Nathini *et al*[11] observed that the dimension of the frontal sinus could possibly be used as a predictor of the vertical growth pattern of orthodontic patient. On the contrary, Göymen *et al*[13] did not report any significant difference in frontal and maxillary sinuses width and height among hyperdivergent, hypodivergent and normodivergent vertical facial patterns. In another study, sphenoid sinus volume was observed to be significantly increased in individuals with skeletal class II pattern compared to Class I and Class III skeletal patterns.[14]

The numbers of study conducted to determine the association between the dimensions of the sphenoid sinus and vertical growth pattern is scarce in the literature. Hence, we could not identify studies specifically relating sphenoid sinus pneumatization and vertical skeletal jaw pattern.

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Therefore, this study was conducted to determine if the sphenoid sinus dimension have any form of association with the vertical skeletal jaw growth pattern using lateral cephalographs. The null hypothesis in this study was that there is no statistically significant difference in the sphenoid width and height in the hyperdivergent, hypodivergent and normodivergent facial pattern. Also, this current study also assumes that the sphenoid sinus width and height do not have any significant correlation with the Frankfort mandibular plane angle.

MATERIAL AND METHODS

This research was a cross sectional descriptive study involving 209 pre-treatments lateral cephalographs of orthodontic patients. The lateral cephalographs were randomly selected from patients who had visited the City Specialist Hospital and from a private orthodontic clinic both within the city metropolis. The age range of the patients' lateral cephalographs was 7 – 55 years; comprising of 79 males and 130 females with a mean age of 19.35 ± 8.81 years. Ethical clearance (A732/8) was obtained prior to commencement of the study.

Selection criteria: clear and undistorted pre-treatments lateral cephalographs were recruited for the study. Individuals with documented history of congenital anomaly and cephalographs with signs of pathological findings that could affect craniofacial growth and development were excluded from the study.

Data collection

The lateral cephalographs of the study participants were taken using the Planmeca Proline XC cephalostat manufactured by Planmeca OY (Helsink, Finland) 2006 model with a magnification factor of 1.08-1.13. All lateral cephalographs were manually traced on a 0.003inch matte acetate paper using a pointed 0.5mm thick HB pencil under a light box. Linear measurements were obtained using plastic meter rule while angular measurements were obtained using standard plastic protractor. In order to guide against exhaustion by the investigator, a maximum of seven lateral cephalographs were traced per day. All 209 lateral cephalographs were traced by the same investigator over a period of five weeks.

Cephalometric landmarks and sphenoid sinus parameters

The classification of the vertical facial skeletal pattern was done using the Frankfort mandibular plane angle (FMA). A line connecting the orbitale and the anatomic porion indicates the Frankfurt plane. This plane was used to correspond to the positioning of the cephalostat and the subsequent measurement of all cephalographs in this current study. On the other hand, the mandibular plane indicates a line connecting the gnathion to the gonion. The reference value for FMA utilised in this study was 20.8^0 ± 3.1^0 for normal occlusion among Nigerians.[15] Frankfort mandibular plane angle (FMA) between 17.7^0-23.9^0 was considered normodivergent while values less than 17.7^0 were considered hypodivergent and values greater than 23.9^0 were considered hyperdivergent.

The size of sphenoid sinus expressed in height and width (anterior-posteriorly dimension) were measured from maximum vertical and horizontal dimension of the sphenoid sinus[8] (Figure 1).

SH: the highest point on sphenoid sinus, SL: the lowest point on sphenoid sinus, SP: posterior point on sphenoid sinus and SA: anterior point on sphenoid sinus in millimeters (mm).

SSH: line joining points SH and SL denoting maximum sphenoid sinus height (yellow line).

SSW: line joining points SP and SA denoting maximum sphenoid sinus width (red line), representing the anterior-posterior dimension.

Reliability test

Twenty (20) lateral cephalographs were traced twice at one-week interval to ascertain intra-rater reliability. Intra-class correlation coefficient (ICC) was used to determine the intra-rater reliability by the investigator. The ICC reliability were as follows: sphenoid sinus width i.e., anterior-posteriorly, (ICC 0.949, P value=0.000), sphenoid sinus height (ICC=0.871, P=0.003) and FMA (ICC=0.804, P=0.012). The findings shows that the intra-rater reliability was statistically significant with the anterior-posterior dimension of the sphenoid sinus showing the greatest value.

Normality distribution was determined using Shapiro-Wilk and were as follows SSW; 0.241, 0.071 and 0.531 for normodivergent, hypodivergent and hyperdivergent skeletal patterns respectively and SSH 0.322, 0.067 and 0.780 for normodivergent, hypodivergent and hyperdivergent skeletal patterns respectively. Parametric tools were thereafter used to analyse the data.

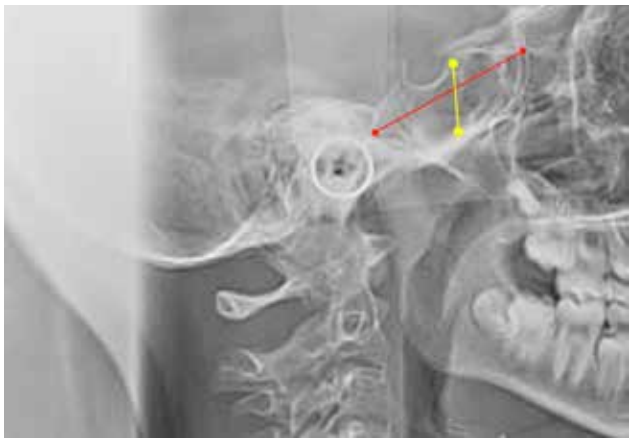

Figure 1. Landmark for measurement of the sphenoid sinus width i.e., anterior-posteriorly, (red) and height (yellow).

Statistical analysis

The data collected were entered and analysed using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics were used to describe data in terms of frequency and percentage, mean and standard deviation. Unpaired t-test was used to compare the mean sphenoid sinus width and sphenoid sinus height in relation to gender in the different vertical skeletal patterns. One-way analysis of variance (ANOVA) was applied to test if the sphenoid sinus width and height differ significantly in the different vertical skeletal facial patterns and Tukey post hoc test was used to determine where the significant difference may have occurred. In addition, Pearson's correlation coefficient was used to test the association between sphenoid sinus dimension and Frankfort mandibular plane angle. Significance for this study was determined when the confidence level (p value) was < 0 .05.

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Results

Table 1. Mean age and the distribution of the study participants

	N(%)	Mean	SD	SEM
Male	79 (37.8)	17.04	8.26	0.93
Female	130 (62.2)	20.75	8.86	0.78
Total	209 (100)	19.35	8.81	0.61

SEM: Standard error of mean

A total of 209 pre-treatment lateral cephalographs were analysed in this study. The mean age of the study participants was 19.35 ± 8.81 years. Majority of the participants were females 130 (62.2%), while the male participants accounted for 37.8% of the pre-treatment lateral cephalographs.

Table 2 describes the mean FMA of the different vertical skeletal patterns according to gender, which were not statistically significant. The results showed that among participants with normodivergent skeletal patterns, females had slightly higher FMA than males although not statistically significant (P=0.218). However, male participants had higher FMA than females among those with hypodivergent and hyperdivergent skeletal patterns, P=0.102 and P=0.077 respectively.

Table 3 showed the comparison of the sphenoid sinus width and height in relation to genders in the different vertical facial types. Among the normodivergent participants, the mean SSW and SSH were not significantly different between genders, P=0.782 and P=0.108 respectively. Similar observations were seen among the hypodivergent participants, P=0.307 in the SSW and P=0.554 in SSH. However, female SSW (26.28 ± 6.07°) was statistical significantly greater than the mean SSW of males (22.50 ± 6.22°), P=0.002 among participants with hyperdivergent facial types.

Comparison of the sphenoid width (anterior-posterior dimension) and height among the three vertical skeletal patterns (normodivergent, hypodivergent and Hyperdivergent) was conducted using One-Way analysis of

Table 2. Mean Frankfort-Mandibular Plane Angle (FMA) according to gender

	Gender	N(%)	Mean (°)	SEM	P value
Normodivergent	Male	24	21.38 ± 2.10	0.43	0.218
	Female	47	22.00 ± 1.76	0.26	
	Total	71	21.79 ± 1.89	0.22	
Hypodivergent	Male	11	14.09 ± 3.21	0.97	0.102
	Female	9	11.89 ± 2.32	0.77	
	Total	20	13.10 ± 2.99	0.67	
Hyperdivergent	Male	44	31.32 ± 5.00	0.75	0.077
	Female	74	29.89 ± 3.65	0.42	
	Total	118	30.42 ± 4.24	0.39	

Table 3. Comparison of mean sphenoid sinus width and height in the different vertical skeletal pattern according to gender.

	Gender	N(%)	Mean(mm)	SEM	Min	Max	P-Value
Normodivergent							
SSW	Male	24	25.86 ± 5.72	1.167	12	35	0.782
	Female	47	25.47 ± 6.02	0.878	12	38	
SSH	Male	24	13.38 ± 3.80	0.78	5	20	0.108
	Female	47	11.87 ± 3.34	0.49	5	21	
SSW	Total	71	25.61 ± 5.88	0.70	12	38	
SSH	Total	71	12.38 ± 3.55	0.42	5	21	
Hypodivergent							
SSW	Male	11	31.00 ± 7.07	2.13	20	44	0.307
	Female	9	28.22 ± 4.66	1.55	20	35	
SSH	Male	11	13.82 ± 2.09	0.63	11	17	0.554
	Female	9	13.00 ± 3.57	1.19	8	17	
SSW	Total	20	29.75 ± 6.12	1.37	20	44	
SSH	Total	20	13.45 ± 2.80	0.63	8	17	
Hyperdivergent							
SSW	Male	44	22.50 ± 6.22	0.94	8	38	0.002
	Female	74	26.28 ± 6.07	0.71	9	40	
SSH	Male	44	12.25 ± 4.22	0.64	4	21	0.794
	Female	74	12.45 ± 3.36	0.39	5	21	
SSW	Total	118	24.87 ± 6.37	0.59	8	40	
SSH	Total	118	12.37 ± 3.69	0.34	4	21	

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Table 4. One-way ANOVA comparison

	Sum of squares	df	Mean square	F	Sig	Post hoc test		
						Normodivergent vs Hypodivergent	Normodivergent vs Hyperdivergent	Hyperdivergent vs Hypodivergent
Total								
SSW	406.811	2	203.406	5.318	0.006	0.024	0.710	0.004
SSH	20.877	2	10.439	0.820	0.442	0.464	1.000	0.426
Male								
SSW	682.679	2	341.339	8.910	0.000	0.066	0.087	0.000
SSH	32.641	2	16.320	1.087	0.343	0.947	0.490	0.457
Female								
SSW	61.733	2	30.866	0.865	0.424	-	-	-
SSH	14.513	2	7.256	0.640	0.529	-	-	-

variance. When genders were not considered, there was a statistically significant difference in the sphenoid sinus width among the vertical skeletal patterns., P=0.006. Tukey post hoc test showed that the differences were between the normodivergent and hypodivergent (P=0.024) and between hyperdivergent and hypodivergent (P=0.004) facial types. It was observed that the difference was only noted in male participants between hyperdivergent and hypodivergent (P=0.000) vertical skeletal patterns. Female participants did not show any significant difference in SSW nor in SSH among the different vertical skeletal patterns.

Table 5. Pearson correlation coefficient between sphenoid sinus dimensions and Frankfort mandibular plane angle

	R	SIG
SSW	-0.164	0.017
SSH	-0.041	0.556

Pearson correlation was conducted to determine the association with the sinus width and height and the Frankfurt mandibular plane angle (FMA). It showed that SSW (anterior-posterior dimension) has a weak and negative statistically significant level of association with the FMA (R=-0.164, P=0.017).

DISCUSSION

An in-depth understanding of the potential influence of sphenoid growth and development on the skeletal pattern is necessary for improved diagnosis and prediction of craniofacial growth pattern. Vertical growth pattern could be a factor to consider between making the decision whether to extract or not in orthodontic treatment planning. While Tulley[16] reported a reduction in vertical dimension after extraction of first premolars, on the contrary, Staggers[17] reported an increase in vertical dimension among extracted and non-extracted patients. In another study, the author reported a statistically significant increase in the post-treatment vertical dimension among patient that had extraction[18]. It is therefore important to choose the proper treatment mechanics when managing patients that have hyperdivergent skeletal pattern to prevent further increase in the vertical dimension because conventional mechanics have not shown to decrease vertical dimension among growing patients.[19] Researches correlating the effect of vertical growth pattern with the dimension of the sphenoid sinus is not as visible in the literature compared to studies relating frontal and maxillary sinuses to vertical and sagittal skeletal jaw patterns.[11-14] This present study was conducted to evaluate sphenoidal sinus dimensional in terms of width (anterior-posterior dimension of the sphenoid sinus) and height in relation to normodivergent, hypodivergent and hyperdivergent vertical skeletal pattern.

Some authors have reported significant level of association between sphenoid sinus width and height and the cervical vertebrae maturation stages in evaluating skeletal maturity and for the prediction of mandibular growth. [7,8] In a study conducted among a population in Indian, using cone beam computed tomography (CBCT), the sphenoid sinus volume was reported to be larger among Class II sagittal skeletal malocclusion compare to Class I and Class III sagittal skeletal malocclusion.[14] Findings from this current study would be compared to observations made between the pneumatization of the other paranasal sinuses and the effect that had on the vertical facial skeletal patterns.

This current study has shown that the sphenoid sinus width was significantly different in the different vertical skeletal pattern. It further revealed that the SSW dimension was significantly higher among the hypodivergent skeletal pattern compared to normodivergent and hyperdivergent individuals. An increase in sphenoid sinus width has been positively correlated with an increase in condylar length.[7] Increase in condylar length has been reported to be more associated with hypodivergent vertical pattern.[20] This could be due to the more anteriorly inclined condylar head in hypodivergent individuals.[21] When genders were considered differently, male participants with hypodivergent patterns had significantly larger SSW compared to hyperdivergent patterns. Sphenoid sinus height did not show significantly different among the different vertical facial pattern irrespective of gender.

Oksayan *et al*[12] observed that maxillary sinus width was significantly lower among high-angle participants than low-angle participants. This finding is comparable to lower sphenoid sinus width among hyperdivergent participants

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compared to hypodivergent participants. In the same vein, in 2016, Nathani et al[11] reported that significant difference in the frontal sinus dimensions also exist among the different vertical skeletal facial pattern and suggested that it could be used a s a tool for growth pattern prediction. On the contrary, a study conducted among a Turkish population did not show significant differences in the frontal and maxillary sinus width and height among high-angle, low-angle and medium angle vertical skeletal types.[13] This present study revealed a significant negative weak correlation between sphenoid sinus width and the Frankfort mandibular plane angle. That is, an increase in the sphenoid sinus width is associate with a decrease in the Frankfort mandibular plane angle, tending towards a hypodivergent vertical facial pattern. There is a dearth of information concerning the direct relationship between the sphenoid sinus and Frankfurt mandibular plane angle, however the growth of the sphenoid sinus does affect the shape of the sella turcica, with hypodivergent skeletal pattern having larger posterior clinoid distance but smaller posterior clinoid height when compared to normodivergent and hyperdivergent skeletal patterns.[22] In this current, the sphenoid sinus height was not significantly different among the different vertical facial types.

Considering that the pneumatization of the sphenoid sinus continues till puberty,[17] a good knowledge of its development could help to predict the vertical skeletal facial growth pattern. This could assist the orthodontist to make early and informed decisions whether to redirect the growth of the jaws or not since this current shows a negative correlation between the sphenoid sinus width (anterior-posterior dimension) and FMA. Also, the decision to embark on extraction or non-extraction orthodontic treatment protocol could be made if a patient's vertical skeletal jaw pattern is predictable, since other studies[18] have shown that extraction could worsen a vertically growing skeletal pattern. In this current study the sphenoid sinus width could be a useful adjunctive tool in the prediction of the vertical skeletal facial type.

Limitation and recommendation

This study was conducted using lateral cephalometric radiograph which could only reveal the anterior-posterior view of a paired 3-dimensional sinus. The use of three-dimensional view with cone beam computed tomography could have given us more insight into the anterior-posterior, vertical and transverse dimensions of the sphenoid sinus.

Conclusion

On the average, this current study showed that there was statistically significant difference in the sphenoid sinus width among the normodivergent, hypodivergent and hyperdivergent vertical facial patterns, P=0.006. The sphenoid sinus width among hypodivergent was significantly higher than normodivergent (P=0.024) and hyperdivergent (P=0.004) participants. Sphenoid sinus height did not show statistically significant difference among the vertical skeletal patterns.

When gender was considered, only male participants showed statistically significant difference in the sphenoid sinus width i.e., anterior-posterior dimension (P=0.000), as the hypodivergent facial types were significantly higher than the hyperdivergent facial type (P=0.000). Female participants did not show significant differences in sphenoid sinus width and height among the different vertical skeletal patterns.

Also, this current study shows that only sphenoid sinus width had statistical negative weak correlation with the Frankfort mandibular plane angle, FMA (r= - 0.164, P=0.017). This shows that as the sphenoid sinus width increases there would be a decrease in the FMA, tending towards a hypodivergent skeletal patterns.

Conflict of interest

The authors declare no conflict of interest.

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REFERENCES

1. Cemil Mutlu, H. Halis Unlu, Cihan Goktan, Serdar Tarhan, Murat Egrilmez. Radiologic anatomy of the sphenoid sinus for intranasal surgery. Rhinology. 2001;39:128–32.
2. Wolf G, Anderhuber W, Kuhn F (1993) Development of the paranasal sinuses in children: implications for paranasal sinus surgery. Ann Otol Rhinol Laryngol. 102: 705-11.
3. Dhiman I, Singla A, Mahajan V, Jaj HS, Seth V, Negi P. Reliability of frontal sinus with that of maxillary sinus in assessment of different types of skeletal malocclusions. J Indian Orthod Soc 2015;49:96-103.
4. Algahefi Ahmed, Al-Ak'hali Mohammed, Halboub Esam, Tong Fei, Almashraqi Abeer, Ghaleb Labib Hazaa, et al. The relationship between the dimensions of frontal air sinus and skeletal malocclusions: A systematic review and meta-analysis. Heliyon.2024; 10(2).e24200. Doi.org/10.1016/j.heliyon.2024.e24200
5. Tehranchi A, Motamedian SR, Saedi S, Kabiri S, Shidfar S. Correlation between frontal sinus dimensions and cephalometric indices: A cross-sectional study. Eur J Dent 2017;11:64-70.
6. Khaitan T, Kabiraj A, Ginjupally U, Jain R. Cephalometric Analysis for Gender Determination Using Maxillary Sinus Index: A Novel Dimension in Personal Identification. Int. J. Dent . 2017. doi.org/:10.115/2017/7026796
7. Kumar S, Tripathi T, Sindhu M.S, Grover S, Diwaker R. Sphenoid Sinus as A Mandibular Growth Prediction - Is It Valid? Indian Journal of Dental Sciences. 2015;1(7):054-055
8. Mahmood HT, Shaikh A, Fida M. Reliability and validity of maxillary and sphenoid sinus morphological variations in the assessment of skeletal maturity. J Ayub Med Coll Abbottabad 2018;30(3):360–65.
9. Abdulhameed A, Abdullahi D.Z. Cephalometric Analysis of Sphenoid Sinus Dimensions for Sex Identification: A Radiologic Study. 2022; ABMS, 3(1):216-19.
10. Banihashem Rad SA, Anbiaee N, Moeini Sh, Bagherpour A. Sex Determination Using Human Sphenoid Sinus in a Northeast Iranian Population: A Discriminant Function Analysis. J Dent Shiraz Univ Med Sci., 2023; 24(1): 95-102.
11. Nathani R, Diagavane P, Shrivastav S, Kamble R, Gupta D, Korde S. Evaluation of frontal sinus as a growth predictor in horizontal, vertical, and average growth pattern in children from 8 to 11 years: A cephalometric study. J Indian Orthod Soc 2016;50:101-5
12. Rıdvan Oksayan, Oral Sokucu, Seher Yesildal. Evaluation of maxillary sinus volume and dimensions in different vertical face growth patterns: a study of cone-beam computed tomography. ACTA ODONTOLOGICA SCANDINAVICA, 2017. 75(5): 345–49
13. Göymen M, Bilgin Büyüknacar G, Güleç A. Effect of Vertical Growth Pattern on Maxillary and Frontal Sinus Sizes. Eur J Ther 2019; 25(3): 197-200.
14. Arshya Kumar, Srirengalakshmi Muthuswamy Pandian. Evaluation of sphenoid sinus volume and cranial base length in subjects with different sagittal skeletal malocclusions. Int J Orthod Rehabil 2023; 14 (2) 54 – 64.
15. Isiekwe MC, Sowemimo G.O.A. Cephalometric Findings in a Normal Nigerian Population Sample and Adult Nigerians with Unrepaired Clefts. Cleft Palate Journal, 1984, 21(4):323-28
16. Tulley WJ. The role of extractions in orthodontic treatment. Br Dent J 1959;107:199-205.
17. Staggers JA. Vertical changes following first premolar extractions. Am J Orthod Dentofacial Orthop. 1994;105:19–24.
18. Hafiza Z Shafique, Rumeesha Zaheer, Abdullah Jan, Alaina T Mughal, Rooma Shahid, Fareena Ghaffar, et al. Vertical Skeletal Changes after Extraction and Nonextraction Orthodontic Treatment. Eur J Dent. 2022 Jul 4;17(1):227–233.
19. Nikolaos Gkantidis , Demetrios J Halazonetis, Evanggelos Alexandropoulos, Nikos B Haralabakis. Treatment strategies for patients with hyperdivergent Class II Division 1 malocclusion: is vertical dimension affected? Am J Orthod Dentofacial Orthop 2011;140(3):346-55.
20. Han Jingwen, Ren Shiqi, Liu Xingyu, Lang Xin, Chu Mengshi, Waseem Saleh Abdo Kaid Algumaei, Zheng Yan. Study on the characteristics of different vertical and sagittal bony facial condyles in adults[J]. International Journal of Stomatology, 2022, 49(2): 153-162.
21. Maryam Paknahad , Shoaleh Shahidi Association between condylar position and vertical skeletal craniofacial morphology: A cone beam computed tomography study. Int Orthod.2017;15(4):740-751.
22. Yan S, Huang S, Wu Z, Liu Y, Men Y, Nie X, Guo J. A CBCT Investigation of the Sella Turcica Dimension and Sella Turcica Bridging in Different Vertical Growth Patterns. J Clin Med. 2023 Feb 27;12(5):1890. doi: 10.3390/jcm12051890.

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Oral health workers' perspectives on systemic challenges and service disparities in denture services provision in selected districts of KwaZulu-Natal, South Africa

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ABSTRACT

Introduction

The access for care related to edentulism remains a challenge for aging and disadvantaged populations reliant on public oral health services in South Africa. There is limited data on the accessibility, availability, and quality of denture services in the districts of KwaZulu-Natal.

Aims and objectives

This study explored denture services delivery in public oral health facilities in the Harry Gwala and eThekwini districts through semi-structured interviews with provincial health executives, public and private oral health workers.

Study design

An interpretivist qualitative research design.

Methods

This study enrolled voluntary and purposively selected participants from both public and private oral health sectors ((n=20). Participants from the public sector included provincial executive managers, managers of public dental facilities, dentists, dental therapists, dental technicians and dental assistants. Participants from the private oral health sector included dentists and dental therapists. Data was collected through a semi-structured interview consisting of three main categories: 1. The awareness of public denture services. 2. Inclusion of public denture services in the essential oral healthcare package and 3. The incorporation of denture services in the National Health Insurance (NHI) essential package. Data analysis was conducted using NVivo 15 Software for Qualitative Data Analysis, ending up with a list of codes and categories which resulted in the emergence of recurring themes.

Results

Four themes emerged from data analysis, namely: Poor availability and access to oral health rehabilitative services; Limited financial and human resources; Challenges with the reprioritisation of oral health service provision in the public dental clinics; and Opportunities and barriers to denture service delivery. The findings revealed disparities in the availability and accessibility across the study sites, with a notable absence of denture services in rural areas and long waiting lists in the urban district.

Conclusion

This study highlights that despite existing infrastructure and trained personnel, denture service provision in KZN remains limited due to systemic challenges, including inadequate funding and shortages in both clinical and technical aspects.

Keywords

Tooth extraction, Edentulism, Prosthodontic services, Denture provision, Public oral health, Dental service disparities, Oral health policy, Access to dental care, Oral rehabilitation, Oral health inequities

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Authors' contribution

1. Y Bandezi: Study conceptualisation, data analysis, manuscript preparation, writing and final editing (70%).
2. S Singh: Data analysis, manuscript preparation and editing (30%).

INTRODUCTION

The fabrication and delivery of complete and partial dentures is considered a basic rehabilitative offering in South African context.[1, 2] However, the delivery of these removable prosthodontic services is often constrained due to inadequate human and infrastructural resources, lack of materials and poor referral systems.[3] The results of these constraints include delayed service delivery and, in some instances, a complete lack of services, predominantly in rural and peri-urban areas. Inadequate access to dentures can severely impact nutrition, speech, self-esteem, and overall

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quality of life.[4] This is concerning since edentulism, whether complete or partial, remains prevalent among South Africa's aging and socioeconomically disadvantaged populations whom depend on public sector oral health services for rehabilitative care, including the provision of removable dentures.[5] Despite the recognised significant burden of edentulism and need for prosthetic rehabilitation, there is limited empirical data assessing the accessibility, availability, and quality of denture services in KZN, particularly within districts such as Harry Gwala and eThekwini.

KwaZulu-Natal (KZN) is one of the most populated provinces of South Africa which reflects substantial variation in access to healthcare services across its urban and rural districts. The eThekwini District, which encompasses the metropolitan area of Durban, is relatively better resourced in comparison to rural districts such as Harry Gwala, which is characterized by high poverty levels and limited healthcare infrastructure.[6] This urban-rural divide bares potentially negative implications on the quality, efficiency, and equity of denture service delivery and access within the provincial public health system. Understanding the determinants of the systemic bottlenecks and contextual differences in service provision is vital to informing provincial health planning, improving service delivery, and ultimately enhancing oral health outcomes for underserved populations.

The purpose of this study was to explore the current state of denture services delivered through public oral health facilities in the Harry Gwala and eThekwini districts through semi-structured interviews with provincial health executives, public oral health division managers, public and private oral health workers. Specifically, it sought to identify systemic challenges and service disparities. Findings from this research are intended to support evidence-based planning to ensure equitable and effective denture service delivery in KZN.

METHODS AND MATERIALS

Study design

This study employed an interpretivist qualitative research design.

Setting

This study was conducted in selected private and public oral health facilities of Harry Gwala and eThekwini districts, KwaZulu-Natal (KZN), South Africa.

Study participants

Participants in this study were selected from both public and private oral health sectors. Participants from the public sector included provincial executive managers, managers of public dental facilities, dentists, dental therapists, dental technicians and dental assistants. Participants from the private oral health sector included dentists and dental therapists. The selection criteria for public sector participants were based on their involvement in the daily service delivery of oral health services, which primarily focused on removable dentures. Private practitioners were selected based on their proximity to the same communities that are being serviced by the public oral health facilities. Executive health managers were included in the study so as to gain insight on systemic challenges, resource allocation, and overall service delivery structure and policy priorities.

Sample size

All study participants were purposely selected and invited to voluntarily participate in this study. A total of twenty participants consented and participated in this study, Table 1.

Table 1: List of interviewees

Interviewee	Position	Location
P1	KZN DOH executive (NHI)	KwaZulu-Natal
P2	KZN DOH executive (Oral Health)	KwaZulu-Natal
P3	Dentist and manager of a public oral health facility.	eThekwini
P4	Dentist in a public oral health facility.	eThekwini
P5	Dentist and manager of a public oral health facility.	eThekwini
P6	Dental therapist in a public oral health facility.	eThekwini
P7	Dental therapist and manager of a public oral health facility.	Harry Gwala
P8	Dental therapist in a public oral health facility.	Harry Gwala
P9	Dentist from a private practice.	eThekwini
P10	Dentist and manager of a public oral health facility.	Harry Gwala
P11	Dental assistant in a public oral health facility.	Harry Gwala
P12	Dentist from a private practice.	Harry Gwala
P13	Dentist from a private practice.	Harry Gwala
P14	Community Service dentist in a public oral health facility.	Harry Gwala
P15	Dentist and manager of a public oral health facility.	Harry Gwala
P16	Dentist from a private practice.	Harry Gwala
P17	Dental therapist from a private practice.	Harry Gwala
P18	Dentist from a private practice.	eThekwini
P19	Dental Technician and manager of a public oral health facility.	eThekwini
P20	Dental Technician in a public oral health facility.	eThekwini

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Data collection instrument

This study used a semi-structured interview to collect data. The interview schedule consisted of three main categories such as the awareness of public denture services, inclusion of public denture services in the essential oral healthcare package and the incorporation of denture services in the NHI essential package. These questions were preceded by introductory questions that required the interviewee to relate their scope of practice and responsibilities in their specific roles.

Data collection procedure

The executive managers, private and public oral health facilities' contact details were retrieved from public websites. Communication was entered into with the listed contact persons who guided the researcher to the relevant gatekeepers. The gatekeepers subsequently connected the researcher with the prospective participants for their voluntary consideration to participate in this study and matters of voluntary participation, anonymity and confidentiality were discussed. Interviews were scheduled with those who have consented to participate in this study at their preferred location. Two participants opted for an online video call via MS Teams and WhatsApp, to accommodate their busy schedules. The rest of the participants were interviewed face-to-face at their places of work. All interviews were recorded to allow for transcription and ease of analysis. The audio recording only ensued after permission was obtained from the interviewee and after they had signed the informed consent form. These interviews were conducted once-off for a duration of 30-60 minutes. The full interview transcripts were returned to participants for review as part of the member-checking process where participants were invited to verify the accuracy of their transcripts and to provide any clarifications, corrections, or additional comments they felt were necessary. This process allowed participants to confirm that their views had been accurately captured and contributed to enhancing the authenticity and trustworthiness of the data. Credibility was ensured through establishing confirmability by using direct quotations to convey the opinions of participants.

Ethical consideration

This research was approved by the Humanities and Social Sciences Research Ethics Committee (HSSREC) of the University of KwaZulu-Natal, with reference number: HSSREC/00000444/2019. Gatekeeper permission was obtained from the KZN Department of Health with reference number KZ_202001_020.

Data analysis

The data from interviews were analysed using thematic analysis which entailed data familiarisation and writing of familiarisation notes by reading through all transcripts and making annotations. Thereafter, the researcher systematically coded the data using NVivo 15 Software for Qualitative Data Analysis. The generated codes were reviewed and organised into categories based on addressing similar concepts of this study. These categories resulted in the emergence of initial themes which were later reviewed by revisiting the codes and the original transcripts to ascertain relevance and alignment with the objective of this study. The final activity was the writing up of the report, substantiating it with extracts of the interviewee's responses.

RESULTS

The analysed data resulted in the emergence of four themes in alignment with the objective of this study. The categories of interview questions were the awareness of public denture

Table 2: Category of interview questions, codes and themes.

Category of interview questions	Codes	Themes
Awareness of public denture services.	KZN public denture service points. Access to denture services. Importance of replacing missing teeth.	**Theme 1:** Poor availability and access to oral health rehabilitative services.
Inclusion of public denture services in the essential oral healthcare package.	Budgetary constraints. Lack of sense of urgency. Long waiting lists for denture patients. Lack of focus on Oral Health. Lack of prescribed indicators for dentures. Additional Dental Laboratories. Practicality of providing denture services at Primary health level. The role of higher education dental facilities	**Theme 2:** Limited financial and human resources. **Theme 3:** Challenges with the reprioritisation of oral health service provision in the public dental clinics.
Incorporation of denture services in the NHI essential package	NHI as a possible solution. Possible challenges for NHI implementation Leveraging the services of the available dentists.	**Theme 4:** Opportunities and barriers to denture service delivery.

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services, inclusion of public denture services in the essential oral healthcare package and the incorporation of denture services in the NHI essential package. The following themes emerged from data analysis (1) Poor availability and access to oral health rehabilitative services, (2) Limited financial and human resources, (3) Challenges with the reprioritisation of oral health service provision in the public dental clinics. and (4) Opportunities and barriers to denture service delivery, (Table 2).

Theme 1: Poor availability and access to oral health rehabilitative services.

Oral health practitioners interviewed in this study highlighted critical challenges related to the availability and access to basic denture services within the public healthcare system of KZN. While they were able to identify the existing public oral health facilities that offer denture services, they indicated that such services were non-existent in rural areas.

"I am not aware of any in the rural areas, and I am pretty sure there is nothing." (P16)

These responses necessitated probing into how the public oral health workers from the rural district address patients in need of oral rehabilitative services. The respondents indicated that they offer patient information on the available options to replace missing teeth and refer them to private dental practices.

"So after doing the extraction you only explain it to the patient that, okay, now we've done the extraction, this is how you're going to, okay, say if you want to close the gap these are the options that you have. If they can be able to put a bridge on, explain it to them, if they're not able to afford a bridge, you explain to them that there's something called a denture and you explain to them that it's a removable denture. But you can't give them exact price, but you can give them a rough estimate and say, okay, maybe move from dentist to dentist, you shop around, yes, R1 000 plus per tooth, maybe, I don't know." (P6)

Some private and public oral health workers from both districts mentioned that although they have referred patients to the known public denture service providers in Durban, they still do not receive these services.

"So, we just refer them, so some patients go there and they can't get the service. And they come back to us, for us to provide some sort of services to them. So obviously it's those that can afford something." (P9)

Respondents pointed out that there is a need to expand denture services into rural areas highlighting that this would be beneficial for under-served populations.

"So, bringing those services will really help and looking at the fact most people are unemployed and low economic factors and all those things. For instance, someone will come to you with an abscess and when you ask why did you wait for so long? they will say that they were waiting to get paid, and to get the social grant. (P7)

One interviewee expressed that such an implementation would make life easier because the denture services will be widespread, leading to the reduction of the long waiting lists in those facilities that are currently over-burdened by having to offer these services to all the referred patients who need of dentures.

These respondents' views were consistent with other participants' statements that highlighted the implications of a lack of rehabilitative services on an individual's oral health-related quality of life. Some interviewees expressed that not replacing missing natural teeth could compromise the proper functioning of the oral cavity, including dietary intake.

"If you have tooth loss you have a risk of the teeth collapsing. You have drifting and mobility. So, if anything, your tooth that is lost, that needs to be replaced by some form like either a denture, a bridge, you know a pontic, something to fill up the gap so you do not have drifting of the teeth. That is the basic purpose of a denture, besides aesthetics and confidence and that." (P5)

Given the implications of non-replacement of missing teeth, as stated by the respondents, it was imperative to explore the possibility of incorporating basic denture services into the essential oral healthcare package and the responses are presented in the next theme.

Theme 2: Limited financial and human resources.

Respondents highlighted several challenges that could hinder the inclusion of denture services into the essential oral healthcare package. Key issues raised included limited funding, shortages of dental materials and laboratory support.

"As I said before we do experience challenges with that, the program is actually in a grey area at the moment because of our challenges with the lab. So, at the moment they have an issue with the materials, they also, when you speak to them I am sure they are going to tell you that they have an issue procuring the materials." (P3)

Interviewees reported shortage of staff in the clinical setting which compromises service delivery regardless of their willingness to perform certain procedures, they end up overwhelmed with patient numbers.

"I think it is also, because we do not have enough staff. Yes. Enough staff to do the work, because sometimes we want to do scaling and maybe fillings, but it gets packed." (P14)

Respondents from the private sector indicated that their previous experiences of working in the public sector, was also characterized by shortages in the availability of dental materials, bad work ethics and prolonged delays in procurement processes to access essential resources. This reported lack of urgency, impacted negatively on service delivery and staff morale as well.

"Because yes, we couldn't do even the fillings, you get there, you ask for materials, you ask for stuff and then it will take a year for them to procure those things. By the time they come with those things, you've already given up, you're leaving that facility." (P12)

The experiences with the slow procurement systems were also supported by the managers of public oral health facilities who stated that repairs on critical equipment could sometime take up to a year.

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"Because even with the scale and polish, we recently got this scaler, maybe last year. We had one which broke, they sent it for repairs, I think for the whole year we never got it back, because also those channels we have to go through the government, everything just takes long for whatever reason." (P15)

The reported budget restrictions and limited resources may have potentially resulted to the issue of long waiting lists for denture services, and this finding was consistent across private and public respondents, irrespective of the reporting district.

"Our waiting list at the moment is something like about six to seven years." (P3)

Theme 3: Challenges with the reprioritisation of oral health service provision in the public dental clinics.

Respondents from the public and private sectors voiced their opinions on the limited inclusion of denture services within the essential oral healthcare package. Participants also pointed to policy gaps and inconsistent prioritization of rehabilitative care in national and provincial strategies, attributing this to lack of oral health representatives in strategic positions at district level.

"But the thing is as I am saying, oral health care is not prioritized. I think that the challenge that we're facing with oral health, it might be represented maybe in the provincial thing but there is no representation in the district level, no one is there to look out for it." (P12)

They further expressed that this general lack of focus on oral health and lack of clear indicators for denture services is the result of the prescribed oral health targets that are focused on extractions to restorations ratios. Respondents added that they end up performing a lot of dental extractions largely to meet the performance indicators. One interviewee added that these oral health targets have little to no concern about following through with what happens to the patients after their teeth have been extracted.

"But they tell us that this is what we have to do, denture facilities are not part of our target requirement at the moment. The things that they are concerned about is the headcount, the extractions that we do, the number of extractions, the number of restorations, the number of outreach and community-based initiatives that we take part in and the ratio of extractions to restorations that we do. So those are the main indicators that we have but there are other services that we do offer here" (P3)

A respondent from the private sector voiced a strong opinion that dental schools play a big role in providing services to communities, by reflecting on their involvement with community dentistry while they were undergoing training. Thus, academic complexes were seen to be able to provide additional resources for the delivery of denture services.

"Even at school I did projects with the dentures, when I was a student, offering communities dentures, that was in Cape Town. Offering communities of Kraaifontein, volunteering for the projects to give dentures to a community." (P13)

One interviewee highlighted a systemic issue within oral and dental education, noting that the current approach places greater emphasis on training clinically oriented dental professionals with less focus on dental laboratory-based education. This necessitates the reassessment and reprioritization of national and provincial oral health objectives and targets.

Theme 4: Opportunities and barriers to denture service delivery.

Participants believed that additional dental laboratories at district level with a proper referral system would make things easier for the delivery of dentures services, because currently there is only one dental laboratory that is servicing the entire KZN province.

"So, we all need to be, if we had a district lab and all the facilities are working together then it makes it easier than saying okay, this facility is only allowed to use this thing, for instance. It needs to work together. Like a referral system, a proper referral system." (P10)

Respondents from the public sector suggested leveraging the services of the dentists that are already in the public health system to incorporate denture services without burdening the Department of Health financially. One interviewee voiced that while there are dentists already employed, there is a need to concurrently enhance the dental laboratory provisions.

"The main problem is going to be where the lab is, we sort that lab out and then we sort of incorporate everybody at all levels wherever there is a dentist employed, then we will not have this situation" (P3)

There was a shared belief that plastic dentures should be classified as a basic service which should be provided at primary health care level. One participant further expressed that the clinicians in the public oral health sector should be enabled to replace teeth that they have extracted, even if it is through dentures. This implies that recognizing dentures as essential would address the current imbalance that exists in the KZN public health systems where tooth extractions are prioritised over tooth replacement.

"I think plastic dentures should be, become a basic service because at the end of the day it is not, what is the word, it is not an invasive procedure it is just impressions. So, I think it should be classified at primary oral healthcare level because it is, as we are saying extractions, fillings, cleanings are basic service, when you extract a tooth you should be able to put a tooth back even though it is a denture not a crown or a bridge. It is something that would really help the patient in terms of as you said appearance, and just basic self-esteem." (P4)

With regards to the National Health Insurance (NHI) system, the majority of interviewees stated that they lack knowledge and understanding of the NHI programme in general, but particularly in the oral health context.

"I will be honest, I do not 100% know exactly how the NHI is going to work, what services they are planning to include or offer, because I know in certain countries they have limited services." (P10)

This reported lack of knowledge was attributed to a poor to non-existent consultative process with the people who are central to the programme's implementation.

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"I do not know anything about NHI. No training, no workshop, nothing. We were not even told anything about it, we just know what we know from the news. And I do not think it would even be successful." (P15)

Most respondents believed that this lack of consultation could challenge the successful implementation of NHI in the public oral health space, highlighting that there is lack of buy-in from the people on the ground, who are central in the execution of the programme.

"They need to get a buy-in from dentistry itself to see how this model is actually going to work. So, and the people that are actually, it cannot be people that are sitting in an office somewhere. That is where most of these things are going to fail. If the people that are making the policies are going to be people that have been sitting in the office maybe for the last 15 years of their lives, they have lost touch with what is happening on the ground. The people that are making the decisions need to consult the people at the bottom to say that listen these are the challenges that we have there. So, at the top somebody can say NHI yes, put it in there and let them provide the service to everybody." (P3)

While most respondents, including public and private practitioners expressed that their lack of knowledge and buy-in into the NHI programme is due to the poor consultation by the province's officials, one participant believed that it is expected that it is expected for private practitioners to show signs of resistance because they provide paid for services and are running for-profit practices.

"Any reforms will attract some resistance because of many reasons. But we are coming from a background of health services being commodified. You are mentioning the private space. That space is driven by profit. Currently in South Africa for a public sector client, generally across the country the cost is about R5 000.00 per person out of the budget. But in the private sector that is servicing only that 14,15, 16%, the cost is about R20 000.00." (P1)

Some participants expressed that there is evidence of NHI failing in other countries that have implemented it before South Africa.

"So, if this is an ideal system the way it is proposed then you will, because in the United Kingdom they have it already and I have been to the United Kingdom and I have seen how it works, they also have their challenges because again waiting lists, again cost factors and again not being paid." (P4)

Unlike the respondents who had no knowledge about NHI, some respondents believed that there is a possibility to transfer and adapt the NHI implementation strategy of contracting private medical practitioners that has already been tested with the general practitioners into the private-public oral health space.

"I think if NHI can, because I know right now that in clinics they are able to contract private doctors to do a service. Maybe if they can use that similar approach okay they get private dentists to do denture service or whatnot. Because there are lab fees involved. Maybe that can work. But to set up the infrastructure like with us in the public sector and providing those resources, I think it would take time, not that it is not feasible, it can be done but it is going to be an exercise that will take a long time." (P2)

Another form of private-public partnership that was mentioned is that of private or commercial dental laboratories being contracted to augment the services that are being offered by the public dental laboratory for the provision of dentures. One participant expressed that their facility used to utilise private laboratory services but this was discontinued due to budget reductions following the impacts of the Covid-19 pandemic.

So, we were doing denture services up until point of COVID, we had services shut down due to COVID itself and then afterwards budget constraints has stopped the service. Basically, we used to use a private lab where we were given a certain amount of budget per year in order to do treatment for, accommodate like forty patients with that budget. (P4)

Some respondents believed that there is a significant role that may be played by the NGOs in closing the existing gaps in service delivery, particularly in the future integration of basic dentures in the primary healthcare level.

So, NGOs, if they were to come, it would help a lot. I think we're actually failing on the aims that we want to achieve. We are far back. So, it would definitely be helpful. (P8)

DISCUSSION

This study explored the current state of denture services provided by public health facilities in the Harry Gwala and eThekwini districts and found various resource constraints that resulted in poor denture service delivery, as expressed by provincial health executives, public oral health division managers, public and private oral health workers. They also expressed opportunities to remedy the current service delivery status.

The findings of this study indicate that there are disparities in the availability and accessibility of oral health rehabilitative services within the identified study sites, particularly highlighting the absence of denture services in rural areas. These findings are consistent with a number of studies that have also reported on rural-urban oral health disparities globally, where rural populations consistently experience reduced access to dental care compared to their urban counterparts.[7, 8] This study also found that not having these services in rural areas resulted in the public oral health providers referring patients to the urban-based private practitioners. These referrals financially burden the patients because the process of obtaining dentures requires multiple consultations and would require them to spend on travelling multiple times.[9, 10] These findings imply that the urban based services create a barrier of access for the rural communities due to cost factors and indicate lack of health-related social justice for the population that majorly depend on social grants while managing competing basic needs, particularly the elderly.[11] The injustice is exacerbated in this vulnerable group since they often are suffering from underlying chronic illnesses that require proper nutritional intake which is compromised by having missing functional teeth.[12, 13]

Of greater concern is the notion reported by several respondents that while select urban facilities in the eThekwini district provide denture services, the referred patients are often met with long waiting lists which further exacerbates

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the cycle of unmet oral healthcare and not just rural areas. This strongly implies that there is a high demand placed on the few public oral health facilities that offer denture services. These findings correspond with current studies from other parts of South Africa, and this suggests that this is a widespread phenomenon in the country's public oral health facilities.[14] These long waiting times, with some respondents citing periods exceeding six years, potentially breaks patients' trust in the public oral health system. Interestingly, some respondents suggested that the absence of dental schools in the province adds to the reduced opportunities for community-based denture provision programmes. Additionally, it was been reported that patients from under-resourced areas turn to the dental schools as a last resort.[14] However, the irony is that this shows lack of awareness that the primary goal of dental training institutions is teaching and learning and that denture service delivery forms part of service-based learning. Numerous studies have also shown that dental training institutions are also under-funded, under-resourced and have the same issue of long waiting lists. [14-16]

The findings of this study highlighted both functional and psychosocial impacts of untreated edentulism, linking tooth loss with compromised mastication, nutritional deficiencies, drifting of adjacent teeth, and reduced self-esteem. This aligns with other global studies that highlight the significant burden of tooth loss on oral health-related quality of life.[17, 18] Despite this information being readily available to all major role players in the oral health space, oral rehabilitation remains under-prioritized in public sector planning and funding, particularly in rural settings of KZN. Some respondents believed that there's an opportunity to improve this situation by decentralizing dental laboratory services from the eThekwini district and establishing additional laboratories in several districts. This decentralization, combined with the creation of a well-coordinated referral system, was viewed as essential to alleviating the current issue of long waiting lists for dental laboratory-based prostheses. This aligns with the assertions by McGarry and Jacobson[19] who highlighted the importance of an improved dentistry and dental technology professions interface whereby the role of dental technology should not be neglected while the focus is being shifted to a future that is centred on preventive care.

In addition to the constraints concerning the dental laboratory services, the findings revealed that routine procedures, including fillings and scaling, are sometimes suspended because of lack of consumables, a phenomenon previously documented in evaluations of public health system efficiency in South Africa.[3, 20] The respondents further described critical infrastructure and equipment breakdowns, with some tools such as scalers remaining non-functional for over a year due to bureaucratic repair processes, which is consistent with recent reports from the KZN Health Department.[21, 22] This finding reflects broader challenges in health system responsiveness, particularly in lower-resource settings where centralised procurement and maintenance systems are slow and often unresponsive and literature indicates that this is not unique to South Africa.[23, 24] The extended delays in obtaining essential resources not only limit service delivery but also contribute to a culture of low morale and professional burnout, as reflected in the demotivation and resignation of oral health professionals from public service. These findings are consistent with studies identifying South Africa's significant oral health workforce shortages, particularly in rural areas, as a critical barrier to expanding the scope of public dental services.[25] Respondents argued that, much like extractions and cleanings, the procedure of taking impressions and fitting removable dentures is relatively non-invasive and could be made mandatory in the current primary care package especially for those individuals whose tooth loss has compromised their quality of life. The 2023-2030 global strategy and action plan on oral health by WHO, advocates for the integration of removable restorations such as dentures to be considered essential within universal health coverage (UHC) frameworks. This further aligns with the advocacy for tailor-made strategies to deliver oral health services for the increasing number of older adults in the aging society as exemplified by Brazil and Hong Kong.[26, 27] However, given the shortages reported above, these provisions need to be interrogated as currently they seem to be creating false hope for the destitute.

Another challenge is that most respondents did not understand the NHI and UHC framework in the South African context, with many reporting that their only exposure to the NHI bill had been through the media. This is contradictory to the findings of a recent national study by Muofhe, Makwakwa,[28] on the perception of oral health practitioners on NHI, which reported good knowledge and positive perception of NHI. Respondents of this study reported that their lack of understanding was attributed to a lack of meaningful consultation and information-sharing from policy-makers, highlighting lack of formal communications, workshops, or forums had been organized to involve oral health professionals, despite their critical role in service delivery. This reported absence of consultation indicates inconsistency in what the policy makers are reporting in their Green and White papers, whereby there are bold statements of extensive public hearings as unpacked by.[29] These inconsistencies raise serious concerns about the feasibility of implementing reforms in oral health under the NHI framework. Some studies have emphasized that a successful healthcare reform requires active engagement and co-design with practitioners, particularly those at the operational level who understand service delivery realities.[28, 30, 31] While the respondents cited lack of knowledge of the SA NHI system, they had a negative outlook towards it being successfully implemented. Surprisingly, this is consistent with the findings of the Muofhe, Makwakwa,[28] even though their overall results pointed towards a positive perception, they reported that serious concerns persisted regarding the successful implementation of the NHI with 63.7% of oral health practitioners indicating that NHI as a state owned enterprise it will not be exempt from corruption and misappropriation of funds.

Nevertheless, there were also participants who saw potential in adapting existing NHI mechanisms used in contracting private general practitioners, proposing that similar public-private partnerships could be extended to dental care. By contracting private dentists for denture provision, particularly in areas where public infrastructure is lacking, the government could expand service reach while avoiding the delays associated with building new facilities. This approach has been successfully employed in other health domains and is supported by literature advocating for hybrid models to bridge service delivery gaps in resource-constrained systems.[32] However, this study found that such partnerships used to exist in KZN, outside the NHI, but they were discontinued due to budget reductions after the Covid-19 pandemic.[33] This could imply that NHI stands a better chance in achieving a fair distribution of denture services

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due to its funding model, however, as mooted by Wood,[20] integrating dental services into the NHI framework poses significant challenges, particularly in addressing the urban–rural disparities. Effective implementation will require targeted investments and strategic incentives. Without such measures, underserved communities may remain excluded even from NHI benefits.[20] Some respondents suggested that groups with critical needs could receive subsidised or fully funded care through Nongovernmental Organisations' (NGO) support. A similar approach exists in Hong Kong, where limited public dental services mean that most people rely on private providers and charitable or religious organisations.[27]

RECOMMENDATIONS

As seen in countries such as Brazil and China as endorsed by the WHO global oral health strategy, plastic removable dentures should be formally recognized as a basic service within the essential oral healthcare package, deliverable at primary healthcare level alongside extractions and restorations.

This study therefore recommends strengthening of stakeholder engagement in NHI implementation, ensuring that the rollout includes targeted consultation for oral health professionals. Engaging practitioners through workshops, forums, and clear communication strategies will build the necessary buy-in for effective implementation through a robust review of systemic challenges and service disparities reported in this study.

The Department of Health should prioritize the establishment of dental laboratories at the district level to reduce the existing bottlenecks in denture service delivery. These labs should be adequately staffed and resourced to process referrals from multiple clinics within their catchment areas.

There is a need for ongoing research to evaluate the long-term impacts of denture service access on oral health-related quality of life, patient satisfaction, and system efficiency. This evidence will be critical for refining policies and scaling interventions provincially and nationally.

STRENGTHS AND LIMITATIONS

The study provided valuable insights into the current state of denture services delivered through public oral health facilities in the Harry Gwala and eThekwini districts of KZN, identifying systemic challenges, resource constraints, and opportunities for strengthening denture services. However, this study's findings are context-specific and cannot not be generalisable beyond the selected districts in KZN and the study's population. The use of a qualitative interpretivist design, while suitable for exploring in-depth perspectives, limits the ability to quantify findings or establish causality representativeness due to the relatively small sample size. Participant selection, particularly from private practitioners located near public facilities, may have excluded broader private sector insights. Additionally, while including executive managers offered valuable systemic perspectives, their views may not fully reflect frontline service challenges.

CONCLUSION

The findings of this study highlighted that the provision of denture services remains limited due to the reported systemic issues such as reported inadequate financial investment, shortage of staff and inadequate dental laboratory services. More efforts are required in ensuring the success of the NHI's funding model in order to enhance equitable access to denture services and avoid continued poor oral rehabilitative services for the underserved communities.

REFERENCES

1. Bhayat A, Chikte U. Human Resources for Oral Health Care in South Africa: A 2018 Update. Int J Environ Res Public Health. 2019;16(10).
2. Mukhari-Baloyi NA, Bhayat A, Madiba TK, Nkambule NR. A review of the South African national oral health policy. South African Dental Journal. 2021;76(9):551-7.
3. Bhayat A, Madiba TK, Nkambule NR. A Three-year Audit of Dental Services at Primary Health Care Facilities in Gauteng, South Africa: 2017 to 2019. J Int Soc Prev Community Dent. 2020;10(4):452-7.
4. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. Health Qual Life Outcomes. 2010;8(1):126.
5. Singh A, Antunes JLF, Peres MA. Socio-Economic Inequalities in Oral Health. In: Peres MA, Antunes JLF, Watt RG, editors. Oral Epidemiology. Textbooks in Contemporary Dentistry. Cham: Springer International Publishing; 2021. p. 279-94.
6. Neely AH, Ponshunmugam A. A qualitative approach to examining health care access in rural South Africa. Soc Sci Med. 2019;230:214-21.
7. Daniel RS, Udgiri R, Karadi R, Rangoli AM. Assessment of oral health practices and their impact on oral health status and quality of life: a cross-sectional study in rural North Karnataka. Discover Public Health. 2025;22(1):455.
8. Gheasi M, Ishikawa N, Kourtit K, Nijkamp P. A meta-analysis of human health differences in urban and rural environments. Letters in Spatial and Resource Sciences. 2019;12(3):167-86.
9. Molete MP, Yengopal V, Moorman J. Oral health needs and barriers to accessing care among the elderly in Johannesburg. Sadj. 2014;69(8):352, 4-7.
10. Ayo-Yusuf IJ, Naidoo S. Social gradient in the cost of oral pain and related dental service utilisation among South African adults. BMC Oral Health. 2016;16(1):117.
11. Motloba PD, Makwakwa N, Machete LM. Justice and oral health-implications for reform: Part Two. South African Dental Journal. 2019;74(4):208-11.
12. Gao Q, Wang X, Jiang Y, Chen W, Gao K, Shi Y. Oral health and nutrition: addressing disparities in socioeconomically disadvantaged older adults in rural China. BMC Public Health. 2025;25(1):977.
13. Wang M, Deng X, Chen H, Diao Y, Liu C, Gao J, et al. Frailty mediated the association between tooth loss and mortality in the oldest old individuals: a cohort study. Frontiers in Public Health. 2024;11:1285226.
14. Motloba DP, Gwengu PR-Q, Moipolai PD. Inaccessible specialised oral health services in South Africa–rationing policy uncertainty. South African Dental Journal. 2023;78(8):414-8.
15. Wood N. Rethinking resource optimisation in South African public dental service and education. South African Dental Journal. 2025;80(2):63-7.
16. Bhayat A, Madiba T, Nkambule N. A review of the South African national oral health policy. SADJ: journal of the South African Dental Association = tydskrif van die Suid-Afrikaanse Tandheelkundige Vereniging. 2021;76:551-7.
17. Ibigbami OI, Folayan MO, Oginni O, Lusher J, Sam-Agudu NA. Moderating effects of resilience and self-esteem on associations between self-reported oral health problems, quality of oral health, and mental health among adolescents and adults in Nigeria. PLoS One. 2023;18(5):e0285521.
18. de Oliveira Rocha A, Goebel MC, Cardoso K, Dos Anjos LM, Cardoso M, Vitali FC, et al. Does the early loss of primary teeth impact the oral health-related quality of life of children? A systematic review and meta-analysis. Clin Oral Investig. 2025;29(4):213.
19. McGarry TJ, Jacobson TE. The professions of dentistry and dental laboratory technology: improving the interface. J Am Dent Assoc. 2004;135(2):220-6.
20. Wood N. Reimagining dental care funding in South Africa: A call for equitable healthcare. South African Dental Association (SADA); 2024. p. 235-7.
21. KwaZulu-Natal Department of Health. Annual report 2021/22. KwaZulu-Natal Provincial Government; 2022.
22. KwaZulu-Natal Department of Health. Annual report 2022/23. KwaZulu-Natal Provincial Government; 2023.
23. Josephin S, Nzala S, Baboo KS. Evaluation of oral hygiene services in selected public health facilities in Lusaka district of Zambia. J Public Health Afr. 2018;9(2):820.
24. Nyamuryekung'e KK, Lahti SM, Tuominen RJ. The relative patient costs and availability of dental services, materials and equipment in public oral care facilities in Tanzania. BMC Oral Health. 2015;15:74.
25. Tiwari R, Bhayat A, Chikte U. Forecasting for the need of dentists and specialists in South Africa until 2030. PLoS One. 2021;16(5):e0251238.
26. Jiang CM, Chu CH, Duangthip D, Ettinger RL, Hugo FN, Kettratad-Pruksapong M, et al. Global Perspectives of Oral Health Policies and Oral Healthcare Schemes for Older Adult Populations. Front Oral Health. 2021;2:703526.
27. Chan AKY, Tamrakar M, Leung KCM, Jiang CM, Lo ECM, Chu CH. Oral Health Care of Older Adults in Hong Kong. Geriatrics (Basel). 2021;6(4).
28. Muofhe T, Makwakwa N, Motloba DP. Knowledge and perception of oral health professionals regarding the National Health Insurance. South African Dental Journal. 2023;78(9):432-6.
29. Malele-Kolisa Y. Unpacking the NHI Bill recently passed by parliament in May 2023: Implications for oral health. South African Dental Journal. 2023;78(9):467-.
30. Gilson L, Barasa E, Nxumalo N, Cleary S, Goudge J, Molyneux S, et al. Everyday resilience in district health systems: emerging insights from the front lines in Kenya and South Africa. BMJ Glob Health. 2017;2(2):e000224.
31. Javadi D, Tran N, Ghaffar A. Building a Workforce for Future Health Systems: Reflections from Health Policy and Systems Research. Health Serv Res. 2018;53 Suppl 2(Suppl Suppl 2):4024-33.
32. Taylor M, Masood M, Mnatzaganian G. Differences in complete denture longevity and replacement in public and private dental services: A propensity score-matched analysis of subsidised dentures in adult Australians across 20 years. Community Dent Oral Epidemiol. 2023;51(2):318-26.
33. KwaZulu-Natal Department of Health. Annual report 2019/20. KwaZulu-Natal Provincial Government; 2020.

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Breast Cancer Patients' Knowledge, Attitudes and Practices of Oral Health and Treatment Related Complications

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ABSTRACT

Introduction

Oral complications from cancer treatment are common yet overlooked, affecting quality of life and treatment outcomes. Breast cancer patients, particularly those on human epidermal growth factor receptor 2 inhibitors (HER2i), face heightened oral health risks due to drug effects and hormonal changes.

Aims and Objectives

To assess the knowledge, attitudes and practices of pre-treatment breast cancer patients from the 'Breast Care Centre of Excellence' (BCCE), Johannesburg, related to oral healthcare and oral complications of cancer treatment.

Design

A descriptive cross-sectional study was conducted using an anonymous online questionnaire, which had been previously validated.

Methods

Convenience sampling was employed by emailing an invitation and link to the questionnaire to breast cancer patients from the BCCE.

Results

Fifty-five breast cancer patients participated, with 72.2% planning surgery, chemotherapy (46.3%) and or radiation (37.4%). Despite recognizing oral care's importance, 90.7% lacked preventive education, 94.4% weren't advised to see a dentist, and 3.7% had pre-treatment dental exams. Most (74.1%) received no oral care education, and financial barriers limited dental treatment access.

Conclusions

Findings revealed a lack of oral health awareness and education. Referral systems and interdisciplinary collaboration between dental and oncology teams should be strengthened to enhance patient education and improve treatment outcomes.

Keywords

Breast cancer, Oral complications, Education, Oral Health, Awareness

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INTRODUCTION

Patients undergoing cancer treatment often experience oral complications. However, these complications are frequently "underreported, underrecognized, and undertreated," despite their significant impact.[1]

The global incidence of cancer continues to increase, leading to more treatment options and related oral complications.[2] Without prevention and proper management, these complications impair normal function and may cause severe physical and psychological harm, reducing the patient's overall quality of life.[1,3,4] Biswal et al. (2008) highlighted this concern whilst reviewing the management of oral mucositis induced by cancer therapy; noting that severe cases led to loss of taste, decreased intake of food and water, increased bleeding, pain, malnutrition, loss of voice, and ultimately a lower quality of life.[4]

Oral mucositis ranks among the most severe and dose-limiting acute conditions associated with cancer treatment.[3,5-7] Oral mucositis is often responsible for reductions in chemotherapy doses, delaying treatment, and increasing hospitalisation,[6,7] with some patients even discontinuing treatment due to its severity.[4] These disruptions can lead to suboptimal treatment outcomes, ultimately reducing patient survival rates.[6,8]

Oral complications during cancer treatment increase supportive care costs, including diagnosis, treatment, referrals, hospitalisation, and post-treatment evaluations. This creates a financial burden on patients, healthcare insurance, government facilities, and medical resources.[9]

Oral complications of cancer treatment should be prevented by educating patients on these potential complications, the importance of treating oral conditions before therapy, and how to identify and report new oral concerns. Comprehensive dental care at every stage of cancer treatment plays a crucial role in improving overall patient outcomes. Epstein et al., (2014) emphasized that preventive dental assessments, early recognition of oral complications, and treatment of pre-existing dental conditions improve treatment outcomes and reduce financial strain on patients and healthcare systems.[9]

Breast cancer constitutes nearly one-third of all new cancer diagnoses in women.[10] Since the mid-2000s, breast cancer incidence has exhibited a consistent annual increase of 0.5%,[2,10,11] surpassing lung and prostate cancers to become

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the most commonly diagnosed cancer worldwide.[2,11] Oral complications are common among patients receiving cancer therapy. Approximately 40% of patients receiving chemotherapy, 80% of hematopoietic stem cell transplant patients and nearly all head and neck radiation patients experience oral complications. [1,5] Among a cohort of 46,154 women with breast cancer, 13% reported experiencing oral mucositis.[12]

Oral complications may be worsened depending on the drug dose, frequency, form of administration, and combination.[13] Human epidermal growth factor receptor 2 inhibitors (HER2i) such as trastuzumab, or pertuzumab are used to stop or slow the growth of HER2 positive breast cancer cells. HER2i therapy is associated with a significantly higher risk for stomatitis, dental caries, and tooth extraction in patients with breast cancer.[14]

The health of soft tissues in the oral cavity, alveolar bone density, and tooth loss are all influenced by a woman's oestrogen status.[15] Consequently, conditions involving decreased hormonal activity, such as menopause or treatment with aromatase inhibitors, significantly increased the risk of gingivitis and tooth loss, due to their impact on bone mineral density and reduced salivary flow.[15]

This study will seek to determine the knowledge, attitudes and practices (KAP) of breast cancer patients concerning oral health and oral complications related to cancer treatment. The objective is to ascertain patients' awareness of the relationship between their cancer treatment and oral health, and to determine how effectively their oral health is being managed.

METHODS AND MATERIALS

A descriptive cross-sectional study was conducted through an anonymous questionnaire, distributed through Google Forms, to examine the KAP of breast cancer patients from the Breast Care Centre of Excellence (BCCE), Johannesburg, South Africa, regarding oral health and oral complications associated with cancer treatment. The questionnaire explored the following themes: demographics, cancer treatment and diagnosis, medical history, fluoride use, mouthwash use, dental and oral care before cancer treatment, and a free response section.

The online questionnaire was modified from previously validated questionnaires.[16,17]

Patients attend the BCCE for surgical treatment and have already received their diagnosis and are informed regarding their planned chemotherapy, radiation, immunotherapy, or targeted intervention.

Convenience sampling was used to select patient participants from the BCCE based on the following inclusion criteria: a new or first-time cancer diagnosis, planned chemotherapy and/or radiation therapy (excluding surgical treatment alone), willingness to participate, and being 18 years or older. Eligible patients were initially identified by reception staff, with final eligibility confirmed by the author. Selected participants were then invited to join the study.

Prospective participants were provided (via email) with a participant information and informed consent document, and an educational booklet that explains the relationship between oral disease and oncological care, as well as instructions on oral care, regardless of their decision to enrol in the study. The principal researcher discussed the research with prospective participants and was available to answer any questions.

Data was collected during April 2024 – September 2024, and automatically captured and stored in Google Forms from where it was exported to Google Sheets for analysis.

The data analysis primarily consisted of descriptive statistics such as means, medians, standard deviations, frequencies, proportions etc. to describe the results coupled with graphical representations to assist in visualizing aspects of the data.

BCCE receives approximately 50 cancer patients per month. Approximately 60% of these patients (30) are 'newly diagnosed cancer patients' (the study sample which met the inclusion criteria).

A power analysis showed that statistical tests like the Chi-square test with a medium effect size of 0.5, using G*Power 3.1.9.4, at an alpha level of 5% and a power of 85%, that a sample size of 55 breast cancer patients was required.

This research was approved by the Human Research Ethics Committee (HREC) at the University of Pretoria (Ethics Reference Number 528/2023).

RESULTS

Fifty-five female breast cancer patients participated in the study. A total of 189 breast cancer patients received invitations to participate, resulting in a 29.1% response rate.

Demographics

Participants ranged in age from 32 to 78 years, with a mean age of respondents of 53.39 ± 12.29. The majority identified as White (68.52%, n = 37), followed by Black and Indian participants (11.11% each, n = 6), Coloured (5.56%, n = 3), and Asian (3.70%, n = 2). The demographics of study participants are presented in Table I.

Most participants, 94.44% (n = 51), had medical insurance. However, 5.56% (n = 3) did not. Educational attainment was varied: 24.07% (n = 13) had completed a Matric certificate, 22.22% (n = 12) held a diploma, 22.22% (n = 12) held a degree, and 14.81% (n = 8) had completed a post-graduate degree. A smaller proportion 9.26% reported having only a higher certificate (9.26%, n = 5) or not completing high school (7.41%, n = 4). Most participants worked in professional careers, while a small percentage were unemployed or retired.

Cancer Diagnosis and Treatment

A summarised table of the cancer diagnoses and treatment plans of patient participants data is captured in Table II.

Most patients were diagnosed with stage 1 or 2 disease, each at 33.3% (n = 18), followed by stage 3 at 13% (n = 7), and stage 4 at 5.6% (n = 3). Some patients, 14.8% (n = 8), did not know the stage of their tumour. A significant proportion, 66.7% (n = 36), received their diagnosis in 2024.

Most participants, 72.2% (n = 39), planned to undergo surgery, followed by chemotherapy at 16.7% (n = 9),

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radiation therapy at 13% (n = 7) , immunotherapy at 9.3% (n = 5), and targeted therapy at 14.8% (n = 8). One participant each (1.9%) planned to receive a hematopoietic stem cell transplant, endocrine therapy, or hormonal therapy. Some participants remained uncertain about their treatment plans. Since multiple treatment modalities could be selected, the total exceeds 100%.

Table I: Demographics of Study Participants

Variable	Category / Statistic	Value
Age	Minimum	32
	Maximum	78
	Median (IQR)	51.0 (44.5 – 62.0)
	Mean (SD)	53.39 ± 12.29
	Mean (95% CI)	53.39 (50.03 – 56.74)
Gender	Male	0 (0%)
	Female	54 (100%)
Race	Asian	2 (3.70%)
	Black	6 (11.11%)
	Coloured	3 (5.56%)
	Indian	6 (11.11%)
	White	37 (68.52%)
Medical Aid	No	3 (5.56%)
	Yes	51 (94.44%)
Highest Qualification	Did not complete high school	4 (7.41%)
	Matric certificate	13 (24.07%)
	Higher certificate	5 (9.26%)
	Diploma	12 (22.22%)
	Degree	12 (22.22%)
	Post-graduate degree	8 (14.81%)
Career (Grouped)	Finance, Accounting & Insurance	16 (29.63%)
	Business, Management & Administration	9 (16.67%)
	Health & Medical Professions	3 (5.56%)
	Education & Training	4 (7.41%)
	IT & Communication Technology	1 (1.85%)
	Law & Legal Services	1 (1.85%)
	Marketing, Media & Communications	2 (3.7%)
	Engineering & Technical Fields	1 (1.85%)
	Entrepreneurship / SBO	6 (11.11%)
	Real Estate & Property	1 (1.85%)
	Hospitality & Tourism	2 (3.7%)
	Stay-at-home	5 (9.26%)
	Retired	3 (5.56%)

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Table II: Cancer Diagnosis and Treatment Plan of Study Participants

Variable	Category / Statistic	Value n (%)
Primary Diagnosis	Stage 1 Breast Cancer	34 (63%)
	Stage 2 Breast Cancer	1 (1.9%)
	Stage 3 Breast Cancer	2 (3.7%)
	Stage 4 Breast Cancer	1 (1.9%)
	Ductal Carcinoma in situ (DCIS)	2 (3.7%)
	Invasive Ductal Carcinoma (IDC)	1 (1.9%)
	Triple Positive Breast Cancer	1 (1.9%)
	Triple Negative Breast Cancer	5 (9.3%)
	HER 2 Positive	2 (3.7%)
	Estrogen Receptor Positive	1 (1.9%)
	Luminal A	2 (3.7%)
	Luminal B	2 (3.7%)
Tumour Stage	Stage 1	18 (33.3%)
	Stage 2	18 (33.3%)
	Stage 3	7 (13.0%)
	Stage 4	3 (5.6%)
	I don't know	8 (14.8%)
Year of Diagnosis	2024	36 (66.7%)
	2023	3 (5.6%)
	2022	3 (5.6%)
	2021	2 (3.7%)
	2020	1 (1.9%)
	2019	2 (3.7%)
	2018	2 (3.7%)
	2017	3 (5.6%)
	2010 & 2024	1 (1.9%)
	2009	1 (1.9%)
Therapy Plan	Surgery	39 (72.2%)
	Chemotherapy	9 (16.7%)
	Radiation Therapy	7 (13.0%)
	Immunotherapy	5 (9.3%)
	Targeted Therapy	8 (14.8%)
	Hematopoietic Stem Cell Transplant	3 (5.6%)
	Endocrine Therapy	5 (9.3%)
	Hormonal Therapy	3 (5.6%)
	I don't know	4 (7.4%)

Medical History

Most participants, 74.1% (n = 40), reported never smoking cigarettes, while 9.3% (n = 5) currently smoked, 3.7% (n = 2) smoked occasionally or socially, and 13% (n = 7) had quit smoking. Among the smokers, three participants reported using vapes, and eleven identified as cigarette smokers, consuming between 1 and 40 cigarettes per day.

The duration of smoking varied significantly. Reported smoking histories were as follows: 28.57% (n = 4) for 0-10 years of tobacco use, 42.86% (n = 6) for 10 – 20 years, 7.14% (n = 1) for 20 – 30 years, 14.29% (n = 2) for 30 – 40 years, and 7.14% (n = 1) for 40 -50 years.

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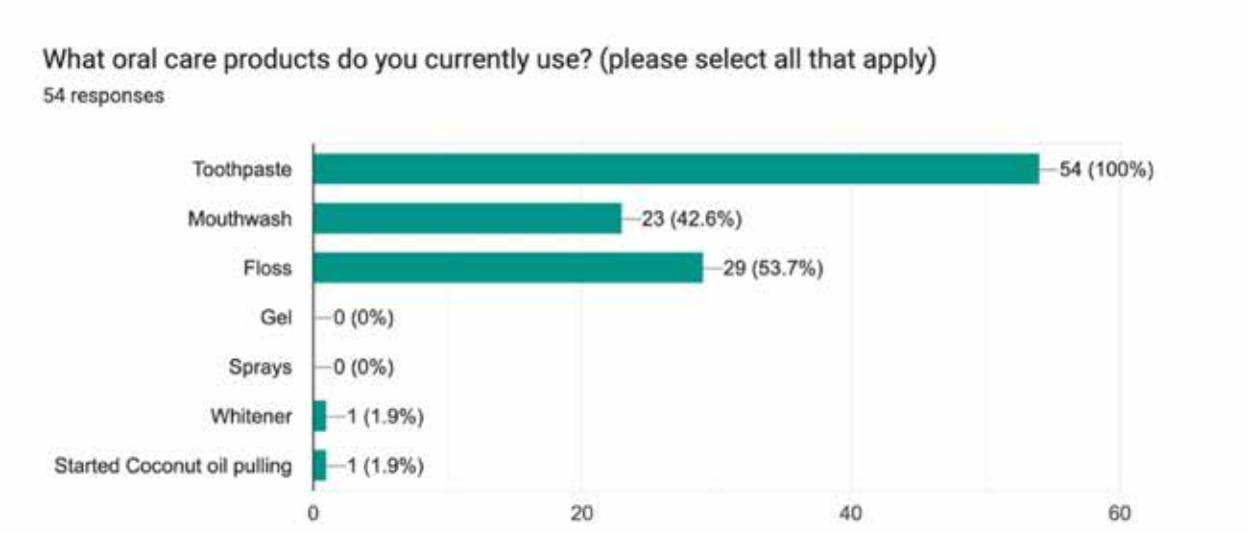

Figure 1

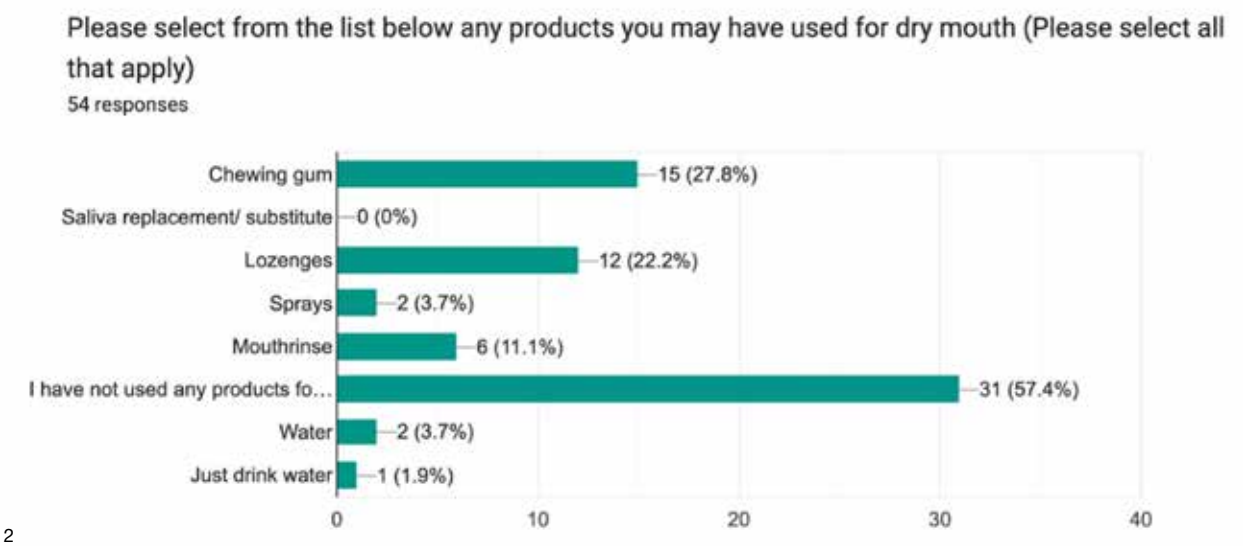

Figure 2

Regarding bisphosphonate use, 3.7% of patients (n = 2) confirmed current or prior use.

Dental and Oral Care

The majority, 82.5% (n = 46) of patients reported no known history of gingivitis or periodontitis. A smaller percentage, 13% (n = 7) expressed uncertainty, while one patient (1.9%) confirmed experiencing gingivitis and/or periodontitis.

Figure 1 summarizes patient responses on oral care practices and products. Toothpaste was the most commonly used product by all patient participants, followed by floss at 53.7% (n = 29) and mouthwash at 42.6% (n = 23). Only one patient participant reported the use of whiteners and coconut oil pulling, whilst no participants used gel or sprays.

Figure 1: Distribution of oral care products used by participants (N = 55). More than half, 57.4% (n = 31), reported not using any products for dry mouth (Figure 2). Among those who did, the most common choice was chewing gum at 27.8% (n = 15), followed by lozenges at 22.2% (n = 12). Other products, such as mouth rinse at 11.1% (n = 6), sprays at 3.7% (n = 2), and water at 3.7% (n = 2), were used less frequently. No participants reported using saliva replacements or substitutes.Figure 2: Products used by participants for dry mouth (N = 55).

Varying monthly expenditures on oral care products were reported. Most patients (40.7%, n = 22) spent between R50 – R100, followed by 22.2% (n = 12) spending between R100 – R150, 22.2% (n = 12) between R150 – R200, 11.1% (n = 6) spending over R200, and 3.7% (n = 2) spending less than R50 per month.

Oral hygiene practices were generally consistent: 87% (n = 47) of patients reported brushing teeth twice daily, 11.1% (n = 6) brushed once a day, and only one patient brushed more than twice daily. No patients reported brushing less than once per day.

Flossing habits showed significant variability, with 31.5% (n = 17) flossing a few times a week, 25.9% (n = 14) flossing daily, 24.1% (n = 13) flossed rarely, 14.8% (n = 8) admitted to never flossing, and 3.7% (n = 2) flossed more than once daily.

Fluoride Use

Regarding fluoridated toothpaste, 18.5% (n = 10) of patients were unsure if their toothpaste contained fluoride, one patient used non-fluoride toothpaste, and the remaining 79.6% (n = 43) use fluoride containing toothpaste. Among those who used mouthwash, one patient used non-fluoride mouthwash, 27.8% (n = 15) used mouthwash with fluoride,

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35.2% (n = 19) did not know if their mouthwash contained fluoride and the remaining 35.2% (n = 19) of patients did not use mouthwash.

Considering professional fluoride applications, 33.3% (n = 18) of patients received fluoride treatments at the dentist, with 5.6% (n = 3) receiving treatments bi-annually. A larger proportion, 35.2% (n = 19), never received professional fluoride applications, 9.3% (n = 5) were unsure, and 16.7% (n = 9) of patients had received a fluoride treatment over a year ago.

Mouthwash Use

Some patients, 16.7% (n = 9), reported using mouthwash daily, while only one patient used it more than once daily. Meanwhile, 25.9% (n = 14) never used mouthwash, and 27.8% (n = 15) used it rarely or only a few times per week. Regarding brand preferences, Listerine was the most popular at 60% (n = 24), followed by Colgate at 20% (n = 8) and Listerine Zero at 12.5% (n = 5). Additionally, individual patients (2.5% each) selected White Glo, Andolex C, and Curaprox Perio Plus.

When exploring the purpose of mouthwash use, 60% (n = 24) use mouthwash as an additional oral hygiene aid, 42.5% (n = 17) to freshen breath, 5% (n = 2) as a floss replacement, and one patient used mouthwash to whiten teeth, treat sore gums, and as a source of fluoride.

Oral Care

All patients agreed on the importance of oral care during and after cancer treatment (Figure 3). The majority, 75.9% (n = 41), strongly agreed that oral care is very important, while 20.4% (n = 11) were uncertain. A small percentage, 3.7% (n = 2), believed oral care was only somewhat important, and no participants selected "Not at all."

Figure 3: Participant agreement on the importance of oral care during and after cancer treatment (N = 55).

Most participants, 63% (n = 34), identified poor oral care as a risk factor for oral complications (Figure 4). The pie chart illustrates how strongly patient participants agreed with this statement: 63% (n = 34) selected "Very much," 14.8% (n = 8) chose "Somewhat," 20.4% (n = 11) responded with "I don't know," and one participant selected "Not at all."

Figure 4: Distribution of responses to the statement: "Poor oral care can increase the risk of mouth sores (oral mucositis) and infections during cancer treatment."

When asked, "Have you received dental/oral care 'Preventive Instruction' that included information on how to maintain your oral/dental health during and after cancer treatment?" only 9.3% (n = 5) of patients answered yes, while 90.7% (n = 49) answered no.

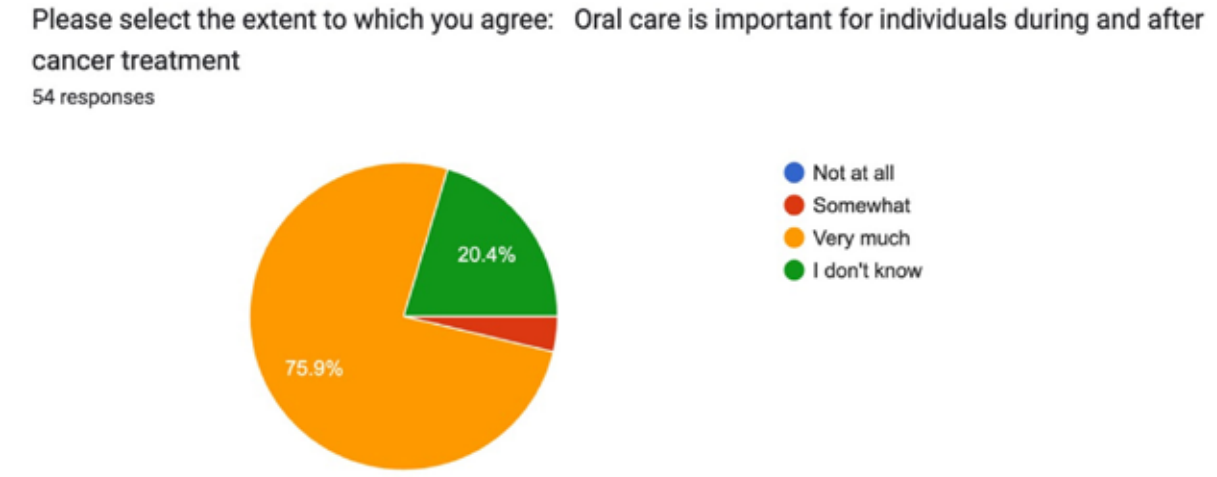

Figure 3: Perceived importance of oral care during and after cancer treatment

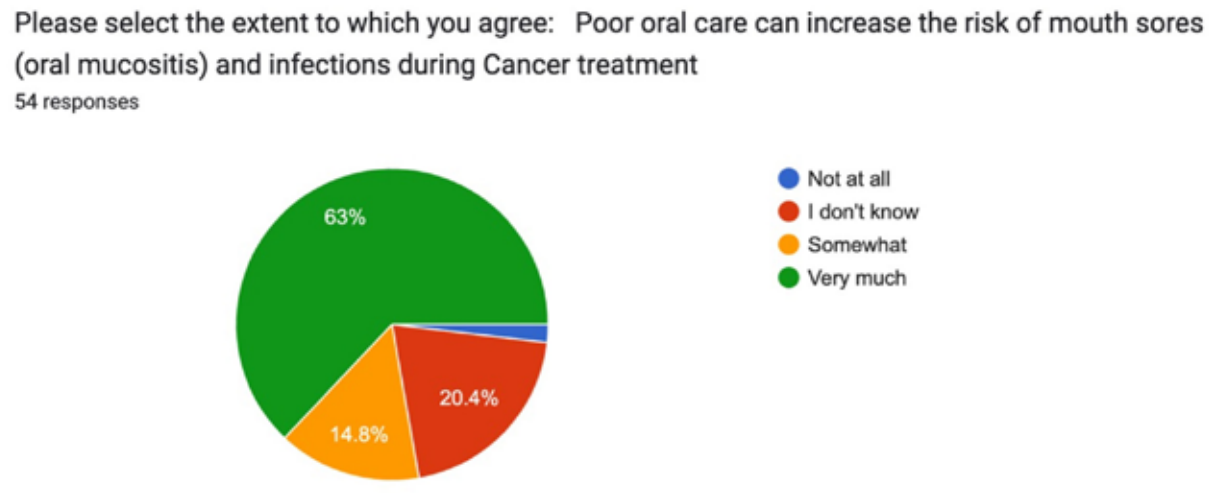

Figure 4: Perceived oral mucositis risk or poor oral care.

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Of the 5 patients, each reported a different source for the preventive education they received: one from a general dentist, one from an oral hygienist, one from a dental assistant at a cancer centre, one from a dentist referred by her cancer centre (a dentist who routinely treats cancer patients), and one patient who had not disclosed her diagnosis to her general dentist but intended to, aiming to ensure better treatment outcomes.

Only 5.6% (n = 3) of patients were recommended by their oncologist or cancer centre to have a dental examination, leaving the majority, 94.4% (n = 51), without this recommendation. Furthermore, only 3.7% (n = 2) actually underwent a pre-treatment dental examination before starting cancer treatment.

The primary reason for not completing dental treatment before starting cancer treatment was lack of awareness, with 65.4% (n = 34) indicating they were unaware of the need for a dental exam or that it was not recommended to them. Additionally, 15.4% (n = 8) cited insufficient time to schedule a dental examination, 9.6% (n = 5) were unsure or didn't know, and 3.8% (n = 2) attributed it to cost. Other responses included patients who had not yet started cancer treatment or were not advised to see a dentist.

Of the only two (3.8%) patients who received a pre-treatment dental examination by their general dentist, one had the exam coincidentally during their annual checkup on the day of their cancer diagnosis. During their exams, neither of the two patients received any preventive instructions on maintaining oral health during cancer treatment. No dental treatment was needed before starting cancer treatment; however, one patient had a routine dental cleaning, and the other received emergency root canal treatment. No start to cancer treatment was delayed due to any outstanding dental treatment.

The majority of participants, 81.5% (n = 44), were not informed about flossing. A smaller portion received recommendations to either continue (11.1%, n = 6) or start (5.6%, n = 3) flossing, with one patient advised to discontinue. (Figure 5)

Majority of patients, 83.3% (n = 45), spent less than R5000 on dental care before starting cancer treatment, followed by 9.3% (n = 5) who spent between R5000 - R10,000. A few individuals reported spending between R10,000 - R15,000 (3.7%, n = 2), and over R25,000 (3.7%, n = 2). (Figure 6)

Only 16.7% (n = 9) of patients were made aware of possible oral complications during cancer treatment, while the remaining 83.3% (n = 45) were not. Some patients were made aware by their oncologist, a nurse, researching online, dentists, or – in one case – through their own experience as a healthcare professional.

Oral complications which patients believed to be caused by cancer treatment was mucositis (77.8%, n = 7), xerostomia (66.7%, n = 6), loss of taste (55.6%, n = 5), followed by

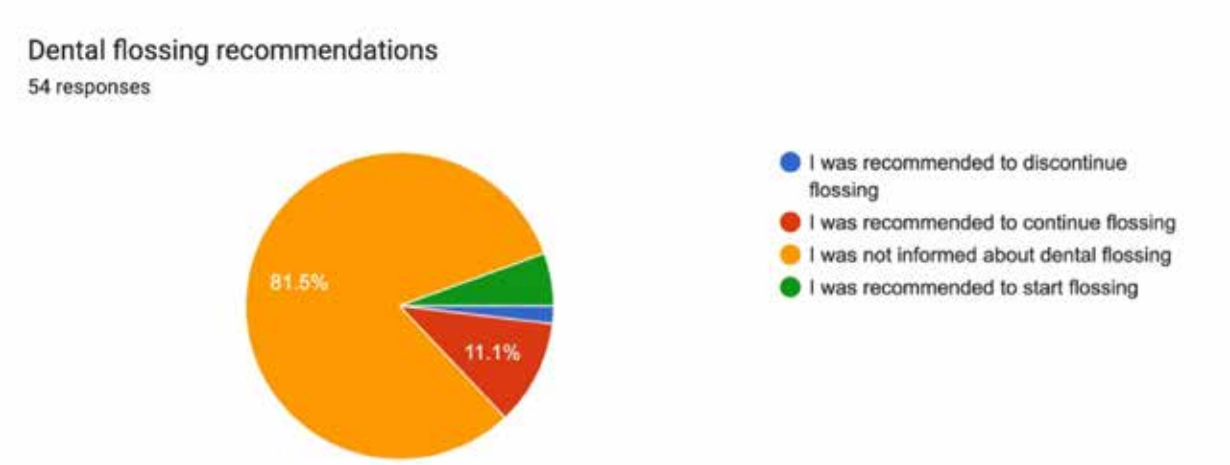

Figure 5: Pie chart depicting the distribution of dental flossing recommendations.

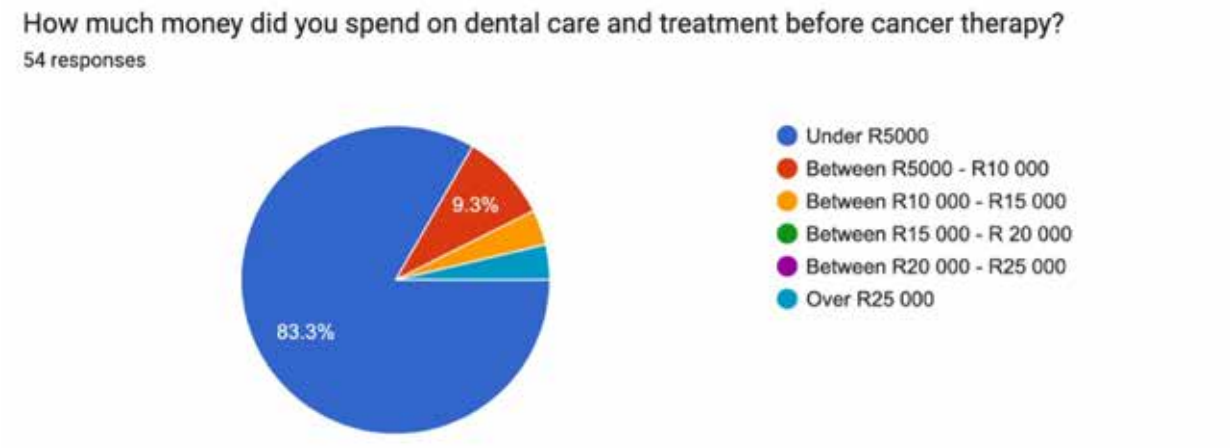

Figure 6: Pie chart depicting the distribution of money spent on dental care and treatment before undergoing cancer therapy.

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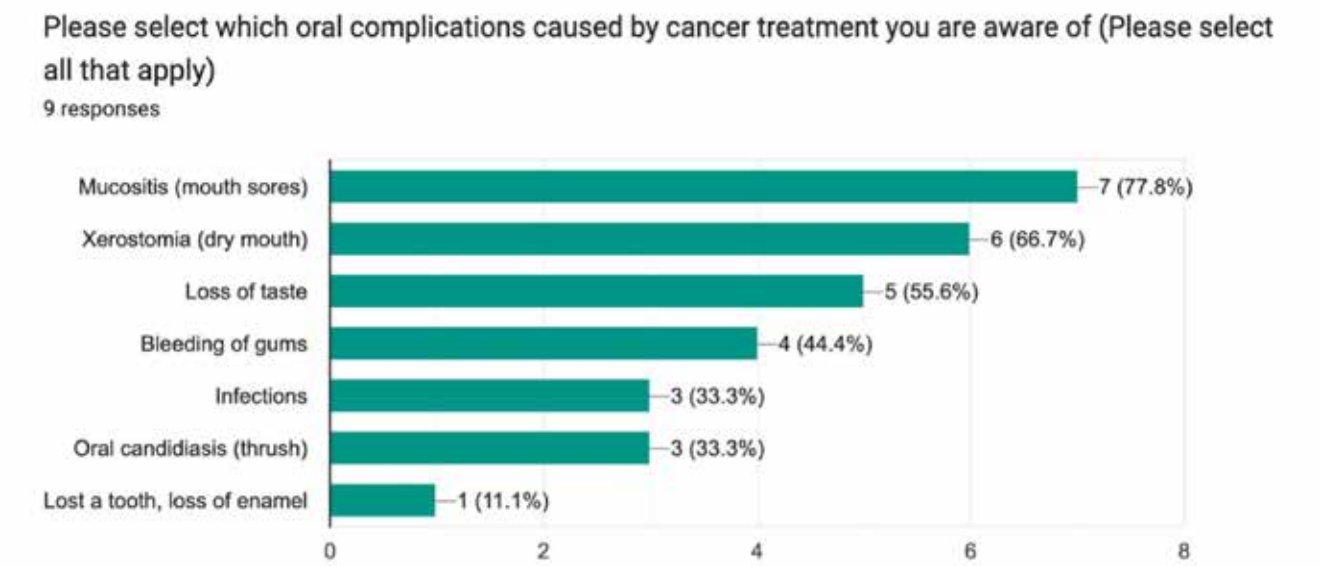

Figure 7: The graph presents the frequency of awareness regarding oral complications due to cancer treatment.

bleeding of gums (44.4%, n = 4), infections (33.3%, n = 3), and oral candidiasis (thrush) at 33.3% (n = 3). One patient participant (11.1%) selected loss of teeth and enamel. Figure 7 shows oral complications selected by patient participants; more than one answer could be selected.

When investigating patient satisfaction; the majority of participants, 74.1% (n = 40), reported not receiving any oral care education. A smaller proportion, 13% (n = 7), indicated a neutral level of satisfaction, while only one patient (1.9%) reported being very satisfied. Additionally, one participant (1.9%) noted that they had not started cancer treatment yet. (Figure 8)

When asked about their satisfaction with the dental care available before starting cancer therapy, most patients, 70.4% (n = 38), gave a neutral response. Smaller percentages reported being satisfied (11.1%, n = 6), dissatisfied (11.1%, n = 6), or very satisfied (5.6%, n = 3). One participant (1.9%) reported very dissatisfied with the care they received. (Figure 9)

Free response section summary:

Participants reported a range of oral health concerns related to cancer care. Several had ongoing or pending dental work, such as crowns and extractions.

A common theme was the lack of dental advice/oral care education given prior to cancer treatment; one patient had underwent a full dental clearance, struggling with dentures and seeking implants and was unsure of how to navigate this concern prior to starting cancer treatment.

Many patients reported limited awareness of oral side effects or treatment restrictions during chemotherapy. Many reports elaborated on receiving no referral to a dentist and expressed a need for more information related to oral hygiene. Financial barriers to receiving dental care were also reported.

DISCUSSION

This study evaluated 55 female breast cancer patients to assess their knowledge, attitudes, and practices of oral health care, the importance of oral health during cancer

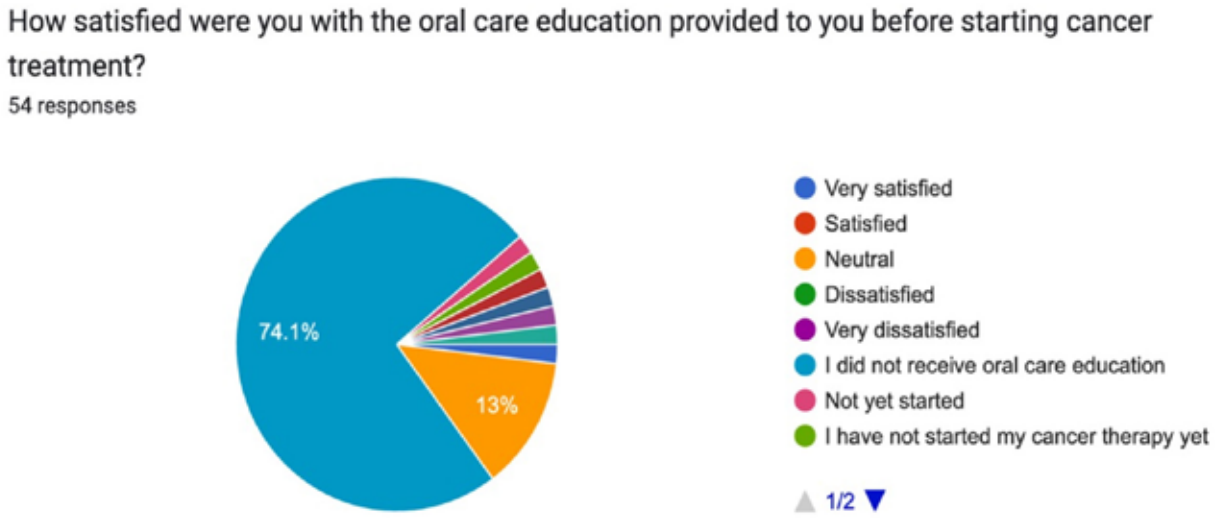

Figure 8: Pie chart depicting the distribution of satisfaction levels regarding oral care education prior to cancer treatment.

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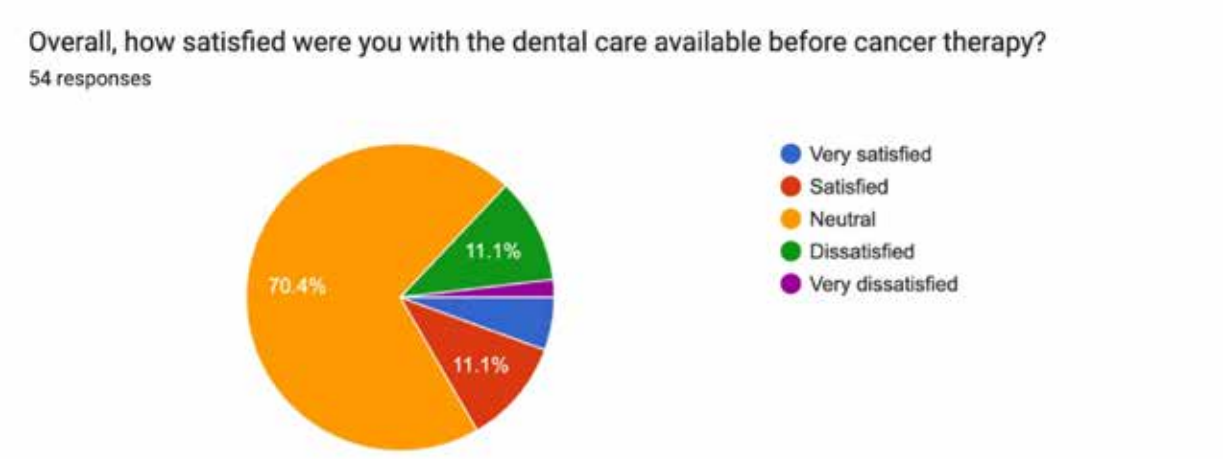

Figure 9: Pie chart depicting the level of satisfaction with dental care available before cancer therapy.

treatment, and oral complications associated with cancer therapy.

Dental and Oral Care

Most patients followed good oral care routines, with 87% brushing their teeth twice daily as recommended. However, a significant portion admitted they never or rarely used dental floss, which may contribute to poor oral hygiene awareness. This was underscored by the finding that 13% of patients did not know whether they had gingivitis or periodontitis, raising concerns about undiagnosed or unrecognized oral health conditions, given the rates of periodontitis (52.2%) and gingivitis (53.6%) in South Africa.[18]

Epstein et al., (2014) highlighted that patients with poor oral health before cancer treatment face a greater risk of oral complications during cancer therapy than those without pre-existing oral disease.[9] Tsuji et al., (2015) demonstrated that when patients with hematopoietic malignancies followed a pre-cancer therapy dental care protocol, they experienced significantly fewer systemic (15.8% vs. 37.4%) and dental complications (2.9% vs. 34.0%) compared to those who did not undergo any pre-cancer dental treatment.[19]

Overall, 79.6% of participants used fluoride toothpaste, and 33% had received professional fluoride applications, indicating that many patients understand fluoride's benefits in dental care. However, most patients had not received professional fluoride treatments or had not done so in over a year, suggesting they had not visited a dentist for an extended period. Anti-fluoridation movements dominating social media and internet platforms may be spreading misinformation to patients regarding health benefits and safety concerns of fluoride use. This may influence patients to discontinue fluoride use and possibly lead to greater oral complications.

Most patients (79.5%) acknowledged the importance of oral care during cancer treatment, while 20.4% remained uncertain about its significance. However, only 63% recognized that poor oral health increases the risk of oral mucositis and infections, leaving a substantial number unaware or unsure.

This reveals a gap in patient education on the link between poor oral health and the development of oral complications during cancer treatment. It may also stem from insufficient interdisciplinary communication and referrals between oncology and dental care providers. Dang et al., (2020) surveyed Massachusetts dentists and found that, even when treating cancer patients, they rarely received responses from oncology teams when seeking input on patient care.[20] Similarly, Epstein et al., (2014) stressed the importance of early planning and coordination between dentists and oncology teams to ensure patients receive appropriate oral care.[9]

Dental Education

An overwhelming 90.7% of patients had not received any preventive guidance on maintaining oral health during cancer treatment, while only 9.3% had. This significant gap in dental education for oncology patients increases their risk of oral complications during treatment. Similarly, Epstein et al., (2007) reported that fewer than half (43.75%) of United States national cancer centers offered oral examinations and preventive treatment to oncology patients – excluding those undergoing radiation therapy – before they began cancer treatment.[21]

Breast cancer patients who received preventive education obtained information from various sources, including a general dentist, oral hygienist, dental assistant at a cancer center, or a dentist recommended by a cancer center. This highlights the lack of standardised care protocols and significant variation in oral care for cancer patients. Similarly, Epstein et al., (2018) found that patients received pre-cancer treatment oral education from diverse sources, including general dentists, medical and dental staff at cancer centers, referred practitioners, and specialists.[16] However, there is an opportunity to educate and expand the multidisciplinary team to a diverse group of oral healthcare providers who encounter and treat cancer patients.

Only 3% of patients were recommended by their oncologist or cancer center to undergo a dental examination. This highlights a potential gap in oncologists' referrals to dental practitioners, increasing the risk of oral complications during cancer treatment. Since 90.7% of patients did not receive any preventive education before starting cancer treatment, this indicates that oncology staff are not emphasizing the importance of dental and oral health. As a result, patients may not be receiving recommendations to visit their general dental provider before beginning cancer therapy.

Only 16.3% of patients were informed about potential oral complications during cancer treatment, leaving 83.3% unaware. Jones et al., (2022) stressed the importance of cancer patients being examined for the presence of oral conditions even without showing any symptoms to prevent the development of oral complications. Evidently, dentists should form part of the oncology multi-disciplinary team.[22]

Licitra et al., (2016) emphasized that effective prevention and management of therapy-induced oral complications require a multidisciplinary healthcare approach, with coordinated care provided at appropriate stages.[23] Without collaboration between dental and oncology teams, the prevention and treatment of cancer-therapy induced oral complications becomes near impossible.

A 2018 online-survey study also conducted by Epstein et al. included 76 cancer patient participants, of which 72.6% of patients reported receiving dental education prior to starting cancer treatment, but, with low satisfaction rates reported. [16] This finding suggests that patients may respond positively to healthcare provider recommendations regarding pre-treatment evaluations and education.

Patient Satisfaction

Patient satisfaction with oral health education and care prior to cancer treatment was mixed. While many patients had not received any oral health education or treatment, leading to neutral responses, smaller proportions expressed more varied opinions. The overall neutral sentiment likely reflects the limited oral care provided before initiating cancer therapy.

Barriers of Dental Care

A lack of awareness about the importance of oral and dental health was the leading reason (65.4%) why patients did not complete necessary dental treatments before starting cancer therapy. Additional factors included limited time, financial constraints, and logistical challenges. These barriers align with those identified by Epstein et al. (2014) and Dang et al. (2020), which include difficulty accessing skilled and willing dental practitioners, lack of insurance or financial support, transportation difficulties, work and family responsibilities, and cultural or educational influences.[9,20]

Limitations

This study relies on patient-reported responses rather than clinical records, which may introduce inaccuracies and biases. Given the sensitive nature of an oncology diagnosis, patients may struggle to recall whether they received dental instructions due to the stress of their diagnosis. The study also includes a small sample size. Although oncologists refer patients from various parts of Gauteng, the study population comes from the BCCE and may not represent the entire Gauteng breast cancer patient population. Patient response bias must also be considered, as participation may have been more likely among breast cancer patients with a particular interest in their oral health.

However, the results align with findings from other studies and highlight significant variability in oral care provision for patients undergoing cancer therapy. The lack of interdisciplinary communication between oncology and dental care providers likely contributes to this inconsistency. This gap may lead to increased oral complications during cancer treatment, higher referral rates with additional costs, and a diminished quality of life.

CONCLUSIONS

This study reveals gaps in oral health awareness, education, and collaboration between oncology and dental care for breast cancer patients. Although most patients practiced basic oral hygiene, nearly 91% had not received preventive dental education from a dental professional, and very few were referred for dental checkups by their oncologists before starting chemotherapy or radiation treatment.

These oversights increase the risk of preventable oral complications that may affect treatment outcomes and impact overall quality of life for patients. The study calls for a multidisciplinary approach that integrates dental professionals into oncology care teams, standardised oral care protocols for patients undergoing cancer therapy, and increased patient education. Addressing financial and communication barriers is also essential to improving oral health support during cancer treatment.

REFERENCES

1. Epstein J.B., Thariat J., Bensadoun R.J. Oral complications of cancer and cancer therapy: from cancer treatment to survivorship. CA Cancer J Clin. 2012;62(November–December (6)):400–422. [PubMed] [Google Scholar]
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. (2021) 71:209–49. doi: 10.3322/caac.21660
3. García-Chías, B., Figuero, E., Castelo-Fernández, B., Cebrián-Carretero, J.L. and Cerero-Lapiedra, R. (2019). Prevalence of oral side effects of chemotherapy and its relationship with periodontal risk: a cross sectional study. Supportive Care in Cancer, [online] 27(9), pp.3479–3490. doi:https://doi.org/10.1007/s00520-019-4650-6.
4. Biswal BM. Current trends in the management of oral mucositis related to cancer treatment. Malays J Med Sci. 2008 Jul;15(3):4-13. PMID: 22570584; PMCID: PMC3341902.
5. Lalla, R.V., Bowen, J., Barasch, A., Elting, L., Epstein, J., Keefe, D.M., McGuire, D.B., Migliorati, C., Nicolatou-Galitis, O., Peterson, D.E., Raber-Durlacher, J.E., Sonis, S.T. and Elad, S. (2014). MASCC/ISOO clinical practice guidelines for the management of mucositis secondary to cancer therapy. Cancer, [online] 120(10), pp.1453–1461. doi:https://doi.org/10.1002/cncr.28592.
6. Sonis ST, Elting LS, Keefe D, Peterson DE, Schubert M, Hauer-Jensen M, Bekele BN, Raber-Durlacher J, Donnelly JP, Rubenstein EB; Mucositis Study Section of the Multinational Association for Supportive Care in Cancer; International Society for Oral Oncology. Perspectives on cancer therapy-induced mucosal injury: pathogenesis, measurement, epidemiology, and consequences for patients. Cancer. 2004 May 1;100(9 Suppl):1995-2025. doi: 10.1002/cncr.20162. PMID: 15108222.
7. Direct costs associated with the management of mucositis: A systematic review. Rodrigues-Oliveira L, Kowalski LP, Santos M, Marta GN, Bensadoun RJ, Martins MD, Lopes MA, Castro G Jr, William WN Jr, Chaves ALF, Migliorati CA, Salloum RG, Rodrigues-Fernandes CI, Kauark-Fontes E, Brandão TB, Santos-Silva AR, Prado-Ribeiro AC. Oral Oncol. 2021 Jul;118:105296. doi: 10.1016/j.oraloncology.2021.105296. Epub 2021 Apr 29. PMID: 33933777 Review.
8. Epstein, J.B., Parker, I.R., Epstein, M.S. and Stevenson-Moore, P. (2004). Cancer-related oral health care services and resources: a survey of oral and dental care in Canadian cancer centres. Journal (Canadian Dental Association), [online] 70(5), pp.302–304. Available at: https://pubmed.ncbi.nlm.nih.gov/15132812/.
9. Epstein, J.B., Güneri, P. & Barasch, A. Appropriate and necessary oral care for people with cancer: guidance to obtain the right oral and dental care at the right time. Support Care Cancer 22, 1981–1988 (2014). https://doi.org/10.1007/s00520-014-2228-x
10. Siegel, R.L., Miller, K.D., Fuchs, H.E. and Jemal, A. (2022). Cancer statistics, 2022. CA: A Cancer Journal for Clinicians, [online] 72(1), pp.7–33. doi:https://doi.org/10.3322/caac.21708.
11. Arzanova E, Mayrovitz HN. The Epidemiology of Breast Cancer. In: Mayrovitz HN, editor. Breast Cancer [Internet]. Brisbane (AU): Exon Publications; 2022 Aug 6. Chapter 1. Available from: https://www.ncbi.nlm.nih.gov/books/NBK583819/ doi: 10.36255/exon-publications-breast-cancer-epidemiology
12. Gomez-Espinosa E, Marroquín Velásquez G. CO149 epidemiology and burden of oral complications following breast cancer treatment-a systematic literature review (PROSPERO CRD42021272130)-mucositis and stomatitis
13. Poulopoulos, A., Papadopoulos, P. and Andreadis, D. (2017). Chemotherapy: oral side effects and dental interventions. A review of the literature. Stomatological Disease and Science, 1(2). doi:https://doi.org/10.20517/2573- 0002.2017.03.
14. Hsieh, Tina Yi Jin & Huang, Pin-Chia & Sroussi, Herve & Chen, Sheng-Yin & Lu, Chuan & Ma, Kevin. (2023). Oral complications in patients with breast cancer treated with HER2-targeted therapies: A population-based cohort study across the United States.. JCO Oncology Practice. 19. 296-296. 10.1200/OP.2023.19.11_suppl.296.
15. Taichman LS, Havens AM, Van Poznak CH. Potential implications of adjuvant endocrine therapy for the oral health of postmenopausal women with breast cancer. Breast Cancer Res Treat. 2013;137:23–32.
16. Epstein J.B., Smith, D.K., Vilines, D., Parker, I., Hameroff, J., Hill, B.R., & Murphy, B.A. (2018). Patterns of oral and dental care education and utilization in head and neck

www.sada.co.za / SADJ Vol. 81 No.3
https://doi.org/10.17159/sadj.v81i03.22389

cancer patients. Supportive Care in Cancer, 26(1), 2591-2603. DOI: 10.1007/s00520-0l 8-4099-z.
17. Smith, A. (2021). Knowledge, Perception, and Implementation of Oral Care in Patients with Head and Neck Cancer Before, During, and After Radiation Therapy. Undergraduate Honors Theses. [online] Available at: https://thekeep.eiu.edu/honors_theses/165/.
18. Chikte U, Pontes CC, Karangwa I, Kimmie-Dhansay F, Erasmus RT, Kengne AP, Matsha TE. Periodontal Disease Status among Adults from South Africa-Prevalence and Effect of Smoking. Int J Environ Res Public Health. 2019 Sep 29;16(19):3662. doi: 10.3390/ijerph16193662. PMID: 31569503; PMCID: PMC6801877.
19. Tsuji K, Shibuya Y, Akashi M, Furudoi S, Yakushijin K, Kawamoto S, et al. Prospective study of dental intervention for hematopoietic malignancy. Journal of dental research. 2015;94(2):289–96. doi: 10.1177/0022034514561768.
20. Dang, R.R., Brar, B., Pasco, J.M., Rebhun, C., Sohn, W. and Salama, A. (2020). Dental Practice Patterns for Oral Care in Medical Oncology Patients—a Survey-Based Assessment of Massachusetts Dentists. Journal of Cancer Education. doi:10.1007/s13187-020-01845-8
21. Epstein, J.B., Parker, I.R., Epstein, M.S., Gupta, A., Kutis, S. and Witkowski, D.M. (2007). A survey of National Cancer Institute-designated comprehensive cancer centers' oral health supportive care practices and resources in the USA. Supportive Care in Cancer, 15(4), pp.357–362. doi:10.1007/s00520-006-0160-4.
22. Jones, J.A., Chavarri-Guerra, Y., Corrêa, L.B.C., Dean, D.R., Epstein, J.B., Fregnani, E.R., Lee, J., Matsuda, Y., Mercadante, V., Monsen, R.E., Rajimakers, N.J.H., Saunders, D., Soto-Perez-de-Celis, E., Sousa, M.S., Tonkaboni, A., Vissink, A., Yeoh, K.S. and Davies, A.N. (2022). MASCC/ISOO expert opinion on the management of oral problems in patients with advanced cancer. Supportive Care in Cancer, [online] 30(11), pp.8761–8773.
23. Licitra, L., Keilholz, U., Tahara, M., Lin, J.-C., Chomette, P., Ceruse, P., Harrington, K. and Mesia, R. (2016). Evaluation of the benefit and use of multidisciplinary teams in the treatment of head and neck cancer. Oral Oncology, [online] 59, pp.73– 79. doi:10.1016/j.oraloncology.2016.06.002.

Online CPD in 6 Easy Steps

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

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Assessing the Knowledge, Attitudes and Practices of Gauteng Dentists Regarding Oral Health and Complications Associated with Cancer Treatment

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ABSTRACT

Introduction

Oral complications from cancer treatments often lead to treatment delays and decreased quality of life. Limited patient education, lack of specialised dental care, and poor interdisciplinary communication contribute to inadequate patient management.

Aims and Objective

To assess the knowledge, attitudes and practices of Gauteng dentists regarding oral health and complications associated with cancer treatment.

Design

A descriptive cross-sectional study was conducted using a previously validated anonymous online questionnaire.

Methods

Convenience sampling was employed by sending general dentists in Gauteng an invitation to participate and a link to the questionnaire via LinkedIn.

Results

A total of 61 general dentists were surveyed, most treat 5–10 cancer patients annually, with 60.7% managing most oral complications themselves. Only 55.7% follow treatment protocols, many unsure of which specific protocol. Communication with oncology teams is inconsistent and many dentists feel inadequately trained to treat oral complications. Key barriers include insufficient pre-treatment time (78.7%), lack of patient education (75.4%), and poor oncology-dental coordination.

Conclusions

This study highlights gaps in general dentists' training, inconsistencies of protocols followed, and a lack of interdisciplinary communication with oncology teams. Standardised protocols, enhanced training, and improved collaboration are essential to optimise oral healthcare for cancer patients.

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Keywords

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INTRODUCTION

Chemo and radiation therapy frequently cause oral mucositis, a serious oral complication with significant implications. Oral mucositis results primarily from chemotherapy-induced suppression of epithelial cell proliferation, which disrupts mucosal renewal and leads to ulceration. This process is compounded by complex inflammatory cascades involving oxidative stress, cytokine release, and tissue signalling, amplifying damage and delaying healing. Oral mucositis presents clinically with varying degrees of erythema, erosion and ulceration.

Cancer patients undergoing chemo and radiation treatments commonly experience oral complications that impair oral function, contribute to physical and psychological challenges, and ultimately reduce their quality of life.[1-3] Oral mucositis often limits the effective administration of chemotherapy and radiation therapy due to its frequency and severity.[2-5] Severe cases of oral mucositis can reduce chemotherapy doses, delay or interrupt treatments, or increase hospitalisations.[5-8] In extreme cases, some patients even discontinue cancer therapy due to the severity of oral mucositis.[3] These interruptions hinder optimal treatment outcomes and negatively affect patient survival rates.[5,7]

Insufficient assessment, diagnosis, treatment, and follow-up, along with under-reporting by patients, often contribute to oral complications in cancer patients. Educating patients about potential oral complications, emphasising the importance of addressing oral concerns before cancer treatment, and encouraging them to monitor and report emerging problems are critical measures needed to prevent and minimise the severity of oral complications experienced during cancer treatment.[9,10] Lack of patient education is a large contributing factor to under-reporting of oral conditions and subsequent oral complications of cancer treatment. Other barriers to adequate oral care include insufficient time before cancer therapy, inadequate dental insurance, limited training, poor communication with oncology teams (including lack of dental referrals), and patients' undervaluation of dental concerns.[8,10,11]

Skilled dentists play a critical role in reducing the incidence of oral complications before cancer therapy. Dental prophylaxis

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reduces the oral bacterial load, effectively reducing the risk oral infections.[12,13]

Designated dental practitioners and specialists, such as Periodontists and Oral Medicine specialists, are essential in oncology teams to manage cancer treatment-related oral complications, ensuring safe and effective care from diagnosis to survivorship.[9] These specialists should establish effective interdisciplinary communication with oncology teams.[8,9] Without these oral care services, significant gaps emerge that can negatively affect cancer treatment outcomes and reduce patients' overall quality of life.[8]

Timely communication by a multidisciplinary healthcare team is essential to prevent and manage cancer-treatment induced oral complications.[1,10] Advanced oncology centres often include dedicated dentists in their teams, as the National Cancer Institute (NCI) recommends.[3,8] However, over half of United States cancer centres lack a dedicated dental department or experienced dental practitioners within their cancer care teams.[9]

Epstein et al., (2018) found that during cancer therapy, 74% of patients experienced oral complications, with the majority being managed by cancer centre medical staff (77%) and a small percentage (4%) treated by community dental providers. Although general dentists primarily perform pre-treatment evaluations, the treatment of oral complications is largely handled by designated dentists affiliated with a cancer centre and other providers such as speech and language pathologists.[14]

General dentists often lack sufficient training and experience to manage medically complex patients, including those undergoing cancer treatment.[8,9,13] Dang et al., (2020) found that while most dentists counsel patients on oral complications of cancer therapy, only half feel adequately trained to provide comprehensive care for these patients.[11] Similarly, Patel et al., (2012) revealed that many dentists feel unprepared to manage patients undergoing head and neck radiation, and highlight the need for enhanced continuing education, additional training opportunities, and improved undergraduate curricula.[11,15] The Institute of Medicine of the National Academy of Sciences (IOM) calls for better preparation of future providers to treat medically complex patients, including oncology patients receiving chemo/radiation therapy.[7]

The objective of this study is to evaluate the Knowledge, Attitudes and Practices (KAP) of general dentists in Gauteng regarding the dental treatment of cancer patients and the management of oral complications associated with cancer therapies.

METHODS AND MATERIALS

A descriptive cross-sectional study was conducted through an anonymous questionnaire, distributed through Google Forms, to examine the KAP of Gauteng general dentists on treating cancer patients and managing cancer treatment-associated oral complications. The questionnaire explored the following themes: treatment of cancer patients, dental services rendered, communication with oncology units, barriers to dental care and a free response section.

The online questionnaire was modified from previously validated questionnaires.[7,11]
Convenience sampling was employed by sending general dentists in Gauteng an invitation to participate and a link to the questionnaire, which was provided through the LinkedIn social media platform. The questionnaire was self-administered and anonymous, and it was completed on Google Forms. Accordingly, POPIA requirements were met as no personally identifiable information was collected or used for the distribution of the questionnaire.

The purpose of the study was clarified, accompanied by the participant information and informed consent document.

Data was collected during September 2024 – December 2024, and automatically captured and stored in Google Forms from where it was exported to Google Sheets for analysis.

The data analysis primarily consisted of descriptive statistics such as means, medians, standard deviations, frequencies, and proportions to describe the results.

The sample size was calculated by a power analysis which showed that statistical tests like the Chi-square test with a medium effect size of 0.5, using G*Power 3.1.9.4, at an alpha level of 5% and a power of 85%, a sample size of 55 dentists was required.

This research was approved by the Human Research Ethics Committee (HREC) at the University of Pretoria (Ethics Reference Number: 528/2023).

RESULTS

A total of 61 general dentists responded to the survey. The total number of dentists reached through the LinkedIn social media platform could not be assessed and therefore a response rate cannot be calculated. Once the sample size was reached, distribution of the survey was halted and collection of responses discontinued.

Treatment of Cancer Patients

Overall, 29.5% (n = 18) of dentists reported treating 3 to 5 cancer patients per year, while 24.6% of dentists (n = 15) treated an average of 1 to 2 patients annually. The remaining 45.6% (n = 28) provided a range of responses, as detailed in Figure 1.

When oral or dental complications arise due to cancer treatment, 60.7% (n = 37) of general dentists reported confidence in managing these issues independently. Additionally, 49.2% (n = 30) referred patients to a Periodontist or Oral Medicine specialist, while 45.9% (n = 28) referred them to a Maxillofacial and Oral Surgeon. Other referrals included 13.1% (n = 8) to an oncologist and 21.3% (n = 13) who specifically refer to the patient's oncologist. Notably, one dentist reported referring patients to a dental professional specialising in oncological care or other specialists, depending on the complication and its complexity, particularly if the problem extended beyond the general dentist's scope. Multiple answers could be selected.

The majority of general dentists, 82% (n = 50), counsel their cancer patients on the oral complications associated with cancer therapy, including long-term oral care. Additionally, 55.7% (n = 34) of dentists follow specific protocols when treating oncology patients. However, 55.9% (n = 19) of the dentists who follow protocols are unsure of which specific protocols they are implementing.

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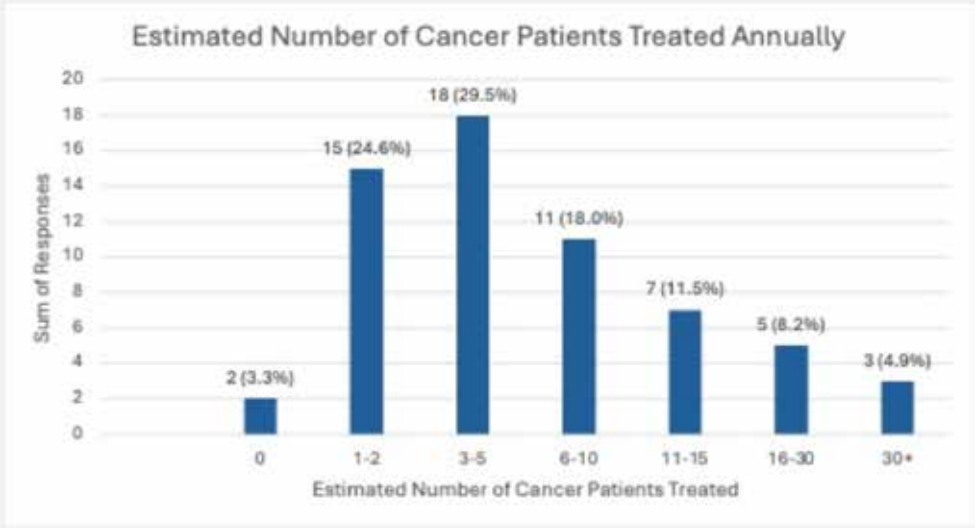

Figure 1: Distribution of responses from 61 dental practitioners estimating the number of cancer patients they treat annually.

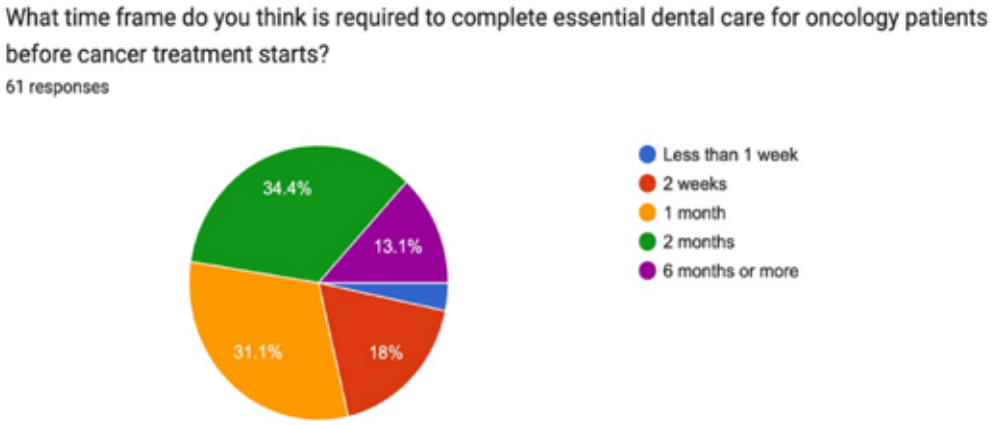

Figure 2: Responses to the question: "What time frame do you think is required to complete essential dental care for oncology patients before cancer treatment starts?" (n=61).

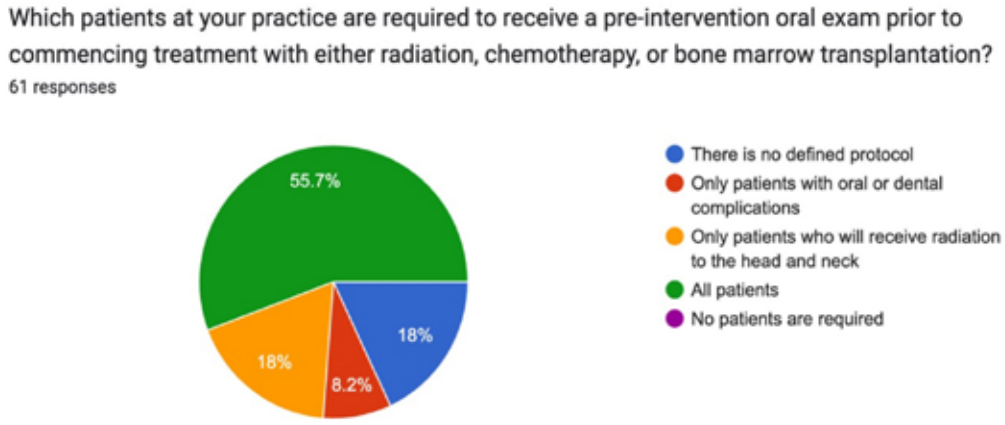

Figure 3: Responses to the question: "Which patients at your practice are required to receive a pre-intervention oral exam prior to commencing treatment with either radiation, chemotherapy, or bone marrow transplantation?" (n=61).

The pie chart (Figure 2) depicts dentists' opinions regarding the optimal time frame for completing necessary dental care prior to cancer treatment. The most common response was 2 months (34.4%, n = 21), followed by 1 month (31.1%, n = 19), 2 weeks (18%, n = 11), 6 months or more (13.1%, n = 8), and less than 1 week (3.3%, n = 2).

The pie chart (Figure 3) illustrates dentist's responses regarding the timeline required for treating cancer patients, and which patients require a pre-treatment dental examination. The majority, 55.7% (n = 34), indicated that all cancer patients undergo a pre-intervention oral exam. Other responses included limiting the examination to patients receiving radiation to the head and neck (18%, n = 11), patients with existing oral or dental complications (8.2%, n = 5), and practices where no defined protocol is in place (18%, n = 11).

The type of dental services provided to cancer patients by dental practitioners are presented in Figure 4. The most commonly offered service was "Pre-intervention oral/dental examination", reported by 78.7% (n = 48) of respondents. This was followed by "Pre-intervention comprehensive dental treatment" (70.5%, n = 43) and "Health education/ health promotion" (68.9%, n = 42). Other services included

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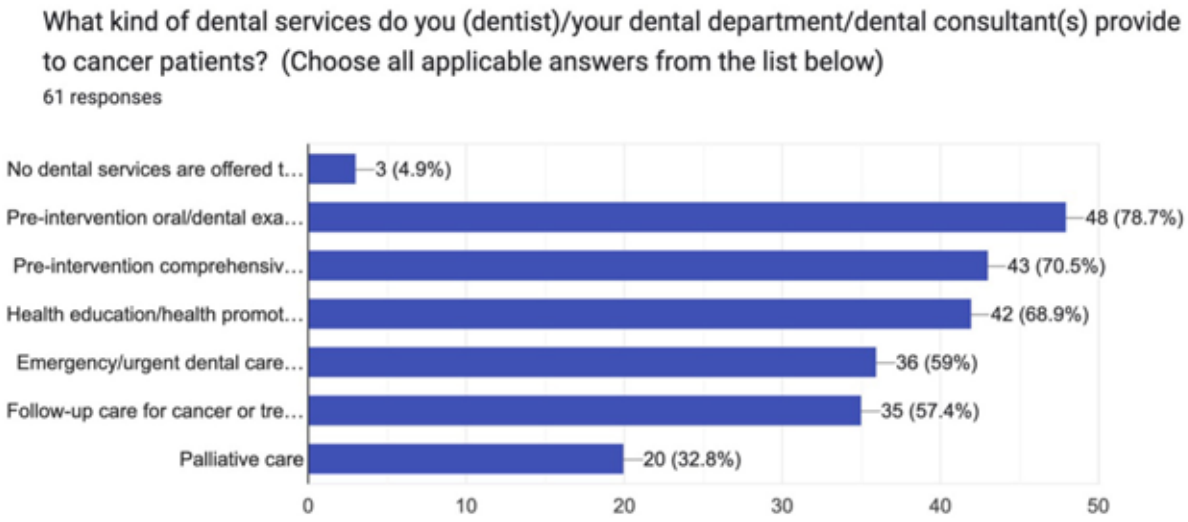

Figure 4: Bar chart illustrating the responses (n = 61) to the types of dental services provided to cancer patients.

"Emergency/urgent dental care" (59%, n = 36), "Follow-up care for cancer or treatment-related complications" (57.4%, n = 35), and "Palliative care" (32.8%, n = 20). A small proportion, 4.9% (n = 3), indicated that no dental services are offered to cancer patients within their practice. Multiple answers could be selected by dentist participants.

Oncology Communication

When asked about correspondence from oncology teams during patient referrals – such as details regarding the patient's cancer diagnosis, start date of cancer therapy, medications – 9.8% (n = 12) of dentists reported always receiving this information. 34.4% (n = 21) stated they sometimes received it, 29.5% (n = 18) rarely did, and 26.2% (n = 16) never received feedback.

Regarding feedback from oncology teams, 19.7% (n = 12) of dentists reported always receiving feedback, 23% (n = 14) sometimes did, 26.2% (n = 16) rarely received feedback, and 31.1% (n = 19) never received feedback.

In terms of communication regarding planned dental treatment, 60.7% (n = 37) of dentists always shared their recommendations with oncology teams for extractions, restorations, periodontal health, and other urgent oral care. Conversely, 23% (n = 14) sometimes communicated such plans, 14.8% (n = 9) rarely communicated, and one dentist never communicated planned dental treatment with oncology teams.

A total 44.3% (n = 27) of general dentists believe they are responsible for providing oral care to patients undergoing cancer treatment. However, 31.1% (n = 19) attributed this role to a dental consultant affiliated with a cancer centre, 23% (n = 14) believed it should be managed by a specialist, and one dentist indicated that this responsibility should lie with a dental school.

Among those who believed a specialist should be responsible for the oral care of cancer patients, responses varied by discipline. The most frequently cited specialities included Oral Medicine (35.7%, n = 5), Maxillo-Facial and Oral Surgery at (21.4%, n = 3), and Dental Oncology (14.3%, n = 2). Other responses, such as Prosthodontics and Periodontics, were less commonly selected. (Figure 5)

The majority of general dentists, 86.9% (n = 53), supported the involvement of a dental oncologist in the multidisciplinary management of oncology patients, citing benefits such as improved patient care and efficiency. In contrast, 13.1% (n = 8) believe that general dentists should handle the oral care needs of cancer patients, reserving specialist referrals for cases requiring specialised intervention. Some responses highlighted concerns about increased financial costs and the benefits of a collaborative, multidisciplinary approach.

When asked whether they felt adequately trained to manage oncology patients, 32.8% (n = 20) of dentists answered "No", 45.9% (n = 28) answered "Somewhat", and 21.3% (n = 13) answered "Yes." Among those who selected "Somewhat",

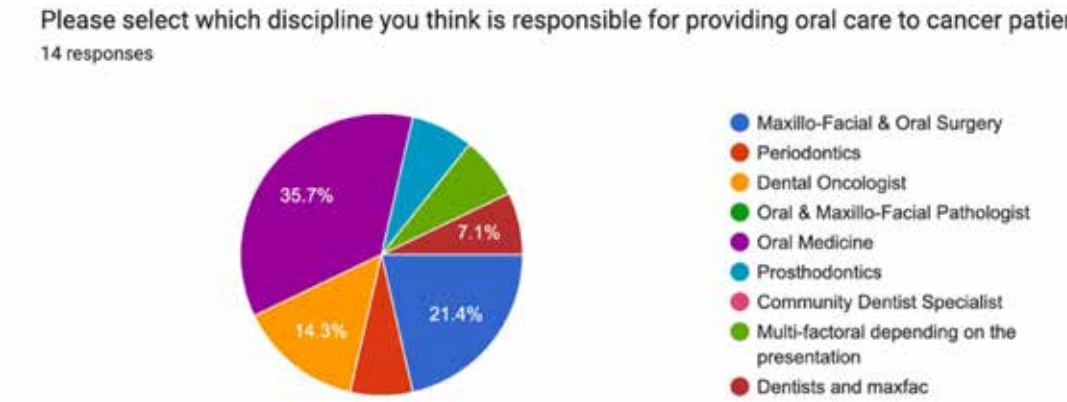

Figure 5: The pie chart depicts the percentage of participants selecting each specialty.

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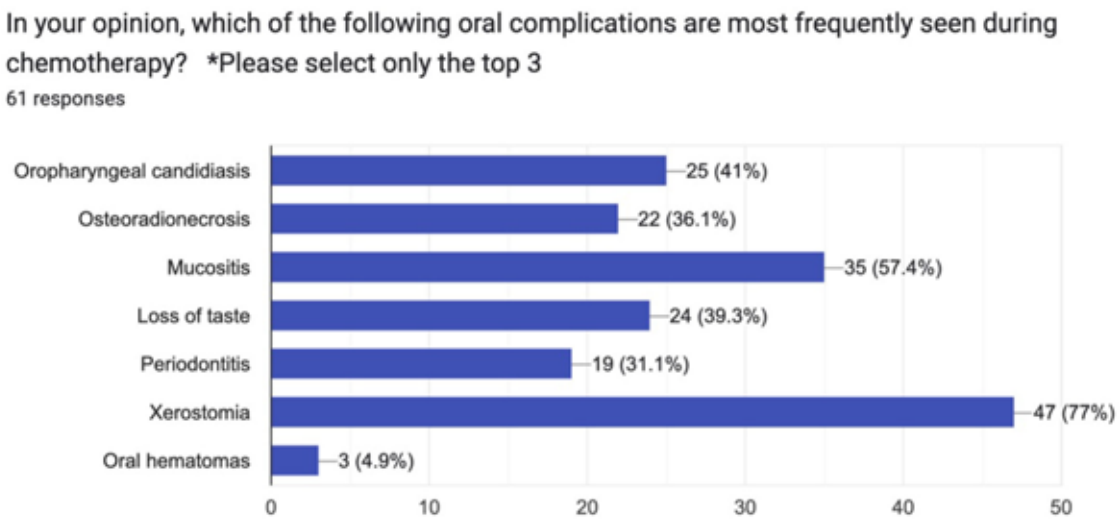

Figure 6: Responses to the question: "Which of the following oral complications are most frequently seen during chemotherapy?" (n=61).

the general consensus was that most dentists received limited or inadequate undergraduate training, resulting in a lack of practical skills required to manage cancer patients effectively.

When asked, "Do you feel confident/ comfortable to manage the oral health of oncology patients?", 67.2% (n = 41) of dentists answered "Yes", while 32.8% (n = 20) answered "No". Among those who did not feel confident, referrals for oncology-related dental consultation and dental care were split equally between Oral Medicine specialists (50%, n = 10) and Prosthodontists (50%, n = 10).

Figure 6 depicts the most commonly seen oral complications seen during chemotherapy, based on the dentists' top three reported complications. The most frequently reported complications were xerostomia (77%, n = 47), mucositis (57.4%, n = 35), and oropharyngeal candidiasis (41%, n = 25). Other reported complications included loss of taste (39.3%, n = 24), osteoradionecrosis (36.1%, n = 22), periodontitis (31.1%, n = 19), and oral hematomas (4.9%, n = 3).

Barriers to Dental Care

The most frequently cited obstacles to providing dental care to oncology patients (Figure 7) were "Insufficient time to provide dental care before the start of therapy" (78.7%, n = 48) and "Lack of patient education on oral complications associated with treatment" (75.4%, n = 46). Other notable barriers included "Inadequate funding from medical aid" (57.4%, n = 35), "Lack of medical aid" (36.1%, n = 22), "Inadequate training" (32.8%, n = 20), and "Practices not accepting medical aid patients" (11.5%, n = 7). Multiple answers could be selected.

Other notable barriers include a lack of oncology input and team management. Many responses highlighted that oncologists do not provide communication or emphasise the need for pre-treatment dental screening, contributing to a lack of multi-disciplinary patient management.

DISCUSSION

This study aimed to assess Gauteng general dentists' KAP on the treatment of cancer patients and management of oral complications caused by cancer therapy.

Confidence and Responsibility of Managing Oral Complications

The findings of this study highlight a notable discrepancy between dentists' perceived competence and their sense of professional responsibility in managing oral complications

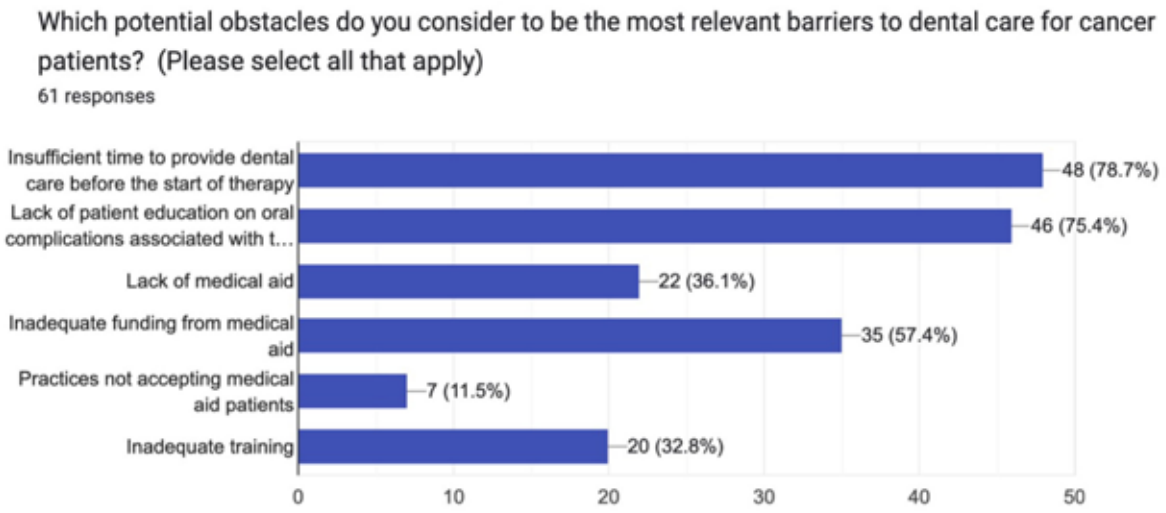

Figure 7: Bar chart depicting the responses (n = 61) to the most relevant barriers to dental care for cancer patients.

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Table I: Free Response Summary

Summary of Free Response Section	
Theme	**Key Insights from Responses**
Limited Exposure to Cancer Patients	Paediatric dentists report minimal encounters with children undergoing cancer treatment and highlight the absence of standardised protocols. General dentists, particularly recent graduates, also have limited experience treating oncology patients.
Referral and Treatment Decisions	Routine dental procedures such as fillings and cleanings are performed by general dentists, while extractions and soft tissue lesions are typically referred to specialists.
Need for Standardised Protocols	Dentists express uncertainty about recommended protocols for different cancer types and stress the need for clear guidelines.
Training and Multidisciplinary Collaboration	Many dentists feel inadequately trained to manage oncology patients and emphasise the importance of integrating dental professionals into the multidisciplinary cancer care team.
Challenges in Pre-Treatment Dental Care	Dentists find invasive procedures difficult once cancer therapy has begun. They stress the need for oncologists to educate patients about pre-treatment dental assessments.
Lack of Oral Health Awareness Among Patients	Cancer patients often seek dental care only when experiencing severe pain, due to a lack of awareness about oral health's role in treatment outcomes.
Communication Barriers with Oncology Teams	Poor coordination and lack of feedback from oncology teams result in inadequate follow-up care for cancer patients.

associated with cancer treatment. While the majority of general dentists report confidence in addressing these complications and frequently manage such cases, less than half consider this aspect of care to fall within their professional remit. This suggests that confidence does not necessarily translate into ownership of responsibility, which may reflect ambiguity in role definition within multidisciplinary cancer care.

The tendency to refer complex cases to specialists underscores the recognition of the need for advanced expertise. However, the perception that cancer centre-affiliated dental consultants, specialists, and even dental schools should assume primary responsibility indicates a systemic gap in integrating general dentists into oncology care pathways. This could be attributed to limited formal training in oncology-related oral health, lack of structured collaboration with cancer centres, or uncertainty regarding medico-legal obligations.

An online survey conducted by Epstein et al., (2018) found that oral complications as a result of cancer therapy were generally treated by medical staff at the cancer centre (77.7%), followed by dentists affiliated with the cancer centre and other providers such as speech and language pathologists. Community dentists provided treatment to only 4.4% of these patients.[14]

Jawad et al., (2015) in a review of head and neck cancer patients, highlighted the crucial role of general dental practitioners in managing oral complications of cancer treatment. With a thorough understanding of oral care for cancer patients and by collaborating with oncology, general dentists should be well-equipped to provide essential guidance and treatment for these patients.[16]

Training and Education

Regarding training and education, 32.8% of dentists reported limited training to manage oncology patients. Another 45.9% state they feel "Somewhat" prepared, while only 21.3% feel fully prepared. Dentists who selected "Somewhat" often cite insufficient or limited undergraduate training as an important limitation. This is evident through the high referral rates to other specialities.

Epstein et al., (2014) similarly found that many dental care providers in community practice are unprepared to address oral complications in cancer patients due to inadequate undergraduate and graduate education, limited continuing education, and minimal experience with medically complex cases.[9]

Dentists lack practical skills for managing cancer patients, as training prioritises referrals over comprehensive care. Epstein et al., (2014) highlight the importance of general dentists and specialists collaborating to deliver safe and effective oral care, stressing the importance of sufficient training to meet this objective.[9]

Dang et al., (2020) reported that although most dentists counsel patients on oral complications of cancer treatment, only 50% felt adequately prepared to manage cancer patients holistically.[11] Similarly, Patel et al., (2012) revealed that many dentists felt inadequately trained to treat patients undergoing head and neck radiation, underscoring the need for enhanced continuing education, additional training opportunities, and improved undergraduate programmes.[15] The IOM reinforces this view, advocating for the preparation of future providers to effectively manage medically complex patients.[7]

Standardisation of Protocols

A total of 55.7% of dentists reported adhering to protocols when treating oncology patients, while 44.3% reported having no specific protocols in place. Among those who claimed to follow protocols, 55.9% (19 dentists) were unsure about the specific protocols they followed. This inconsistency highlights a significant gap in standardisation

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and may explain the frequent need for general dentists to refer cancer patients to specialists.

Epstein et al., (2007) identified similar challenges, noting significant gaps in dental care and the lack of clearly defined protocols for addressing dental needs at NCI designated cancer centres.[8] Likewise, Barker et al., (2005) surveyed 212 members of the Multinational Association of Supportive Care in Cancer (MASCC) and the International Society for Oral Oncology, highlighting the urgent need for evidence-based, standardised protocols and guidelines to enhance dental care in oncology settings.[17]

The lack of standardised protocols creates inconsistencies in the time general dentists require to provide dental care to oncology patients before initiating cancer treatment. Only 55.7% of dentists routinely conduct pre-intervention oral examinations for all patients before starting cancer therapy. Similarly, Epstein et al., (2018) found that general dentists performed the majority of pre-cancer therapy evaluations (55.8%), while medical practitioners managed most oral supportive care during therapy (77.7%), with cancer centre dentists contributing minimally (8.9%).[14] These findings highlight the need for a well-prepared oral care team to effectively manage oncology-related oral complications.

Standardised protocols could streamline practice patterns, unify management strategies, and clarify referral processes, fostering more consistent and coordinated care for oncology patients.

The lack of standardised treatment protocols to guide general dentists further contributes to inadequate undergraduate training. Carvalho et al., (2018) addressed this gap by reviewing 54 systematic and randomised control studies, offering one of the few evidence-based guidelines for preventing and managing oral complications before, during, and after cancer treatment.18 The absence of a standardised protocol for general dentists results in inconsistent care and leaves dentists without clear guidance on providing adequate oral care for cancer patients.

Epstein et al., (2018) reported that cancer patients are generally unsatisfied with the pre-treatment education that they received from dental practitioners and attribute it to a lack of consistency and standardised protocols.[14]

A national consensus statement that includes clear guidelines, should be developed to define essential oral and dental care before, during, and after cancer treatment. This should then be implemented into undergraduate dental training.

Multidisciplinary Management

Most general dentists (86.9%) believe that incorporating a dental oncologist into the multidisciplinary management of oncology patients, either through employment or outsourcing, would enhance efficiency and improve patient care. However, some dissenting dentists argue that general practitioners should possess the skills to manage cancer patients and their oral complications independently, thereby avoiding referrals and reducing associated costs.

Epstein et al., (2007) emphasised the critical role of general dentists within a multidisciplinary team (MDT), stating, "A MDT, with active participation of dentists in the care of oncology patients, can lead to highly effective preventive and therapeutic outcomes." [8] The MASCC also endorses the involvement of dentists in oncology care, with most advanced cancer centres including dentists in their MDT's as standard practice.[3] This approach aligns with recommendations from the NCI.[8]

Several governing bodies, including the European Society for Medical Oncology (ESMO), and the National Comprehensive Cancer Network (NCCN), advise establishing treatment plans through a MDT.[19] However, achieving this proves difficult as only 9.8% of dentists routinely receive correspondence from their patients' oncology teams, while 26.2% never receive it, 34.4% sometimes, and 29.5% rarely. Despite this gap, 60.7% of dentists consistently communicate dental treatment plans—such as extractions, restorative needs, periodontal care, and urgent oral health concerns – to oncology teams. Yet, only 19.7% of dentists report always receiving feedback, 23% sometimes, 26.2% rarely, and 31.1% never receive any feedback. This significant communication disconnect between general dentists and oncology teams hinders effective multidisciplinary care for oncology patients. Similarly, Dang et al., (2020) found that most dentists rarely or never receive correspondence from oncology teams regarding cancer diagnosis, type or stage, therapy start dates, medications, or complete blood counts.[11]

Comprehensive dental care across all phases of cancer therapy (pre-treatment, during treatment, and post-treatment) forms an integral part of the multidisciplinary management of oncology patients.[9,10,13]

General dentists play a pivotal role in ensuring adequate oral care for cancer patients, which necessitates timely collaboration between dental and oncology teams. Clear and effective communication between these teams is critical to preventing and addressing oral complications arising from cancer treatment. The absence of multidisciplinary care can hinder patients' understanding of the oral implications of cancer therapy, delay necessary dental interventions, and elevate the risk of complications, potentially disrupting the continuity of oncologic treatment.

Barriers to Care

Key obstacles in providing dental care to oncology patients include limited time to deliver care before therapy (78.7%), inadequate patient education on oral complications (75.4%), insufficient or absent medical aid (36.1%), inadequate medical aid funding (57.4%), practices not accepting medical aid (11.5%), and insufficient training for dental practitioners (32.8%). Poor coordination and communication with oncology teams further exacerbate these challenges. Dentists highlighted a lack of input from oncologists and insufficient emphasis on pre-treatment dental screenings, revealing critical gaps in multidisciplinary patient management. Dang et al., (2020) identified similar barriers, the most frequently cited was insufficient time to complete dental treatment before cancer therapy commences and lack of patient education regarding oral complications.[11]

Epstein et al., (2018) emphasised that the obstacles to dental care of oncology patients should be identified and addressed to ensure optimal oral care. Specific targeted interventions included patients receiving and retaining oral

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care education, improved access to oral care professionals who are sufficiently trained in treating cancer patients, with the implementation of dedicated clinics.[14]

Collectively, these challenges highlight the urgent need for better coordination, enhanced communication, and comprehensive training between oncology and dental care teams to optimise patient care and outcomes.

Limitations

This study utilised an online survey and collected 61 responses, exceeding the target sample size of 55 general dentists. Notably, 60% (37 respondents) graduated between 2020 and 2024, likely reflecting greater engagement with digital platforms and online surveys among recent graduates. However, this demographic may have limited experience in treating cancer patients, which could impact the generalisability of the findings to the wider population of Gauteng dentists. Nevertheless, the results are consistent with findings in previous research studies conducted, revealing considerable variability in the oral and dental care offered to patients undergoing cancer therapy.

CONCLUSIONS

This study identifies significant gaps in the knowledge, training, and coordination of general dentists in Gauteng regarding the oral care of oncology patients. Many dentists feel confident to manage oral complications related to cancer treatment, however, fewer than half consider it their primary responsibility. Only 55.7% follow protocols, but many are unsure about which protocols they are implementing. This inconsistency contributes to delays in care and over-reliance on dental specialists.

The findings of this study highlight the need for standardised, evidence-based protocols, improved undergraduate and continuing education, and better communication between dental and oncology teams. Barriers such as limited time, inadequate funding and resources further hinder effective care. In conclusion, strengthening training, defining roles within MDT's, and enhancing collaboration between dental and oncology teams are critical steps toward more consistent, coordinated, and effective oral healthcare for oncology patients.

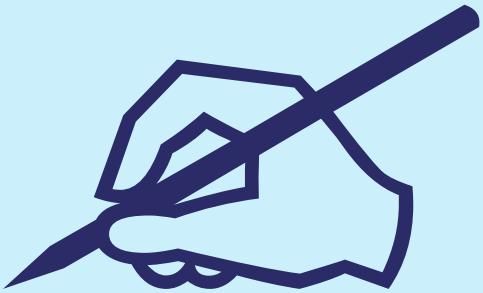
Future studies should explore the design and benefits of standardised cancer patient management protocols.

REFERENCES

1. Epstein J.B., Thariat J., Bensadoun R.J. Oral complications of cancer and cancer therapy: from cancer treatment to survivorship. CA Cancer J Clin. 2012;62(November–December (6)):400–422. [PubMed] [Google Scholar]
2. García-Chías, B., Figuero, E., Castelo-Fernández, B., Cebrián-Carretero, J.L. and Cerero-Lapiedra, R. (2019). Prevalence of oral side effects of chemotherapy and its relationship with periodontal risk: a cross sectional study. Supportive Care in Cancer, [online] 27(9), pp.3479–3490. doi:https://doi.org/10.1007/s00520-019-4650-6.
3. Biswal, B. (n.d.). CURRENT TRENDS IN THE MANAGEMENT OF ORAL MUCOSITIS RELATED TO CANCER TREATMENT. [online] Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3341902/pdf/mjms-15-3-004.pdf [Accessed 6 Mar. 2023].
4. Lalla, R.V., Bowen, J., Barasch, A., Elting, L., Epstein, J., Keefe, D.M., McGuire, D.B., Migliorati, C., Nicolatou-Galitis, O., Peterson, D.E., Raber-Durlacher, J.E., Sonis, S.T. and Elad, S. (2014). MASCC/ISOO clinical practice guidelines for the management of mucositis secondary to cancer therapy. Cancer, [online] 120(10), pp.1453–1461. doi:https://doi.org/10.1002/cncr.28592.
5. Sonis ST, Elting LS, Keefe D, Peterson DE, Schubert M, Hauer-Jensen M, Bekele BN, Raber-Durlacher J, Donnelly JP, Rubenstein EB; Mucositis Study Section of the Multinational Association for Supportive Care in Cancer; International Society for Oral Oncology. Perspectives on cancer therapy-induced mucosal injury: pathogenesis, measurement, epidemiology, and consequences for patients. Cancer. 2004 May 1;100(9 Suppl):1995-2025. doi: 10.1002/cncr.20162. PMID: 15108222.
6. Vera-Llonch, M., Oster, G., Hagiwara, M. and Sonis, S. (2006). Oral mucositis in patients undergoing radiation treatment for head and neck carcinoma. Cancer, [online] 106(2), pp.329–336. doi:https://doi.org/10.1002/cncr.21622.
7. Epstein, J.B., Parker, I.R., Epstein, M.S. and Stevenson-Moore, P. (2004). Cancer-related oral health care services and resources: a survey of oral and dental care in Canadian cancer centres. Journal (Canadian Dental Association), [online] 70(5), pp.302–304. Available at: https://pubmed.ncbi.nlm.nih.gov/15132812/.
8. Epstein, J.B., Parker, I.R., Epstein, M.S., Gupta, A., Kutis, S. and Witkowski, D.M. (2007). A survey of National Cancer Institute-designated comprehensive cancer centers' oral health supportive care practices and resources in the USA. Supportive Care in Cancer, 15(4), pp.357–362. doi:10.1007/s00520-006-0160-4.
9. Epstein, J.B., Güneri, P. & Barasch, A. Appropriate and necessary oral care for people with cancer: guidance to obtain the right oral and dental care at the right time. Support Care Cancer 22, 1981–1988 (2014). https://doi.org/10.1007/s00520-014-2228-x
10. Jones, J.A., Chavarri-Guerra, Y., Corrêa, L.B.C., Dean, D.R., Epstein, J.B., Fregnani, E.R., Lee, J., Matsuda, Y., Mercadante, V., Monsen, R.E., Rajimakers, N.J.H., Saunders, D., Soto-Perez-de-Celis, E., Sousa, M.S., Tonkaboni, A., Vissink, A., Yeoh, K.S. and Davies, A.N. (2022). MASCC/ISOO expert opinion on the management of oral problems in patients with advanced cancer. Supportive Care in Cancer, [online] 30(11), pp.8761–8773.
11. Dang, R.R., Brar, B., Pasco, J.M., Rebhun, C., Sohn, W. and Salama, A. (2020). Dental Practice Patterns for Oral Care in Medical Oncology Patients—a Survey-Based Assessment of Massachusetts Dentists. Journal of Cancer Education. doi:10.1007/s13187-020-01845-8.
12. Integrating oral health throughout cancer care. Hartnett E. Clin J Oncol Nurs. 2015 Oct;19(5):615-9. doi: 10.1188/15.CJON.615-619. PMID: 26414580
13. Bertl, K., Savvidis, P., Kukla, E.B., Schneider, S., Zauza, K., Bruckmann, C. and Stavropoulos, A. (2021). Including dental professionals in the multidisciplinary treatment team of head and neck cancer patients improves long-term oral health status. Clinical Oral Investigations, 26(3), pp.2937–2948.
14. Epstein J.B., Smith, D.K., Vilines, D., Parker, I., Hameroff, J., Hill, B.R., & Murphy, B.A. (2018). Patterns of oral and dental care education and utilization in head and neck cancer patients. Supportive Care in Cancer, 26(1), 2591-2603. DOI: 10.1007/s00520-0l 8-4099-z.
15. Patel Y, Bahlhorn H, Zafar S, Zwetchkenbaum S, Eisbruch A, Murdoch-Kinch CA (2012) Survey of Michigan dentists and radiation oncologists on oral care of patients undergoing head and neck radiation therapy. J Mich Dent Assoc 94(7):34–45
16. Jawad, Huda. (2015). A review of dental treatment of head and neck cancer patients, before, during and after radiotherapy: part 2. British dental journal. 218.
17. Barker GJ, Epstein JB, Williams KB, Gorsky M, Raber-Durlache JE (2005) Current practice and knowledge of oral care for cancer patients: a survey of supportive health care providers. Support CareCancer 13(1):32–41
18. Carvalho CG, Medeiros-Filho JB, Ferreira MC (2018) Guide for health professionals addressing oral care for individuals in oncological treatment based on scientific evidence. Support Care Cancer
19. Licitra, L., Keilholz, U., Tahara, M., Lin, J.-C., Chomette, P., Ceruse, P., Harrington, K. and Mesia, R. (2016). Evaluation of the benefit and use of multidisciplinary teams in the treatment of head and neck cancer. Oral Oncology, [online] 59, pp.73– 79. doi:10.1016/j.oraloncology.2016.06.002.
20. Sonis ST. Oral mucositis. Anticancer Drugs. 2011;22(7):607-12.

CPD questionnaire on page 216

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



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Oral health professionals' knowledge, perceptions, and practices regarding community engagement in rural South Africa

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ABSTRACT

Background

Oral health remains a significant public health concern globally, particularly in developing countries such as South Africa (SA). Oral health professionals (OHPs) continue to endure the burden of oral diseases particularly in rural communities due to oversight of oral health in all levels of healthcare system and lack of initiatives that promote oral health and quality of life. Oral health community engagement activities (OHCEAs) are mechanisms for achieving the key goals of the national oral health policy and strategy for delivering oral health services in rural communities. This initiative is a purpose-driven collaborative effort involving OHPs, nurses, community healthcare workers (CHWs), community leaders, and members, aimed at promoting oral health, increasing access to oral health services, and improving the general health of underserved populations in rural SA.

Aim and objectives

The study aimed to explore the knowledge, perceptions, and practices of OHPs regarding OHCEAs in a South African rural setting.

Methods

This was a mixed-methods cross-sectional study. A self-administered questionnaire of closed and open-ended questions was used to collect information among 32 OHPs providing oral healthcare services in a public healthcare sector. Quantitative data were analysed using SPSS version 29.0 (IBM Corp, USA), while qualitative was analysed thematically using ATLAS.ti software version 7.1.3.

Results

The response rate of the study was 100% (n=32). More than half (56.3%) agreed that there was no active availability of OHCEAs in the surrounding communities, while nearly half (46.9%) expressed uncertainty regarding the monitoring and evaluation. Half (50%) of the participants believed that introduction of OHCEAs enhanced oral health awareness among rural community members, while 78.1% of participants perceived OHCEAs as a long-term and ongoing strategy for promoting oral health. Some of main emergent themes included: resource constraints and infrastructural challenges; and integrated oral health and curative care approaches.

Conclusion

The study demonstrated that OHPs had sound knowledge of OHCEAs and positive perspectives regarding their impact on implementation. However, this initiative remains poorly implemented, with service provision predominantly confined to curative care owing to challenges arising from various levels of the public healthcare system.

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2. KJ Ramphoma – conceptualization, data analysis, final editing, supervision
3. R Maart – conceptualization, data analysis, final editing, supervision

INTRODUCTION

Oral health is a key indicator of an individual's overall health, well-being, and quality of life.[1–3] Nevertheless, the prevalence of oral diseases continues to pose a public health challenge, affecting an estimated 3.5 billion individuals worldwide.[4] In Africa, over 480 million individuals struggle with untreated oral diseases daily.[5] Although SA produces highly skilled OHPs to address these issues, oral health has not been prioritized by policymakers and government leaders.[6] As a result, SA has reported a prevalence of approximately 41% for untreated caries in deciduous teeth, 27.9% for untreated caries in permanent teeth, 24.8% for severe periodontal disease, and 8.4% for edentulism, in addition to nearly 1933 new cases of lip and oral cavity cancer.[7]

These diseases can be effectively prevented through the establishment of supportive environments, adequate access to Primary Health Care (PHC) resources, sufficient financial resources, mindful health behaviours, and increased awareness of oral health.[8,9] However, the current healthcare system in SA faces significant challenges in adequately meeting the healthcare demands of its population.[10–12] These challenges include the maldistribution and shortage of OHPs, as the country only 6,350 dentists, 898 dental therapists, and

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1,252 oral hygienists[13]. Moreover, there has been decades of underfunding for oral health, a lack of an oral health directorate for ministerial health discussions,[6] lack of advocacy for oral health policy review[14], and unclear integration of oral health into PHC.[15–17]

Social support is a key initiative endorsed by the World Health Organization (WHO),[18] which can be realized through community engagement (CE), mainly for underserved groups. This collaborative effort aims to foster relationships among stakeholders to address health-related issues and enhance overall well-being by achieving positive health outcomes[19]. This effort aligns with the Sustainable Development Goals (SDGs), particularly SDG 3 (good health and well-being), SDG 4 (quality education), SDG 10 (reduced inequality), and SDG 17 (partnerships for goal achievement)[20] and holds the potential to improve oral health outcomes and promote Universal Health Coverage (UHC) for all individuals[21,22]. However, this effort faces several challenges, including a lack of competencies among OHPs to conduct CE[6], a concentration of OHPs in urban areas,[23] insufficient governmental support, unsustainable resources allocated to oral health promotion,[24] and community members poor knowledge and negative attitudes towards oral health, which are deeply rooted in cultural beliefs.[25]

Furthermore, these communities frequently encounter significant obstacles in accessing and utilizing high-quality public oral health services.[26] In Limpopo Province, SA, approximately 67.5% of the rural population lives in poverty, rendering it the most socioeconomically disadvantaged province in the country[27]. Consequently, dental extractions account for approximately 85% of oral health services in the province, attributable to several factors. These factors include a shortage of OHPs, poor supportive policy frameworks, lack of financial resources, and poor representation of oral health in the healthcare system[28]. Additionally, the ineffective implementation of community outreach programs is primarily due to a lack of dental equipment and materials, coupled with a deficiency in mobile oral health services and inadequate infrastructure[28–30]. Furthermore, there is a noticeable trend of community dentistry specialists relocating from rural to metropolitan areas,[12] while facility managers have not effectively promoted these programs, largely due to their limited oral health knowledge.[30]

To address these challenges, there is an increasing global demand for strategies to reduce the prevalence of oral diseases, particularly in rural communities. These strategies include, but are not limited to, the adoption of e-health approaches[31–33], implementation of interprofessional and collaborative practice[15,33–35], introduction of incentives for OHPs for rural practice[6,36–38], and training and distribution of CHWs[16,39,40]. Despite these initiatives, OHPs are still heavily burdened by the high prevalence of oral diseases in rural communities. Therefore, this study aimed to explore the knowledge, perceptions, and practices of OHPs regarding OHCEAs in the Vhembe District of Limpopo Province.

METHODOLOGY

Study design and setting

This mixed-methods cross-sectional study was conducted to investigate the extent of OHPs' knowledge, perceptions, and practices related to OHCEAs, which are integral to promoting oral health in rural communities. The study was conducted in the Vhembe district, one of the five districts in Limpopo Province in SA. The study population was drawn from 12 healthcare facilities, including seven hospitals and five community health centers, all of which provided oral healthcare services to rural communities in the district.

Sampling and selection criteria

A whole population approach was used to identify the participants in the district. The study participants (n=32) comprised OHPs, including dentists (n=22), dental therapists (n=3), and oral hygienists (n=7) who provided oral health services in the district. The inclusion criteria for participation in the study were based on the assumption that all OHPs were engaging and interacting with rural community individuals in terms of oral health care service provision. The study excluded all professionals who did not consent to participate in the study.

Participant recruitment

Following the receipt of approval to conduct the study from the Human Resource Development Office of each healthcare facility, meetings were organized with OHPs. These meetings were led by clinical managers, who serve as the leaders of the oral health team at each facility, to apprise them of the study's objectives. The researcher ensured that information sheets, informed consent forms, and questionnaires were left with the clinical managers for distribution to those who were willing to participate. The researcher emphasized that participation in the study was entirely voluntary. Weekly follow-ups were done, and all signed informed consent forms and completed questionnaires were collected from the managers. Recruitment process was conducted between November 2023 and February 2024

Data collection

The self-administered questionnaire consisted of both open- and closed-ended questions, which were adapted from previous studies[30,41–43] and validated through pretesting to eliminate any ambiguities and refine the questions. The questionnaire included 24 questions systematically organized into two sections. The first section of the questionnaire focused on the demographic characteristics of the participants, including age, sex, profession, highest level of education, and experience in the public sector. The second section of the questionnaire was divided into three subsections: the first addressed knowledge, the second examined perceptions, and the third explored practices related to OHCEAs in the rural communities of the Vhembe district.

Knowledge-related questions included the following closed-ended questions: leadership and management ensure long-term sustainability of OHCEAs; OHCEAs supported by adequate infrastructure, financing, and resources; sufficient OHPs available to conduct OCHEAs; active availability of OHCEAs in surrounding rural communities; existence of other established oral health initiatives; lengthy implementation of OHCEAs in rural communities and monitoring and evaluation system. The question regarding the challenges experienced was open-ended.

Perception-related questions included the following closed-ended questions: OHCEAs increased oral health awareness among rural community members; healthcare facility managers prioritize oral health promotion through OHCEAs; sufficient support for OHPs development to conduct OHCEAs and OHCEAs as a long-term intervention strategy. The question on strategies that could be integrated to enhance the implementation of OHCEAs was open-ended.

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Practice-related questions included the following open-ended questions: What types of oral health services do OHPs provide during community engagement? What other strategies do you integrate in your facility that build up to advance OHCEAs in rural communities?

All closed-ended questions were structured using a Likert scale, allowing participants to indicate their level of agreement with the following options: (1) Strongly Agree, (2) Agree, (3) Unsure, (4) Disagree, and (5) Strongly Disagree. Similarly, all open-ended questions permitted participants to elaborate on their responses, thereby enabling them to express their perspectives and provide insights without any constraints. To ensure participant anonymity, each returned questionnaire was assigned an alphanumeric code (e.g., P1).

Data analysis

Close-ended data were first cleaned and coded and then each response to each question was captured onto an Excel spread sheet and analysed using the Statistical Package for Social Sciences (SPSS) Version 29.0 (IBM Corp, USA). The data analysis included descriptive statistics such frequencies, and percentages, which were used to describe the characteristics of the study participants, as well as Knowledge and Perceptions scores, and thereafter results are presented in tables.

Open-ended data were entered into an Excel spreadsheet. Thematic analysis was employed for the open-ended questions. The responses were initially read multiple times by the primary author to gain familiarity with the data (to establish connections within the data). For the subsequent steps, the data were uploaded into ATLAS.ti software (version 7.1.3) to facilitate coding and categorization, enabling assessment and comparison of emergent themes for possible associations, and to enhance the efficiency of the data analysis process. Confirmability was established by including actual verbatim quotations from the participants.

Ethical approval

Ethical approval was obtained from the Biomedical Research Ethics Committee at an institution of higher education and training in the Western Cape, SA (BM23/6/16) and the Limpopo Department of Health (LP_2023-10-006). Additionally, the Vhembe district municipality granted gatekeeper permission to recruit participants (S5/4/2/3). An information sheet detailing the purpose of the study was distributed to all participants, and informed consent was obtained from all participants who agreed to participate in the study. The participants were informed that they could withdraw from the study at any time, without penalty. The institution's name and data were anonymized to ensure confidentiality. Data reporting was conducted with caution to safeguard participants' identities. The raw data were securely stored in a locked cupboard, and the electronic data were protected by passwords, with access restricted to the researchers.

RESULTS

Demographic characteristics of participants

The study achieved a complete response rate of 100% (n=32). Approximately 37.5% of the participants were aged between 35 and 40 years old. Most participants were male (59.4%). The predominant professional background of the participants was dental surgery, with 68.8% identifying as dental surgeons. Furthermore, 59.4% of the participants held BDS/BChD degrees as their highest level of education. Slightly more than half (53.1%) of the participants reported possessing 5–10 years of experience in public sector. Other demographic characteristics of participants are listed in Table 1.

Table 1. Demographic characteristics of participants

Variables		n	%
Age ranges	23-28 years	3	9,4%
	29-34 years	11	34,4%
	35-40 years	12	37,5%
	41> years	6	18,8%
Gender	Female	13	40,6%
	Male	19	59,4%
Profession	Dental Surgeon	22	68,8%
	Dental Therapist	3	9,4%
	Oral Hygienist	7	21,9%
Highest level of education	BDS/BChD	19	59,4%
	BDT	1	3,1%
	MDS/MSc	1	3,1%
	MPH	1	3,1%
	OH/BoH	6	18,8%
	PG Dip Dent	3	9,4%
	PG Dip Public Health	1	3,1%
Experience in Public Sector	0-5 years	5	15,6%
	5-10 years	17	53,1%
	10-20 years	6	18,8%
	20>	4	12,5%

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Knowledge

More than half (59.4%) of the participants disagreed that leadership and management support for the long-term viability of the OHCEAs in promoting oral health in rural communities existed. Furthermore, an overwhelming majority of participants (90.1%) disagreed that there was adequate infrastructure, financing, and other resources necessary to support these activities (Table 2).

In response to whether there were sufficient OHPs to conduct OHCEAs in rural communities, the majority (71.9%) of the participants disagreed with the distribution of such personnel. This shortage posed a challenge to surrounding rural communities, as more than half (56.3%) of the participants disagreed that OHCEAs were actively available in these settings.

More than half (59.4%) of the participants agreed that there are other established oral health initiatives that promoted oral health in rural communities. Furthermore, 43.7% of the participants agreed that these initiatives had been implemented in rural communities for a longer period. However, almost half (46.9%) of the participants were uncertain about the monitoring and evaluation of all these initiatives.

Several emerging themes were identified in response to the following question: What challenges do you experience in implementing OHCEAs? Table 3 shows the themes and subthemes of the challenges experienced by OHPs in implementing OHCEAs.

Table 3: Challenges experienced by OHPs in implementing OHCEAs.

Themes	Sub-themes
Resource constraints, infrastructure, and transportation challenges	• Shortage of OHPs • Lack of financial support for OHCEAs • Lack of mobile health services • Geographical isolation of communities
Oral health policy	• Inadequate PHC facilities for OHCEAs • Lack of clear guidelines for OHCEAs
Intrinsic determinants of oral health	• Lack of oral health knowledge • Lack of community interest and participation to OHCEAs
Administrative and organizational challenges	• Lack of leadership and advocacy for oral health • Lack of staff development and training for community health

Resource constraints, infrastructure, and transportation challenges

Participants highlighted that the scarcity of OHPs poses a significant barrier to the effective implementation of OHCEAs designed to promote oral health in rural communities.

"There are very limited resources, particularly dental professionals, available in order to provide wholesome community engagement initiatives" (P27)

Participants indicated that insufficient financial support constrains OHPs' capacity to expand their reach and effectively engage with underserved communities through OHCEAs

Table 2: Knowledge of OHCEAs for rural communities

Knowledge	Strongly Agree n (%)	Agree n (%)	Not Sure n (%)	Disagree n (%)	Strongly Disagree n (%)
Leadership and management promote oral health by ensuring the long-term sustainability of OHCEAs in rural communities.	0 (0%)	12 (37.5%)	1 (3.1%)	7 (21.9%)	12 (37.5%)
These initiatives are supported by adequate infrastructure, financing, and other resources.	1 (3.1%)	1 (3.1%)	1 (3.1%)	18 (56.3%)	11 (34.4%)
There are sufficient OHPs available to promote oral health through OHCEAs in rural communities.	4 (12.5%)	2 (6.3%)	3 (9.4%)	18 (56.3%)	5 (15.6%)
In the surrounding rural communities, OHCEAs are actively available.	0 (0%)	7 (21.9%)	7 (21.9%)	15 (46.9%)	3 (9.4%)
Other established oral health initiatives also exist that promote oral health in these communities.	4 (12.5%)	15 (46.9%)	5 (15.6%)	8 (25.0%)	0 (0%)
These have been implemented in rural communities for an extended period of time.	1 (3.1%)	13 (40.6%)	6 (18.8%)	10 (31.3%)	2 (6.3%)
There is a system in place for the monitoring and evaluation of these activities.	1 (3.1%)	6 (18.8%)	15 (46.9%)	10 (31.3%)	0 (0%)

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"Lack of financial support to make those initiatives possible on a large scale and this leaves the practitioners not functioning fully" (P13)

Participants emphasized the need for mobile oral health services in rural communities, noting that the current mobile dental units are frequently in substandard condition. This challenge impedes service delivery and restricts the implementation of OHCEAs beyond teeth extractions.

"Lack of functional mobile clinic to service remote areas, when we do go, we only offer single treatment to the patients which is only extractions" (P22)

Participants highlighted geographical isolation as a major challenge in implementing effective OHCEAs. They emphasized that the remote locations required significant travel over long distances on bad roads to reach the nearest community.

"We have challenges with transportation to go to the communities, particularly regarding distance and bad roads which makes us compromise the service provision" (P23)

Oral health policy

Participants expressed the necessity of revising oral health policy to improve the integration of oral health services into PHC. This need arises from the existing inadequacies in PHC facilities, which currently hinder the effective organization and implementation of OHCEAs aimed at promoting preventive oral health.

"Lack of infrastructure, such as not having a good physical structures, such as primary health care facilities that support oral health" (P14)

The need for guiding principles in community oral health initiatives, particularly concerning the implementation of OHCEAs in rural communities, remains a significant challenge. It has been identified as both relevant and essential for adoption to establish a framework for oral health promotion, as current initiatives are sporadic and typically conducted as and when.

"Lack of proper strategy to reach out to the communities. We do not have any guidelines or strategies other than conducting oral health awareness campaigns during oral health months" (P26)

Community members knowledge and attitude

Participants identified poverty as a significant barrier to the effective implementation of OHCEAs because of its substantial impact on educational attainment. Limited access to educational opportunities leads to low health literacy, resulting in poor oral health knowledge uptake. This challenge is central to the low participation rates in the OHCEAs.

"Lack of knowledge about oral health as they are people who are poor…" (P31)

"Lack of basic education that can help enhance oral health education" (P24)

Participants observed that community members held unfavourable perspectives regarding oral health, emphasizing the need for a paradigm shift to stress the significance of oral health and its association with overall health. This concern has been recognized due to strong cultural beliefs, inadequate response and low participation rate in OHCEAs.

"Oral health is not seen as a priority. There is a lack of interest and participation from community members, their turn up is low and they do not find it necessary to listen to us and practice what we teach them. Communities strongly guided by cultural beliefs" (P16)

Administrative and organizational challenges

Participants highlighted a significant lack of advocacy for oral health, as healthcare services predominantly focus on medical care, neglecting the integration of OHCEAs. This persistent fragmentation within healthcare services fosters the misconception that oral health is separate from overall health and well-being.

"Lack of support from the district leadership including facility managers because they prioritize medical care instead" (P29)

Participants expressed the need for additional training and development for OHPs to enhance their competencies in community health services, particularly for the effective implementation of OHCEAs. Nonetheless, a significant challenge persists owing to insufficient leadership support for professionals seeking to acquire these skills.

"Strengthen oral health services by training dental professionals for community services" (P08)

"Lack of interest from government in terms of staff support, growth and involvement…" (P09)

Perceptions

When asked for their opinions, half (50%) of the of the participants agreed that the introduction of OHCEAs increased awareness of oral health among rural community members. In contrast, one-fourth (25%) of the participants remained uncertain about its impact. In response to whether healthcare facility managers prioritize oral health promotion through OHCEAs in rural communities, nearly half (46.9%) of the participants expressed disagreement (Table 4).

Table 4: Perceptions of OHCEAs rural communities

Perceptions	Strongly Agree n (%)	Agree n (%)	Not Sure n (%)	Disagree n (%)	Strongly Disagree n (%)
I believe that the introduction of OHCEAs has increased rural community members awareness of oral health.	5 (15.6%)	11 (34.4%)	8 (25,0%)	8 (25.0%)	0 (0%)
I believe that healthcare facility managers prioritize oral health promotion through OHCEAs in rural communities.	3 (9.4%	11 (34.4%)	3 (9.4%)	13 (40.6%)	2 (6.3%)
I believe that there is sufficient support for OHPs (e.g., staff development) to conduct OHCEAs.	1 (3.1%)	1 (3.1%)	2 (6.3%)	18 (56.3%)	10 (31,3%)
I believe that OHCEAs in rural communities are a long-term and ongoing intervention strategy.	5 (15.6%)	20 (62.5%)	2 (6.3%)	3 (9.4%)	2 (6.3%)

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Regarding the availability of staff support, a significant majority (87.6%) of participants expressed disagreement with the assertion that adequate support was provided for further training in oral health. A significant proportion (78.1%) of participants expressed agreement with the assertion that OHCEAs in rural communities constitute a long-term and on-going intervention strategy.

Several emerging themes were identified in response to the following question: What strategies do you think can be integrated to enhance implementation of OHCEAs in rural communities? Table 5 shows the themes and sub-themes of strategies to enhance implementation of OHCEAs in rural communities.

Table 5: Strategies to enhance implementation of OHCEAs in rural communities.

Themes	Sub-themes
Integrated oral health	• Interprofessional practice
Community services	• Community oral health workers
e-health adoption	• Communication technology
Community leaders' involvement	• Engaging community leaders

Integrated oral health

Participants demonstrated a strong belief in the importance of an integrated approach to oral health, highlighting the need to introduce oral health education training for nurses. This initiative aims to foster interprofessional practice, a collaboration that believed to have potential to improve OHCEAs and consequently improve overall health and well-being.

"Education facility managers e.g., Nurses particularly in PHC/CHC about the importance of oral health and the emphasis of how oral health relates and directly affects overall general health, so that we can work hand in hand" (P07)

Community services

Participants believed that there is a critical need for the training and deployment of community oral health care workers to enhance collaboration, bridge the gap between rural communities and OHPs, and facilitate the implementation of OHCEAs. These workers are believed to be deeply connected with the communities and are knowledgeable about of local contexts.

"By training and placing community oral health workers in the deep rural areas, as oral health professionals can work with them in the promotion and awareness of oral health…they knowledgeable about the communities" (P27)

e-Health adoption

The adoption of e-health, particularly integration of communication technologies such as the WhatsApp mobile application, is considered by participants as a promising strategy for engaging and reaching members of rural communities. The participants believed that this method could enhance the implementation of OHCEAs, thereby improving oral health promotion.

"Improving our ways of reaching people…there can be WhatsApp groups created in the communities to convey messages when the oral health outreach personnel go for visits so that people can be there in numbers" (P16)

Community leaders' involvement

Participants believed that rather than imposing community oral health interventions, a more effective strategy might involve consistent meetings with community leaders to introduce oral health in a broader context. This strategy can improve community members' participation in OHCEAs.

"Organise and conduct frequent community meetings which involve community leaders and introduce them to oral health education" (P02)

Practices

An emerging theme was identified in response to the following question: What types of oral health services do OHPs provide during community engagement?

Curative care approach

Participants reported performing more dental extractions than any other dental procedure, and this is often at the request of patients, which impedes OHPs from implementing preventive and promotive measures through OHCEAs.

"Extraction of teeth is done more than preventing and promote oral health services" (P08)

"…unless we are providing extractions, they are not interested in any other procedure or even oral health education and screening" (P27)

Two emerging themes were identified in response to the following question: What other strategies do you integrate in your facility that build up to advance OHCEAs in rural communities? Table 6 shows strategies advancing OHCEAs

Table 6: shows strategies advancing OHCEAs

Themes	Sub-themes
Awareness campaign	• Mass media campaigns e.g., Radio broadcasting • National oral health month
Preventive measure	• Screening, education, and referrals

Awareness campaign

The participants indicated the incorporation of mass media campaigns to advance oral health. This medium facilitates communication between OHPs and community members, thereby enhancing the dissemination of oral health information and increasing participation in OHCEAs through community radio stations.

"Getting word out there, through health talks e.g., a session at a community radio station to have oral health talks where people can also call and ask advice" (P16)

Participants highlighted leveraging national oral health month as a strategic opportunity to promote OHCEAs and encourage community members to prioritize oral health. This initiative emphasizes the significance of preventive and promotional strategies for enhancing oral health outcomes.

"We extend oral health services during oral health month" (P08)

Preventive measures

Participants noted their involvement in delivering various oral health services, with a particular focus on preventive strategies

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such as screenings, oral health education, and referrals within healthcare settings. These efforts are supplementary activities designed to bolster OHCEAs, typically executed by dentists and oral hygienists.

"Oral hygienist in PHC in the rural communities provide oral health screenings, education, referrals, while Dentist provide extractions, oral health education, and screenings at various clinics" (P26)

DISCUSSION

The aim of this study was to explore the knowledge, perceptions, and practices of OHPs regarding OHCEAs using a mixed-method approach guided by closed and open-ended self-administered questionnaires. Mixed-method research provides a robust framework for exploring complex problems by combining the strengths of both quantitative and qualitative approaches within a single study.[44,45] As a result, a mixed-methods approach was utilized in this study to allow the researchers to gain a more detailed and nuanced understanding of OHCEAs in rural communities among OHPs. As a result, this study holds significant potential to inform OHPs, administrative structures (facility, district, and provincial managers), dental education, and policymakers in the pursuit of the SDGs and UHC. It can also serve as a beneficial resource for other districts seeking to implement OHCEAs in their oral health initiatives, particularly considering the current numerous challenges faced nationwide.

Knowledge

Overall, the participants in this study exhibited sound knowledge of OHCEAs for oral health promotion in rural communities, with more than half (56.3%) disagreeing about the active availability of OHCEAs in the surrounding communities. This finding aligns with a recent review study that highlighted a lack in the effective implementation of OHCEAs in rural communities, attributed to a lack of knowledge regarding its content and a poor understanding of its impact.[24] This issue may stem from OHPs' lack of comprehensive undergraduate training in community engagement and service learning[6].

Furthermore, the findings of this study indicated that nearly half (46.9%) of the participants expressed uncertainty regarding the monitoring and evaluation of oral health service delivery, including OHCEAs. This finding is not unexpected, given that slightly more than half (53.1%) of the participants had work experience ranging from 5 to 10 years. This duration is considerably shorter than the period since the national oral health survey was conducted,[6,46] thereby suggesting that these participants may not recognize its significance in terms of facilitating informed decision-making, resource distribution, monitor progress, identify key performance for improvement, and ensure accountability.[47]

However, these participants identified the challenges that impede effective implementation of OHCEAs in rural communities. For instance, this study revealed that resource constraints remain a significant challenge, with 90.1% of participants disagreeing that there was adequate infrastructure, financing, and other resources necessary to support OHCEAs, and 71.9% of participants disagreed that there was a sufficient distribution of OHPs to conduct these activities. These oral health challenges are not unexpected; rather, they have progressed beyond the stage of novelty, yet they continue to afflict individuals worldwide.[48–51]

Amid these constraints, mobile oral healthcare services have the potential to broaden the reach and accessibility of oral health services in rural communities. These services are particularly advantageous for socioeconomically disadvantaged populations.[52–54] However, the findings of the present study indicate a lack of availability of these services, with participants reporting infrequent maintenance and suboptimal conditions of mobile dental units. Additionally, participants highlighted the considerable challenge posed by the necessity of traveling long distances on poorly maintained roads, which impedes the effective implementation of OHCEAs. This observation aligns with previous studies that identified geographical location[55] and inadequate road infrastructure[56] as obstacles to accessing oral healthcare.

Following years of neglect and inadequate attention from policymakers concerning the review and amendment of the national oral health policy, a recent update from the Ministry of Health highlighted the need to integrate oral health care into PHC and chronic disease management.[6] However, the strategies to achieve this integration remain ambiguous.[6,14–16,57] The present study reflects this ambiguity, as the participants emphasized the absence of guiding principles for the implementation of OHCEAs, resulting in their sporadic execution. Additionally, participants noted a lack of suitable PHC facilities to address the oral healthcare needs of the rural population and support the establishment of OHCEAs for oral health promotion. In light of these challenges, the pursuit of SDGs and UHC in oral health remains elusive and seemingly unattainable in rural communities.

The findings of this study revealed that a low level of basic education leads to low health literacy and influences the uptake of oral health education among the rural population. This finding aligns with a previous study that demonstrated that rural communities are frequently linked with lower educational attainment, which has been associated with low health literacy and suboptimal utilization of healthcare services.[58] Moreover, the findings of this study demonstrated that community members had poor attitudes towards oral health, which led to a low participation rate in OHCEAs. Similar studies have paralleled this finding by indicating that urban populations demonstrate positive attitudes towards oral health and possess higher level of understanding of oral diseases than their rural counterparts.[59–61]

The absence of leadership and advocacy in oral health is not merely an administrative oversight at the provincial or district level; rather, it reflects systemic issues within the broader healthcare system at the macro level. This challenge became apparent when oral health was excluded from the SA public health agenda, particularly during discussions on the National Health Insurance Bill.[6] Consequently, it was unsurprising that the findings of this study revealed fragmentation at the district level, where medical care was reported to be more prioritized. This finding aligns with previous studies that noted the exclusion of oral health from discussions on UHC and regarded it as a low priority.[62,63] This prioritization perpetuates the flawed notion that dentistry is an ancillary branch of healthcare.[64]

Perceptions

A study conducted in Saudi Arabia indicated that oral health providers perceived community oral health initiatives as instrumental in fostering positive oral health attitudes and

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behaviours within society.[65] This observation aligns with the findings of the current study, which revealed that half (50%) of the participants believed that the introduction of OHCEAs enhanced awareness of oral health among rural community members. Niranjan et al.[66] emphasized the importance of disease prevention over treatment, positing that the promotion of oral health is a gradual process rather than one that produces immediate results. This perspective is consistent with the findings of the current study, wherein the majority (78.1%) of participants perceived OHCEAs in rural communities as a long-term and continuous strategy for promoting oral health. A recent study demonstrated that OHCEAs enhance CE, improve oral health knowledge, attitudes, and behaviours, and effectively promote long-term oral health in rural communities.[24]

This study highlights the critical need to adopt the WHO's recommendations for interprofessional education & collaborative Practice in healthcare. This approach aims to address the isolation often observed in professional practice, which tends to operate independently or competitively, thereby fostering collaborative efforts to enhance healthcare delivery,[67] particularly among rural healthcare professionals. Prior studies have indicated that this approach yields positive outcomes in healthcare delivery, such as mitigating fragmented care practices, reducing unnecessary duplication of health services, enhancing effective communication among healthcare professionals, and improving the coordination and quality of patient care.[68–70] The results of this study resonate with these findings, as the participants believed that further oral health educational training for healthcare professionals, particularly nursing professionals, could facilitate the adoption of this approach and improve collaborative healthcare service delivery, particularly for the effective implementation of OHCEAs.

Makgetla and Molete[71] endorsed the utilization of CHWs, emphasizing the necessity of comprehensive training to enable them to effective participation in oral health promotion and disease prevention. This community oral health service interventional approach aligns with the views expressed by Kolisa,[15] Ramphoma,[16] and Khan.[72] The findings of this study align with preceding views, as participants believed that there is a critical need for the training and deployment of CHWs to enhance collaboration and bridge the gap between rural communities and OHPs. This initiative will facilitate the implementation of OHCEAs in rural communities.

While further prospective studies, clinical trials, and cost analyses are necessary to fully understand the impact of e-oral health in rural communities, current evidence indicates that e-oral health is linked to enhanced patient satisfaction and serves as an effective and dependable approach[73] and has been recognized as a potential intervention to enhance oral health in rural communities.[66] Considering the aforementioned resource constraints, including geographical isolation, the study participants believed that the implementation of e-health, particularly through the integration of communication technologies such as the WhatsApp mobile application, can enhance engagement and facilitate outreach for rural communities, thereby improving oral health outcomes. This mobile application adoption has proven to promote oral health in various regions.[74–76]

The findings of this study suggest that participants believed that, instead of imposing community oral health interventions, engaging in frequent and continuous consultations with community leaders to introduce oral health initiatives and emphasize their significance may be a more effective approach for increasing the reception of OHCEAs in rural communities for oral health promotion. This approach takes into an account the preceding findings regarding poor attitudes towards oral health and cultural entrenchment. The rationale for this approach may have been shaped by multiple factors, such as the acknowledgment of these cadres as pivotal gatekeepers within their communities.[77] They function as liaisons between their communities and external entities, thereby enhancing access to resources and information.[78,79] Furthermore, they have the authority to shape community health beliefs.[80]

Practices

The WHO advocates for interventions specifically designed to meet the unique needs of communities. This approach highlights the significance of comprehending local contexts, behaviours, and cultural nuances to enhance health outcomes. By utilizing insights derived from behavioural and cultural studies, the WHO advocates for customizing services, policies, and communication strategies to effectively address the different needs of different populations.[81] Previous studies have shown that customizing strategies to engage and communicate with communities through radio can lead to beneficial outcomes. These outcomes include improved recall of campaigns,[82] a greater increase in oral health knowledge among adults than among children[83] and heightened awareness of periodontal health and disease.[84] The findings of this study revealed that participants integrated mass media campaigns, such as radio broadcasting, into their awareness efforts to connect with communities, with the objective of raising oral health awareness and advancing OHCEAs in rural settings.

Moreover, this study highlights the need to implement innovative strategies to promote oral health in a cost-effective manner, advance OHCEAs, and incorporate community volunteer peer-led initiatives, given the constraints posed by resource shortages.[85] Although the study identified that participants utilized National Oral Health Months to promote OHCEAs, it remains uncertain whether such opportunities will consistently be available, as these activities occur sporadically.[24] In addition to the already overburdened district health system,[86] there remains a significant shortage of dental therapists, as this study indicated that oral health services are predominantly provided by dentists and oral hygienists, focusing primarily on daily screening, education, and referral. Amidst the national difficulties related to the referral system,[87] dental extraction remains the most frequently conducted procedure, while regular screening seems to lack effectiveness.

Study limitations

This study provides baseline data that can be used to develop a framework to guide oral health promotion in rural communities. Additionally, it can contribute to the restructuring of district healthcare services. However, this study had several limitations. The participants' keenness to participate in the study may have been influenced by their lengthy experience with the challenges inherent in the district healthcare system. Consequently, self-reported data may be subject to social desirability bias, which could compromise validity of the findings. The primary author may have had a significant influence on the study due to their strong interest

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in the topic, potentially introducing bias in the formulation of research questions. The study's focus on a single district introduced potential bias, as it may not fully represent the diversity of the entire province. However, considering that the majority of participants faced similar challenges and likely had analogous oral health-related demands, the findings of the study may be applicable to other national districts.

CONCLUSION

The overall findings of this study revealed that OHPs are aware of the merits and impacts of OHCEAs as well as limitations hindering their effective implementation. In addition, the professionals show positive perspectives of OHCEAs, believing that their district healthcare system has potential to support strategies that would improve OHCEAs' implementation for health oral health promotion. However, their practices are limited to curative care services, hindering effective implementation of OHCEAs. This is due to various challenges stemming from public healthcare system levels. At the micro-level, challenges include community knowledge and attitudes, cultural beliefs, and poor reception of OHCEAs. At the meso-level, issues arise from poor oral health policy implementation, lack of interprofessional and collaborative practice, and dental education training, particularly regarding the inadequate preparation of graduates to conduct CE. At the macro-level, obstacles include the lack of national oral health policy amendments, lack of oral health representation in ministerial health discussions, and poor resource distribution. These challenges impede the realization of the SDGs and UHC, continuing unabated even though the WHO has characterized the situation of oral health as "alarming" and has called for prompt intervention from all relevant stakeholders.[48]

DECLARATION

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Conflict of interest

The authors declare that there is no conflict of interest.

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REFERENCES

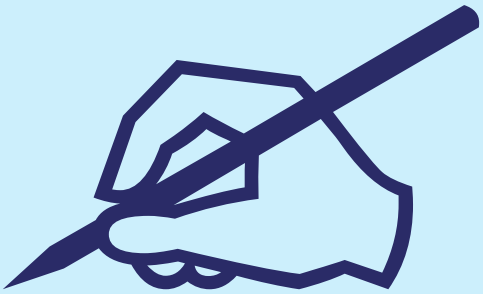
1. Petersen PE, Kwan S. The 7th WHO Global Conference on Health Promotion-Towards Integration of Oral Health, Nairobi, Kenya, 26-30 October 2009.
2. Vujicic M, Atun R, Benzian H, Listl S, Ryan M, Tsakos G. The economic rationale for a global commitment to invest in oral health. InWorld Economic Forum. White paper. May 2024.
3. World Health Organization. Oral Health [internet]. Geneva: WHO [cited 2025 April 02]. Available from: https://www.who.int/health-topics/oral-health#tab=tab_1
4. Kassebaum NJ, Smith AGC, Bernabé E, Fleming TD, Reynolds AE, Vos T, et al. GBD 2015 Oral Health Collaborators. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. J Dent Res. 2017; 96(4):380-7.
5. Regional Committee for Africa, 66. Regional oral health strategy 2016–2025: addressing oral diseases as part of noncommunicable diseases: report of the Secretariat. World Health Organization. Regional Office for Africa, 2016
6. Naidoo S, Benzian H. Decades of neglect: Oral health crisis demands urgent policy reform and action [Internet]. South Africa: Daily Maverick; [posted 2025 March 25; cited 2025 April 02]. Available from: https://www.dailymaverick.co.za/article/2025-03-20-decades-of-neglect-oral-health-crisis-demands-urgent-policy-reform-and-action/
7. World Health Organization. Oral Health South Africa 2022 country profile [internet]. South Africa: WHO; [cited 2025 April 02]. Available from: https://cdn.who.int/media/docs/default-source/country-profiles/oral-health/oral-health-zaf-2022-country-profile.pdf?sfvrsn=a28a9d3d_7&download=true
8. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. Int Dent J. 2006; 56(2): 61-70.
9. Wetterhall S, Burrus B, Shugars D, Bader J. Cultural context in the effort to improve oral health among Alaska Native people: the dental health aide therapist model. Am J Public Health. 2011; 101(10): 1836-40.
10. Coovadia H, Jewkes R, Barron P, Sanders D, McIntyre D. The health and health system of South Africa: historical roots of current public health challenges. Lancet. 2009; 374(9692): 817-34.
11. Department of Health. Annual Report 2013/14. Pretoria: DoH; 2014
12. Ramphoma KJ. Oral Health in South Africa: Exploring the role of dental public health specialists. South African Dental Journal. 2016; 71(9): 402-3.
13. Health Professions Council of South Africa. Health Professions Council of South Africa Annual Report 2023/2024. Pretoria: HPCSA; 2024
14. Mukhari-Baloyi NA, Bhayat A, Madiba TK, Nkambule NR. A review of the South African national oral health policy. South African Dental Journal. 2021; 76(9): 551-7.
15. Kolisa Y. Assessment of oral health promotion services offered as part of maternal and child health services in the Tshwane Health District, Pretoria, South Africa. Afr J Prim Health Care Fam Med. 2016; 8(1): e1-8.
16. Ramphoma K, Rampersad N, Singh N, Mukhari-Baloyi N, Naidoo S. The proposed need for integrated maternal and child oral health policy: A case of South Africa. Front Oral Health. 2022; 3: 1023268.
17. Thema LK, Singh S. Integrated primary oral health services in South Africa: The role of the phc nurse in providing oral health examination and education: Open forum. African Journal of Primary Health Care and Family Medicine. 2013; 5(1): 1-4.
18. World Health Organisation. Increasing access to health workers in remote and rural areas through improved retention: Global policy recommendations. Geneva: WHO; 2010
19. World Health Organization. WHO community engagement framework for quality, people-centred and resilient health services. Geneva: WHO; 2017
20. World Health Organization. Community engagement: a health promotion guide for universal health coverage in the hands of the people. Geneva: WHO; 2020
21. Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. Int Dent J. 2003; 53(5): 285-8.
22. World Health Organization. WHO Discussion Paper: Draft Global Oral Health Action Plan (2023-2030). Geneva: WHO; 2022
23. Ogunbodede EO, Kida IA, Madjapa HS, Amedari M, Ehizele A, Mutave R, Sodipo B, Temilola S, Okoye L. Oral Health Inequalities between Rural and Urban Populations of the African and Middle East Region. Adv Dent Res. 2015; 27(1): 18-25.
24. Nghayo HA, Palanyandi CE, Ramphoma KJ, Maart R. Oral health community engagement programs for rural communities: A scoping review. PLoS One. 2024; 19(2): e0297546.
25. Folàyan MO, Bernard OT, Titus OS, Alade O, Aliyu TK, Bhayat A, Ndembi N, Fasiku G, El Tantawi M. Cultural practices, oral health service utilisation and oral health policy and guidelines development in Africa: insights from the yorùbá ethnic group. Front Oral Health. 2025; 6: 1539827.
26. Lambert RF, Yu A, Orrell C, Haberer JE. Perceived oral health interventions by medical providers in Gugulethu, South Africa. PLoS One. 2020; 15(5): e0233437.
27. Statistics South Africa. Five facts about poverty in South Africa [Internet]. South Africa: StatsSA [cited 2025 April 03]. Available from: https://www.statssa.gov.za/?p=12075
28. Thema KL, Singh S. Oral health service delivery in Limpopo Province. South African Dental Journal. 2017; 72(7): 310-4.
29. Thema LK, Singh S. Epidemiological profile of patients utilising public oral health services in Limpopo province, South Africa. Afr J Prim Health Care Fam Med. 2017; 9(1): e1-e5.
30. Thema L, Singh S. A conceptual framework to guide public oral health planning in Limpopo province. Health SA. 2019; 24: 1109.
31. World Health Organization. Improving oral health through use of digital technology [Internet]. Geneva: WHO; [cited 2025 April 03]. Available form: https://www.who.int/news/item/17-09-2021-improving-oral-health-through-use-of-digital-technology
32. Emami E, Kadoch N, Homayounfar S, Harnagea H, Dupont P, Giraudeau N, Mariño R. Patient satisfaction with E-Oral Health care in rural and remote settings: a systematic review protocol. Syst Rev. 2017; 6(1): 174.
33. Chew C, Rosen D, Watson K, D'Alesio A, Ellerbee D, Gloster J, et al. Implementing a Community Engagement Model to Develop a Community-Driven Oral Health Intervention. Prog Community Health Partnersh. 2024; 18(1): 67-77.
34. McNeil DW, Pereira DB, Ensz OS, Lukose K, Harrell G, Feller DB. Toward a Comprehensive Model of Medical-Dental-Behavioral Integration. JDR Clin Trans Res. 2024; 9(1_suppl): 23S-31S.
35. FDI World Dental Federation. Optimal oral health through inter-professional education and collaborative practice. Geneva: FDI World Dental Federation; 2015
36. Noochpoung R. The Impact of Financial Incentives on Urban-Rural Disparities in Dental Supply: Evidence from Thailand (Doctoral dissertation, University of South Carolina).
37. Luo H, Moss ME, Basu R, Grant FT. Rural-Urban Differences in Use of Dental Services and Procedures Among Medicare Beneficiaries in 2018. Public Health Rep. 2023; 138(5): 788-795.
38. Dewanto I, Koontongkaew S, Widyanti N. Characteristics of Dental Services in Rural, Suburban, and Urban Areas Upon the Implementation of Indonesia National Health Insurance. Front Public Health. 2020; 8: 138.
39. Barnett T, Hoang H, Stuart J, Crocombe L. Non-dental primary care providers' views on challenges in providing oral health services and strategies to improve oral health in Australian rural and remote communities: a qualitative study. BMJ Open. 2015; 5(10): e009341.
40. Eskandari A, Abolfazli N, Lafzi A, Golmohammadi S. Oral Health Knowledge and Attitudes of Community Health Workers in East Azerbaijan, Iran. J Dent (Shiraz). 2016; 17(4): 297-300.
41. Reddy M, Singh S. Viability in delivering oral health promotion activities within the Health Promoting Schools Initiative in KwaZulu-Natal. South African Journal of Child Health. 2015; 9(3): 93-7.
42. Reddy M, Singh S. The promotion of oral health in health-promoting schools in KwaZulu-Natal Province, South Africa. South African Journal of Child Health. 2017; 11(1): 16-20.
43. Glassman P, Harrington M, Namakian M. Promoting oral health through community engagement. Journal of the California Dental Association. 2014; 42(7): 465-70.
44. Venkatesh V, Brown SA, Bala H. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. MIS quarterly. 2013; 1: 21-54.
45. Dawadi S, Shrestha S, Giri RA. Mixed-methods research: A discussion on its types, challenges, and criticisms. Journal of Practical Studies in Education. 2021; 2(2): 25-36.
46. The National Department of Health Report: National Children's Oral Health Survey. South Africa; 2003; 1-18
47. Verdugo-Paiva F, Urquhart O, Matanhire-Zihanzu CN, Martins-Pfeifer CC, Booth E, Booth HA, et al. Barriers to and facilitators for creating, disseminating, implementing,

www.sada.co.za / SADJ Vol. 81 No.3
https://doi.org/10.17159/sadj.v81i03.21938

monitoring and evaluating oral health policies in the WHO African region: A scoping review. Community Dent Oral Epidemiol. 2024; 52(6): 775-785.
48. World Health Organization. Global oral health status report: towards universal health coverage for oral health by 2030. Geneva: WHO; 2022.
49. Boniol M, Kunjumen T, Nair TS, Siyam A, Campbell J, Diallo K. The global health workforce stock and distribution in 2020 and 2030: a threat to equity and 'universal' health coverage? BMJ Glob Health. 2022; 7(6): e009316.
50. Wen PYF, Chen MX, Zhong YJ, Dong QQ, Wong HM. Global Burden and Inequality of Dental Caries, 1990 to 2019. J Dent Res. 2022; 101(4): 392-399.
51. Jain N, Dutt U, Radenkov I, Jain S. WHO's global oral health status report 2022: Actions, discussion and implementation. Oral Dis. 2024; 30(2): 73-79.
52. Bourke L, Humphreys JS, Wakerman J, Taylor J. Understanding rural and remote health: a framework for analysis in Australia. Health Place. 2012; 18(3): 496-503.
53. Alston M. Globalisation, rural restructuring and health service delivery in Australia: policy failure and the role of social work? Health Soc Care Community. 2007; 15(3): 195-202.
54. Uguru N, Onwujekwe O, Ogu UU, Uguru C. Access to Oral health care: a focus on dental caries treatment provision in Enugu Nigeria. BMC Oral Health. 2020; 20(1): 145.
55. Vashishtha V, Kote S, Basavaraj P, Singla A, Pandita V, Malhi RK. Reach the unreached - a systematic review on mobile dental units. J Clin Diagn Res. 2014; 8(8): ZE05-8.
56. Patel J, Hearn L, Gibson B, Slack-Smith LM. International approaches to Indigenous dental care: what can we learn? Aust Dent J. 2014; 59(4): 439-45.
57. Molete M, Stewart A, Moolla A, Igumbor JO. Perceptions of provincial and district level managers' on the policy implementation of school oral health in South Africa. BMC Health Serv Res. 2021; 21(1): 18.
58. Booysen F, Burger R, Du Rand G, Von Maltitz M, Van Der Berg S. Trends in poverty and inequality in seven African countries [Internet]. SSRN Electronic Journal; [Published 2007 Jan 1; cited 2025 April 03]. Available from: https://doi.org/10.2139/ssrn.3173170
59. Kikwilu EN, Frencken JE, Mulder J. Utilization of toothpaste and fluoride content in toothpaste manufactured in Tanzania. Acta Odontol Scand. 2008; 66(5): 293-9.
60. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. Int Dent J. 2006; 56(2): 61-70.
61. Bayne A, Knudson A, Garg A, Kassahun M. Promising practices to improve access to oral health care in rural communities. Rural Evaluation Brief. 2013; 7: 1-6.
62. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of untreated caries: a systematic review and metaregression. J Dent Res. 2015; 94(5): 650-8.
63. Wang TT, Mathur MR, Schmidt H. Universal health coverage, oral health, equity and personal responsibility. Bull World Health Organ. 2020; 98(10): 719-721.
64. Wood NH. Reimagining dental care funding in South Africa: A call for equitable healthcare. South African Dental Journal. 2024; 79(5): 235-7.
65. Shubayr MA, Kruger E, Tennant M. Oral health providers' views of oral health promotion in Jazan, Saudi Arabia: a qualitative study. BMC Health Serv Res. 2023; 23(1): 214.
66. Niranjan VR, Kathuria V, Venkatraman J, Salve A. Oral Health Promotion: Evidence and Strategies. Insights into Various Aspects of Oral Health. IntechOpen. 2017; 10: 195-217.
67. World Health Organization. Framework for Action on Interprofessional Education & Collaborative Practice. Geneva: WHO, 2010.
68. Gilles I, Filliettaz SS, Berchtold P, Peytremann-Bridevaux I. Financial Barriers Decrease Benefits of Interprofessional Collaboration within Integrated Care Programs: Results of a Nationwide Survey. Int J Integr Care. 2020; 20(1): 10.
69. Ndibu Muntu Keba Kebe N, Chiocchio F, Bamvita JM, Fleury MJ. Profiling mental health professionals in relation to perceived interprofessional collaboration on teams. SAGE Open Med. 2019; 7: 2050312119841467.
70. Ho JT, See MTA, Tan AJQ, Levett-Jones T, Lau TC, Zhou W, Liaw SY. Healthcare professionals' experiences of interprofessional collaboration in patient education: A systematic review. Patient Educ Couns. 2023; 116: 107965.
71. Makgetla LM, Molete MP. The knowledge and participation of community health care workers in oral health promotion. South African Dental Journal. 2022; 77(2): 73-6.
72. Khan MA, Okeah BO, Mbivnjo EL, Kisangala E, Pritchard AW. The role of community health workers in oral health promotion and the impact of their services in sub-Saharan Africa: a systematic review. South African Dental Journal. 2022; 77(5): 284-93.
73. Emami E, Harnagea H, Shrivastava R, Ahmadi M, Giraudeau N. Patient satisfaction with e-oral health care in rural and remote settings: a systematic review. Syst Rev. 2022; 11(1): 234.
74. Pubalan S, Zi Hong O, Yongxian T, Mabel L. Assessing effectiveness of WhatsApp messaging program in oral hygiene care for orthodontic patients: A randomised controlled trial. J Orthod. 2024; 51(4): 407-14.
75. Wan Abd Manan WNH, Abg Abd Mohd Rizal DNS, Borhan FW, Lestari W, Ismail A, Che Musa MF, et al. Impact of WhatsApp on improving denture care knowledge and the awareness of the relationship between edentulism and general health. J Prosthet Dent. 2024; 29: S0022-3913(24)00740-6.
76. Al-Ak'hali MS, Halboub ES, Asiri YM, Asiri AY, Maqbul AA, Khawaji MA. WhatsApp-assisted Oral Health Education and Motivation: A Preliminary Randomized Clinical Trial. J Contemp Dent Pract. 2020; 21(8): 922-925.
77. Seale H, Harris-Roxas B, Heywood A, Abdi I, Mahimbo A, Chauhan A, Woodland L. The role of community leaders and other information intermediaries during the COVID-19 pandemic: insights from the multicultural sector in Australia. Humanities and Social Sciences Communications. 2022; 9(1). 1-7
78. Bénit-Gbaffou C, Katsaura O. Community Leadership and the Construction of Political Legitimacy: Unpacking B ourdieu's 'Political Capital'in Post-Apartheid Johannesburg. International Journal of Urban and Regional Research. 2014; 38(5): 1807-32.
79. Berenschot W. Informal democratization: brokers, access to public services and democratic accountability in Indonesia and India. Democratization. 2019; 26(2): 208-24.
80. Holden K, Akintobi T, Hopkins J, Belton A, McGregor B, Blanks S, Wrenn G. Community Engaged Leadership to Advance Health Equity and Build Healthier Communities. Soc Sci. 2016; 5(1): 2.
81. World Health Organization. A guide to tailoring health programmes: using behavioural and cultural insights to tailor health policies, services and communications to the needs and circumstances of people and communities. Copenhagen: WHO Regional Office for Europe; 2023
82. Goldberg E, Eberhard J, Bauman A, Smith BJ. Mass media campaigns for the promotion of oral health: a scoping review. BMC Oral Health. 2022; 22(1): 182.
83. Banakar M, Lankarani KB, Vali M, Tabrizi R, Taherifard E, Akbari M. The effect of mass media campaigns on oral health knowledge: A systematic review and meta-analysis. Int J Dent Hyg. 2024; 22(1): 15-23.
84. Gholami M, Pakdaman A, Montazeri A, Jafari A, Virtanen JI. Assessment of periodontal knowledge following a mass media oral health promotion campaign: a population-based study. BMC Oral Health. 2014; 14: 31.
85. Bhayat A, Chikte U. Human Resources for Oral Health Care in South Africa: A 2018 Update. Int J Environ Res Public Health. 2019; 16(10): 1668.
86. Barron P, Mahomed H, Masilela TC, Vallabhjee K, Schneider H. District Health System performance in South Africa: Are current monitoring systems optimal? S Afr Med J. 2023; 113(12): 13.
87. Matolengwe A, Murray D, Okafor UB. The Challenges of Implementing a Health Referral System in South Africa: A Qualitative Study. Risk Manag Healthc Policy. 2024; 17: 855-864.

CPD questionnaire on page 216

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



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Is there a Need for Analogue Imaging in the Modern Dental Radiology Curriculum? Use of Analogue and Digital Imaging in Gauteng, South Africa.

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ABSTRACT

Introduction

Digital radiographic dental imaging enhances diagnostic accuracy, patient care, and clinical efficiency; however, adoption remains uneven due to cost, access, and infrastructure constraints. In South Africa, limited data on imaging modalities in dental practice highlight the need to align dental curricula with contemporary clinical practice.

Aims and Objectives

To assess analogue and digital radiographic imaging use among dentists practising in Gauteng Province, which represents approximately 40% of the national dental workforce, and to determine the relevance of analogue imaging in the revised dental radiology curriculum.

Design

A descriptive, quantitative and cross-sectional research design was used.

Methods

An online questionnaire was distributed via REDCap® and Google Forms® to practising general dentists and dental specialists in Gauteng. Non-practising dentists were excluded.

Results

Of the 144 respondents, 77.8% were general dentists and 22.2% specialists with most (59.7%) practising in the private sector. Analogue intraoral imaging was more common in the public sector (38.7%) and teaching institutions (26.5%) than in individual (10.9%) or group practices (14.0%). Analogue panoramic imaging was reported by 7.7% of individual practices.

Conclusion

Analogue radiography has limited relevance in contemporary practice; therefore, dental radiology curricula should prioritise digital imaging, supported by foundational knowledge of analogue principles.

Keywords

dental radiography, dentist, imaging, dental specialist, curriculum

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INTRODUCTION

Dental radiography plays a pivotal role in the diagnosis, treatment planning, and monitoring of oral diseases and is thereby a fundamental component of the dentistry curriculum[1] Radiographic images may be obtained using either analogue or digital imaging equipment modalities, encompassing both intraoral and extraoral techniques. Digital imaging methods include direct digital imaging (DD), photostimulable phosphor plate systems (PSP), and indirect digital imaging. In DD imaging, a digital sensor captures and immediately displays the image on a workstation. PSP utilises phosphor plates to capture the X-ray image, which is later displayed as a digital image using a laser scanner.[2] In indirect digital imaging, the analogue film is converted into a digital image using a film digitiser, digital camera, or smartphone [3].

Over the past two decades, dental imaging has seen a significant evolution from traditional analogue systems to advanced digital radiography, which offers numerous benefits, including reduced radiation exposure and dose, faster image acquisition, and enhanced image manipulation capabilities.[4,5] Digital imaging also supports improved patient communication and satisfaction, as clinicians can directly display the patient's images and use various software tools to outline different treatment options.[6] This shift from analogue to digital imaging has transformed diagnostic workflows, enabling better patient care and integration with emerging technologies such as Computer-Aided Design/ Computer-Aided Manufacturing (CAD/CAM) and Artificial Intelligence (AI). However, there has been a notable disparity in the adoption of these digital dental imaging technologies into dental practices and training curricula, predominantly due to the noteworthy cost and infrastructure demands that digital imaging requires.[7–9]

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Advancements in technology necessitate that educators remain up to date with these developments to ensure that dental curricula remain aligned with current dental practices. In light of global trends, it is pertinent to question the continued inclusion of analogue imaging in the revised dental radiology curriculum and whether educational emphasis should instead be placed predominantly on digital imaging.[10–12] In Brazil, for example, only a limited number of universities provide access to digital radiology, and consequently, the use of analogue imaging methods remains prevalent.[13] This has led to a significant demand for the expansion of teaching and training in specialised digital technologies, such as CBCT and related software, at both undergraduate and postgraduate levels.[14]

Before revising the dental radiology curriculum, it is essential to determine the imaging methods currently used by dentists and dental specialists in South Africa. Gauteng, as South Africa's wealthiest and most populous province, offers a unique lens through which to assess the state of dental radiographic imaging. Gauteng houses a high density of dental professionals and training institutions, yet significant socio-economic disparities persist within the province.[15] Understanding the prevalence and types of imaging methods used in Gauteng, as well as the extent to which digital imaging has been adopted, can provide insights into broader national trends and inform curriculum development and policy decisions.[12] This study aims to explore the use of digital imaging among dentists in Gauteng, including the impact of age and sector on technology adoption, and the implications for the revised dental curriculum.

LITERATURE REVIEW

The availability of intraoral, extraoral, and CBCT imaging equipment varies significantly worldwide. While there has been considerable growth in the digital imaging market, analogue imaging remains in widespread use.[16,17] In Saudi Arabia, digital imaging adoption has risen from 5.7% in 2003 to 90% in 2021.[12] However, 75% of dentists continue to use both analogue and digital imaging, while 21% rely exclusively on digital methods.[10,12] Similarly, Sweden (98%), the Netherlands (90%), Belgium (90%), India (84%), New Zealand (88,7%) and Iraq (70%) have experienced rapid increases in digital dental radiography use.[18–22 22–24] Analogue imaging remains in use to a lesser degree in Brazil (48,9%) and Jordan (47.8%).[13,23] In Singapore (11,1%) and Korea (10%), analogue imaging is used to an even lesser extent for intraoral radiography.[24,25]

The majority of dentists in Canada (88,7%), New Zealand (58%), Pakistan (69%), Belgium (90%), and Sweden (98%) have access to digital radiographic technology.[14,22,25–27] In Brazil, there has been a steady increase in the use of digital imaging in dentistry, particularly in the dental specialities.[14] Globally, the extent to which analogue and digital imaging methods are integrated into dental curricula varies considerably. A study conducted across 15 European countries found that 86% of dental schools utilise digital imaging exclusively, while 14% incorporate both digital and analogue imaging in their curriculum.[28]

In the United States and Brazil, intraoral phosphor plates are used extensively in dental schools for educational and clinical teaching purposes. [3,29] The reasons are twofold: phosphor plates are similar to conventional film and are more cost-effective than DD, and cause minimal patient discomfort compared to the DD sensors.[29–31] DD sensors are thick, rigid and connected via a cable, which frequently contributes to increased patient discomfort and poses challenges for optimal intraoral positioning.[29] Positioning of DD intraoral sensors requires an experienced operator to minimise geometric distortion and limit positioning errors, which frequently occur in comparison to the intraoral PSP.[17,32,33] Whilst DD is superior in terms of image acquisition speed, PSP is reportedly superior to DD in terms of overall image quality.[34]

The use of PPS with the thinner intraoral phosphor plates enables the student to gain confidence in digital intraoral imaging and to adopt the practice more readily.[35] Another disadvantage of DD is the initial cost of setting up a DD system, in comparison to PSP.[17] In Saudi Arabia, both digital and analogue imaging techniques remain prevalent in clinical practice, as digital methods offer advantages for certain applications, while analogue-based methods are preferred for others. Consequently, both methods continue to be taught in dental curricula.[10] However, this places substantial strain on limited training resources and due to this, many countries in Europe have removed conventional analogue dental imaging (film imaging) from the dental curriculum.[10]

While extensive research has been conducted globally on the use of digital imaging among dentists, there is limited data on the use of analogue and digital imaging among dentists in South Africa. As new dental imaging technologies and imaging methods arise, these are added to the dental curriculum, and thus the curriculum has expanded to cover both conventional and digital imaging approaches.[36] In addition to the explicit resources required and the maintenance thereof, the inclusion of analogue imaging in the current dental radiology curriculum requires a large amount of valuable additional teaching time, which places a significant strain on the curriculum and limited available resources.[12] This study investigated the radiographic imaging methods used by general dentists and dental specialists to assess the continued relevance of including analogue imaging in the current dental radiology curriculum.

METHODS

Research Design

A descriptive, quantitative and cross-sectional research design was used. The survey questionnaire consisted of closed-ended questions divided into six sections. Section one captured demographic details, including gender, age, professional designation, practice setting, and type of practice. Section two explored the use of intraoral imaging equipment, while section three addressed intraoral imaging methods and techniques. Sections four and five examined extraoral imaging equipment and methodologies. Section six gathered participants' perspectives on how patient safety, image quality, and patient throughput influenced their choice of imaging equipment and techniques. Responses in the first five sections were recorded using index-based inputs, whereas the sixth section utilised a five-point Likert scale, ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree").

Population and Sampling

Gauteng Province has an estimated 2,739 registered dentists, comprising 2,459 general dentists and 280 dental specialists.[15,37] Given the constraints imposed by the Protection of Personal Information (POPI) Act and the wide

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geographic distribution of dentists and dental specialists, non-probability convenience sampling was used. Despite its limitations, convenience sampling is valuable in such studies where the eligibility criteria are not associated with the primary variables of interest.[38] The study population included dentists and dental specialists actively practising in the private, public, or academic sectors. Dental specialities considered included community dentistry, maxillofacial and oral surgery, oral pathology, orthodontics, prosthodontics, oral medicine, and periodontology. Following statistical consultation, a minimum of 100 participants was deemed necessary to achieve statistical significance. Ultimately, 144 responses were received and analysed.

Data Collection

An online questionnaire was distributed through dental organisations, online databases, and peer networks via email and WhatsApp®. The data collection tool, a questionnaire that was adapted from previous studies,[11,27,39–41] was initially hosted on REDCap®, an electronic data capture platform which uses audit trails to secure the captured data. This yielded a poor response rate of 66 participants. As a result, the survey was later compiled using Google Forms®, which yielded a higher response rate of 78 responses. The total sample was 144 respondents. The survey was closed once the target number of participants had been reached.

Responses were coded numerically (e.g., Yes = 1; No = 2), and incomplete questionnaires without any data were excluded. Due to their valuable content, partial responses (n = 12) were included in the total of 144 responses. Statistical analysis was conducted using IBM SPSS (V.30ersion 15), including descriptive statistics (frequencies, percentages, means, standard deviations) and cross-tabulations. Fisher's Exact Test was used, and Pearson's Chi-Square was adopted when tables with more than two categories occurred. Indices were used in the first five sections of the questionnaire. The level of significance was $p \leq 0.05$. In the final section, a five-point Likert scale was used, and measures of central tendency (mean, median, mode) were calculated for these responses.

Validity and Reliability

An online survey questionnaire, adapted from previous studies, was used to enhance the validity and reliability of the data collection. A pilot study was conducted to evaluate the content for clarity, intended purpose, and comprehensiveness, thereby contributing to both the internal and external validity of the study.[42] During the pilot study, electronic accessibility to the online survey was repeatedly tested using various devices and platforms. Responses from the pilot study were excluded from the final research data.

Experts in the dental field assessed the questionnaire on its alignment with the target population, the scope of covered content, and the equal representation of key constructs. To mitigate threats such as shifts in clinical practice over time, the survey was open for a limited duration. Consistency in questionnaire format, platform, and distribution channels helped limit external variability. All data were reviewed for consistency before submission to the statistician.

ETHICAL CONSIDERATIONS

Ethical approval for the study was obtained from the Research Ethics Committee at the University of Johannesburg (REC-1769-2022). Additionally, permission was granted by the Gauteng Department of Health (NHRD 2022_10_0222), as well as by the chief directors of the health districts and the three dental teaching institutions located in Gauteng. All participants received information letters and consent forms and could not access the questionnaire until consent had been given. The questionnaire was anonymous, and the resultant data were also encoded to safeguard the confidentiality and privacy of the participants.[43]

RESULTS

Demographics of Respondents

A total of 144 responses were received, with 52.1% of respondents identifying as male and 47.2% as female. The largest age group comprised individuals aged 31 to 40 years (30.6%), while 13.9% of respondents were over 60 years old (Table I). The majority of participants (59.7%) were employed in the private sector, 25% worked in the public sector, and 15.3% practised in both sectors. In terms of workplace setting, 42% of respondents worked in individual practices, 32.7% in group practices, and 24.7% in teaching institutions. General dentists accounted for the majority of participants (77.8%), while 22.2% were dental specialists (Table I).

Table I: Demographics

		Frequency	Percentage
Age Category of Dentists	*Less than 30 years*	19	13.2%
	31 - 40 years	44	30.6%
	41 - 50 years	31	21.5%
	51 - 60 years	30	20.8%
	61 and over	20	13.9%
	TOTAL	144	100.0%
Sex of Dentists	*Male*	75	52.1%
	Female	68	47.2%
	Prefer not to say	1	0.7%
	TOTAL	144	100.0%
Type of Business	*Public Sector*	36	25.0%
	Private Sector	86	59.7%
	Both	22	15.3%
	Total	144	100.0%
Type of Practice	*Individual*	68	42.0%
	Group	53	32.7%
	Teaching Institution	40	24.7%
	Other	1	0.6%
	Total	162*	100.0%
Type of Dentist	*General Dentist*	112	77.8%
	Specialist	32	22.2%
	Total	144	100.0%
Years of Professional Experience	*Up to 5 years*	21	14.6%
	5 – 10 years	30	20.8%
	11 – 20 years	38	26.4%
	More than 20 years	55	38.2%
	Total	144	100.0%

Availability of Dental X-ray Equipment

The majority of respondents (93.1%) reported having access to intraoral X-ray units, while 6.9% did not have access to such equipment (Table II). Panoramic radiography was

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Table II: Availability of Dental X-ray Equipment in the Public and Private Sectors

Type of Business		Intraoral X-ray Unit			Panoramic X-ray Unit			CBCT X-ray Unit		
		Yes	No	Total	Yes	No	Total	Yes	No	Total
Public Sector	Count	35	1	36	25	7	32	23	9	32
	Percentage	97,2%	2,8%	100,0%	78,1%	21,9%	100,0%	71,9%	28,1%	100,0%
Private Sector	Count	77	9	86	63	17	80	22	58	80
	Percentage	89,5%	10,5%	100,0%	78,8%	21,3%	100,0%	27,5%	72,5%	100,0%
Both	Count	22	0	22	14	6	20	5	15	20
	Percentage	100,0%	0,0%	100,0%	70,0%	30,0%	100,0%	25,0%	75,0%	100,0%
Total	Count	134	10	144	102	30	132	50	82	132
	Percentage	93,1%	6,9%	100,0%	77,3%	22,7%	100,0%	37,9%	62,1%	100,0%

Table III: Type of Image Receptor Used in Dental Radiography

	Intraoral X-ray Unit		Panoramic X-ray Unit	
	Frequency	Percentage	Frequency	Percentage
Film/ Analogue	21	15.4%	6	5,7%
Direct Digital Imaging	102	75.0%	97	92,4%
Phosphor plate imaging	13	9.6%	2	1,9%
Total	136	100.0%	105	100,0%

available to 77.3% of respondents. There was no statistically significant difference in the availability of panoramic units between public and private sectors (p=0.699) or between general dentists and dental specialists (phi=0.217). Cone Beam Computed Tomography (CBCT) equipment was accessible to 37.9% of respondents, indicating a moderate level of adoption of advanced imaging technologies (Table II). *The number of responses regarding the type of practice is higher as some dentists work in more than one practice and were therefore not limited to only denoting one response.

Of the 84,6% of respondents who used digital imaging for intraoral radiography, 75.0% utilised DD, while 9.6% relied on PSP (Table III).

Intraoral Radiography

As shown in Table IV, intraoral radiographs were mainly executed using DD imaging systems across all sectors and age groups. However, analogue imaging remained more common among dentists over the age of 40 (22.9%) compared to the younger cohort (9,4%) and in the public sector (38.7%).

Table IV: Image Receptors Used in Intraoral Radiography

			Intraoral Image Receptor			
			Film/ Analogue	Direct Digital imaging	Phosphor Plate imaging	Total
Age of Dentist	*40 years and younger*	Count	5	48	6	59
		Percentage	9,4%	90.6%	11,3%	
	Older than 40 years	Count	16	54	7	77
		Percentage	22,9%	77,1%	10,0%	
	Total	Count	21	102	13	136
Type of Business	*Public Sector*	Count	12	26	0	38
		Percentage	38,7%	83,9%	0,0%	
	Private Sector	Count	7	60	10	77
		Percentage	9,7%	83,3%	13,9%	
	Both	Count	2	16	3	21
		Percentage	9,5%	76,2%	14,3%	
	Total	Count	21	102	13	136
Type of Practice	*Individual*	Count	6	41	10	55
		Percentage	10,9%	74,5%	18,2%	
	Group	Count	7	41	6	50
		Percentage	14,0%	82,0%	12,0%	
	Teaching Institution	Count	9	28	3	34
		Percentage	26,5%	82,4%	8,8%	
	Total	Count	20	101	13	123

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Table V: Image Receptors Used in Panoramic Radiography

Panoramic Radiography Image Receptors						
			Film/ Analogue	Direct Digital Imaging	Phosphor Plate Imaging	Total
Age of Dentist	*40 years and younger*	Count	4	45	0	46
		Percentage	8,7%	97,8%	0,0%	
	Older than 40 years	Count	2	52	2	56
		Percentage	3,6%	92,8%	3,6%	
	Total	***Count***	6	97	2	102
Type of Business	*Public Sector*	Count	1	25	0	25
		Percentage	4,0%	100,0%	0,0%	
	Private Sector	Count	3	59	2	63
		Percentage	4,8%	93,7%	3,2%	
	Both	Count	2	13	0	14
		Percentage	14,3%	92,9%	0,0%	
	Total	Count	6	97	2	102
Type of Practice	*Individual*	Count	3	34	2	39
		Percentage	7,7%	87,2%	5,1%	
	Group	Count	1	44	1	45
		Percentage	2,2%	97,8%	2,2%	
	Teaching Institution	Count	2	32	0	32
		Percentage	6,3%	100,0%	0,0%	
	Total	Count	6	96	2	101

Among dentists and dental specialists in the private sector, PSP imaging was used by 13.9% of respondents. The use of digital imaging (PSP and DD) in teaching institutions (73,5%) was less than that of individual (89,1%) and group (85,1%) practices. The use of analogue imaging in individual (10.9%) or group practices (14.0%) was lower than in teaching institutions (26.5%). Conversely, PSP imaging was more frequently used in individual (18.2%) and group practices (12%) compared to teaching institutions (8.8%).

Panoramic Radiography

DD imaging was the preferred method for panoramic radiography across all age groups, with 97.8% of younger dentists and 92.8% of older dentists utilising this technology (Table V). The use of analogue imaging for panoramic radiography was limited, with 7.7% of dentists in individual practices using analogue systems, and minimal usage in teaching institutions (6.3%). PSP for panoramic imaging was not used by the teaching institutions. Some respondents reported using more than one imaging method, indicating a possible transitional phase or the use of analogue imaging as a backup system.

DISCUSSION

Demographics of Respondents

There is scarce data regarding the proportion of male and female dentists in South Africa. This study observed a higher proportion of male dentists compared to similar research conducted in the USA.[44] Approximately 60% of dentists in South Africa work in the private sector, providing dental services to only 16% of the population, while the majority of the population relies on a limited number of public-sector dentists for treatment. This imbalance is a significant concern and aligns with previous studies predicting a critical shortage of dentists in the public sector by 2030.[15,45,46]

Intraoral X-ray Equipment

As one of the wealthiest provinces in South Africa, Gauteng has a high number (93,1%) of intraoral X-ray units, comparable to Australia (96,8%), Belgium (94%) and Morocco (87,2%).[22,47,48] In this study, intraoral x-ray units were more commonly available among general dentists than among dental specialists. The majority of dentists using analogue film were over the age of 40, likely due to their familiarity with the technology and the significant costs associated with transitioning to digital imaging infrastructure.

Despite the drawbacks of intraoral DD, it was widely adopted in both the public and private sectors in this study. PSP imaging was not used in the public sector and had limited use in the private sector. PSP plates are small, prone to scratches, loss or theft, and costly to replace, making them impractical for large teaching institutions and overcrowded public-sector clinics.[29] The continued use of analogue film in teaching institutions may be attributed to its inclusion in the current dental curriculum.

Panoramic Radiography

The availability of panoramic radiography in Gauteng (77%) is comparable to that of developed countries, including Saudi Arabia (90%), Canada (77%), Belgium (76%), Korea (96%), and Sweden (61%).[12,22,25,26,48,49] In this study, panoramic X-ray units were equally accessible in both the public (78.1%) and private sectors (78.8%), a higher proportion than in Sweden, where 68% of dentists working in the public sector 32% of dentists working in the private sector have access to these units.[26] The findings of this study align with those from Belgium, Pakistan, and Turkey, where a greater proportion of dental specialists, compared to general dentists, had access to panoramic radiography.[11,22,50] Similar to findings in Belgium, Korea, and Saudi Arabia, few dentists in this study

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reported using PSP or analogue film for panoramic imaging.[12,22,25] The widespread adoption of DD imaging for panoramic radiography across the public and private sectors, teaching institutions, and various practice types can be attributed to its cost-effectiveness, speed, and efficiency, particularly in high-volume public healthcare settings.[51]

Digitising the Analogue Film

Analogue radiographic images can be digitised using a film digitiser, digital camera, or smartphone.[52] This process enables access to the benefits of digital technology, including electronic archiving, image enhancement, and efficient storage.[53] However, the image quality of digitised films remains inferior to that of DD systems.[3] Despite the limitations in image quality, digitising analogue films remains a valuable practice, offering many of the advantages inherent to digital imaging systems.

Digital vs analogue imaging

Dental radiographic images can be captured, viewed, and transmitted using either digital or analogue methods. Digital imaging presents several advantages, including reduced radiation exposure, enhanced sensitivity, and increased efficiency in archiving and sharing radiographic images across various platforms.[11,29] Digital dentistry also enables the integration of imaging software with the Computer-Aided Design/Computer-Aided Manufacturing (CAD-CAM) technology and intraoral scanners, which allows for precise planning, design, and fabrication of dental restorations with high accuracy and efficiency.[54] Digital radiography is widely utilised in most teaching institutions in Gauteng, with limited use of analogue film for intraoral radiography. A possible explanation for this continued use of analogue imaging is that training institutions may include it in their curriculum to illustrate the fundamental principles of image formation and to facilitate the interpretation of older radiographic images.

The use of digital imaging for intraoral radiography was slightly higher among the younger cohort for both intraoral (90.6%) and panoramic (97.8%) imaging. The older cohort demonstrated a stronger preference for intraoral analogue imaging (22,9%) compared to their younger counterparts. These findings are consistent with research conducted in Pakistan and Saudi Arabia,[27,52] which also suggests that the competitive nature of the dental profession drives younger dentists to adopt new technologies more readily in response to growing patient expectations.[27,52] In contrast, older dentists may not feel the same level of urgency to adopt these technologies into their practice.[40] This trend contrasts with findings from Brazil, where the high cost of digital imaging has resulted in a higher prevalence of analogue film use among younger dentists compared to their older counterparts.[13]

Globally, the ease of digitally communicating patient health records and radiographic images has enabled the efficient sharing and storage of dental radiographs via email, tablets, and smartphones, forming an integral component of a patient's comprehensive dental health record.[52] This digital capability has enhanced treatment planning and improved dental healthcare delivery, particularly in rural and remote areas.[55] However, in countries such as Belgium and Ecuador, the digital transmission of patient health records and radiographic images has raised serious concerns regarding patient privacy and data security, which remain significant challenges.[22,56–58]

LIMITATIONS

This study was only conducted in one province, and these results may therefore not be generalised to the rest of South Africa, as the use of analogue and digital dental imaging in other provinces may differ. Despite the low response rate, the data obtained still offers valuable insights into current digital imaging practices and highlights trends that warrant further exploration.

CONCLUSION

The findings of this study highlight the need to revise the dental radiology curriculum to integrate additional competencies, including digital literacy in dental radiography, Teledentistry, and the responsible use of CBCT and specialised dental imaging. The dental radiology curriculum must continually evolve to reflect technological advances and clinical practices, ensuring graduates are competent and adaptable to this dynamic field. As digital imaging becomes the standard, ethical concerns around data security must be addressed, with adoption influenced by factors such as practice size and global collaboration. The use of AI, which is already prevalent in forensic dentistry, is expected to completely transform dentistry due to its efficiency and cost-effectiveness and its ability to classify numerous dental pathologies faster and more easily than humans.[59,60]

Despite the high cost of digital imaging infrastructure, the enhanced efficiency and patient throughput of digital imaging have made it popular among dentists[27] as it enhances diagnostic capabilities and access to care, though challenges in privacy, infrastructure, and educational integration remain. Consequently, while the theoretical understanding of analogue imaging remains relevant, it is no longer necessary to include analogue imaging in clinical training due to the widespread shift towards digital systems. A balanced approach is essential to embrace innovation without compromising core radiographic principles.

This information will benefit the dental profession in its entirety, as the resulting data will inform and guide the dental radiology curriculum and serve as the foundation for further research in this discipline. Consequently, it will also provide insight into some of the skills a newly qualified dentist will need in this burgeoning field of dental radiology.

RECOMMENDATIONS

Based on the results of this study, the inclusion of analogue imaging in the dental radiology curriculum is no longer necessary, given the widespread adoption of digital imaging technologies in current dental practices. Revision of the current dental radiology curriculum must include emerging digital imaging technologies, Teledentistry and AI, notwithstanding digital ethics and data security.

FURTHER RESEARCH

Further research across all South Africa's provinces is necessary to develop a more comprehensive understanding of national dental radiography practices.

Declaration of Interest

The authors declare that they have no competing interests to disclose

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REFERENCES

1. Erdelyi RA., Duma VF, Sinescu C, Dobre GM, Bradu A, Podoleanu A. Dental Diagnosis and Treatment Assessments: Between X-rays, Radiography and Optical. Materials (Basel). 2020;13(4825):1–24.
2. Van Der Stelt PF. Filmless imaging: The uses of digital radiography in dental practice. Journal of the American Dental Association. 2005;136(10):1379–87. doi: 10.14219/jada.archive.2005.0051
3. Supriyadi S, Prastyarini S, Hidayati L, Lestari P. Dentist Perceptions on Dental-Radiodiagnosis Using Smartphone: Crossectional study. Journal of International Dental and Medical Research. 2022;15(2):783–8.
4. Pauwels R. History of Dental Radiography: Evolution of 2D and 3D Imaging Modalities. Medical Physics International. 2020;8(1):235–77.
5. Sattar MA, Aluaan SH, Alrazzaq WA. Evaluation of KV Reduction on image quality in OPG X-Ray. Ind J Forensic Med & Tox. 2020;14(2)2459-66.
6. Khurshid Z. Digital Dentistry: Transformation of Oral Health and Dental Education with Technology. Eur J Dent. 2023;17(4):943–4.
7. Duong AH, Nguyen TD, Duong GH, Tran TT. Assessing digital transformation readiness: a comprehensive study of local clinics in Northwest Vietnam. International Journal of Information Technology (Singapore). 2025 Apr 1;17(3):1607–17.
8. Fahad Alotaibi K, Mohd Kassim A. A Fully Integrated System for Digital Dentistry Workflow and Manufacturing Management. Journal of Advanced Research Design Journal. 2026; 139:175–86. Available from: https://akademiabaru.com/submit/index.php/ard
9. Gangavati R, Baad R, Vibhute N, Varma S, Kamte S, Sankpal S. An Insight into the Radiographic Practice Among Dentists of Karad City, India. European Journal of Pharmaceutical and Medical Research. 2016;3(3):368–73.
10. Abbas H, Arabi Al, Baroudi B, Makhdom S, Alwadani MA, Akhdar ES Al, et al. Intraoral Radiographic Processing Skills among Dentists in Saudi Arabia. Open Access Maced J Med Sci. 2021; 9:139-42.
11. Samejo I, Kumar B, Musharraf H, Ahmed J, Memon L, Bhatti R. Assessment of Knowledge and Perspective toward Dental Radiography among Dental Practitioners of Sindh Province Pakistan. J Evol Med Dent Sci. 2021;10(29):2186–93.
12. Al Sadhan R. A cross-sectional survey of dentists' use of digital radiographic techniques in Riyadh, Saudi Arabia. Saudi Journal of Oral Sciences. 2021;8(3):139.
13. Moreira-Souza L, de Oliveira Reis L, Nogueira-Reis F, da Costa E, Freitas D. How is the Use of Digital Dental Radiology in a Developing Country? An Overview of Brazil. Int J Dent Sci [Internet]. 2022;24(3):176–90. Available from: https://www.researchgate.net/publication/360230509
14. Freire DBL, Celeste RK, Vizzotto MB, Nunes LN, Arús NA, Silveira HLDD. Impact of dentists and equipment in the performing dental imaging examinations: a longitudinal analysis. Braz Oral Res. 2022;36(47). doi: 10.1590/1807-3107bor-2022.vol36.0047.
15. Tiwarii R, Bhayat A, Chikte U. Forecasting for the need of dentists and specialists in South Africa until 2030. PLoS One [Internet]. 2021; 16:1–14. doi: 0.1371/journal.pone.0251238
16. Hasan A, Naz F, Ali A, Khan JA, Ali B. Technical Errors in Intra Oral Radiographs Obtained in Endodontic Department of a Teaching Dental Hospital. J Pak Dent Assoc. 2019;28(2)50-4
17. Zhang W, Huynh C, Jadhav A, et al. Comparison of Efficiency and Image Quality of Photostimulable Phosphor Plate and Charge-Coupled Device Receptors in Dental Radiography. J Dent Educ. 2019;83(10)1205-12. doi: 10.21815/JDE.019.120.
18. Panwar A, Gupta S, Nagaraju K, Malik S, Goel S, Sharma A. Awareness of radiation protection among dental practitioners in UP and NCR region, India: A questionnaire-based study. Journal of Oral Medicine and Radiology. 2022;(2):13–20.
19. Torresan TT, Rodrigues IC, Poletto MC, et al. Radioprotection in Dentistry: knowledge and practices. Res Soc Dev. 2021;10(14):1–14.
20. Al-Nuaimi N, Mahdee AF, Al-Hashimi R, Mannocci F. Knowledge and Attitude of Iraqi Dentists Towards the Use of Cone Beam Computed Tomography in Endodontics: A Questionnaire Study. International Medical Journal. 2021;28(6):658–63.
21. van der Zande MM, Gorter RC, Aartman IH, Wismeijer D. Adoption and use of digital technologies among general dental practitioners in the Netherlands. PLoS One. 2015;10(3): e0120725. doi: 10.1371/journal.pone.0120725.
22. Snel R, Van De Maele E, Politis C, Jacobs R. Digital dental radiology in Belgium: a nationwide survey. Dentomaxillofacial Radiol. 2018;47(8):20180045. doi: 10.1259/dmfr.20180045.
23. Al-Mousa DS, Alakhras M, AlSa'di AG, Chau M, Hayre C, Mahasneh AM. Attitudes and practices of radiation protection among Jordanian dental radiography practitioners. Radiography (Lond). 2024;30(6):1556-62. doi: 10.1016/j.radi.2024.09.061.
24. Ng AYQ, Lai CWM, Ho CXH, Lim LZ. Dental imaging in Singapore: a survey of 2D radiographic techniques and CBCT practices. Dentomaxillofac Radiol. 2025;54(8):649-58. doi: 10.1093/dmfr/twaf033.
25. An SY, Lee KM, Lee JS. Korean dentists' perceptions and attitudes regarding radiation safety and protection. Dentomaxillofacial Radiology. 2018;47(3):1–8.
26. Svenson B, Ståhlnacke K, Karlsson R, Fält A. Dentists' use of digital radiographic techniques: Part II - extraoral radiography: a questionnaire study of Swedish dentists. Acta Odontol Scand. 2019;77(2):150-7. doi: 10.1080/00016357.2018.1525763.
27. Hasan A, Khan JA, Ali B, Afshan Z, Shakir MN, Shah SYA. Practices of Dentists about Digital Techniques in Dental Radiology and Radiographic Safety. J Pakistan Dent Assoc. 2019;28(04):181–6. DOI: https://doi.org/10.25301/JPDA.284.181.
28. Ahlqvist J, Jäghagen EL, Friedlander-Barenboim S et al. Resources Allocated for Undergraduate Education in Oral Radiology in European Dentistry Programmes: A Survey Study. Eur J Dent Educ. 2025;29(2):384-91. doi: 10.1111/eje.13078.
29. Elkhateeb SM, Aloyouny AY, Omer MMS, Mansour SM. Analysis of photostimulable phosphor image plate artifacts and their prevalence. World J Clin Cases. 2022;10(2):437-47. doi: 10.12998/wjcc. v10.i2.437.
30. Cesur AK, Demirel O, Altan SG, Özcan M. Evaluation of two dental digital imaging systems based on quality scorings, burn-out effects and cervical width determination. Balkan Journal of Dental Medicine. 2020;24(2):71-6. doi: 10.2478/bjdm-2020-0012.
31. Souza-Pinto GN, Santaella GM, Coli AA, Oenning AC, Haiter-Neto F. Analysis of the deterioration of photostimulable phosphor plates. Dentomaxillofacial Radiology. 2020;49(6):20190500. doi: 10.1259/dmfr.20190500.
32. Anu Sushanth A, Srivastava KC, Shrivastava D, Hosni HA, Khan ZA, Al-Johani K, et al. Recommendations, practices and infrastructural model for the dental radiology set-up in clinical and academic institutions in the COVID-19 era. Biology (Basel). 2020;13;334(9). doi: 10.3390/biology9100334.
33. Beshtawi KR, Shaik S, Peck MT, Chetty M. The accuracy of various radiographic modalities for implant therapy. S. Afr. Dent.J. 2021;76(7): 396-403. Doi: 10.17159/2519-0105/2021/v76no7a1.
34. Farrier SL, Drage NA, Newcombe RG, Hayes SJ, Dummer PM. A comparative study of image quality and radiation exposure for dental radiographs produced using a charge-coupled device and a phosphor plate system. Int Endod J. 2009;42(10):900-7. doi: 10.1111/j.1365-2591.2009.01593. x.
35. Saucke K. Analysis of a Quality Assurance Program For Intraoral Photostimulable Phosphor Plates at a Large Academic Institution and Recommendations for Programmatic Enhancements. [dissertation] San Antonio: University of Texas Health Science Center. 2021;(August). Available from: https://uthscsa.edu/biomedical-sciences/programs/radiological-sciences-phd/career-paths/alumni
36. Witwatersrand U of. School of Oral Health Sciences, Department of General Dental Practice, Maxillo-Facial and Oral Radiology Study Guide BDS III, BDS IV. 2024.
37. Bhayat A, Nkambule NR, Madiba TK. A Review of the 2030 Human Resources for Health Strategy: Implications for Dentistry in South Africa. South African Dental Journal. 2021;76(06):367–73. doi: 10.17159/2519-0105/2021/v76no6a7.
38. Winton B, Sabol M. A multi-group analysis of convenience samples: free, cheap, friendly, and fancy sources. Int J Soc Res Methodol. 2022;00(00):1–16. doi: 0.1080/13645579.2021.1961187.
39. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: Building an international community of software platform partners. J Biomed Inform. 2019;95(May):103208. doi: 10.1016/j.jbi.2019.103208.
40. Masyte V, Sefeldaite S, Venskutonis T. A Questionnaire of Digital Radiography and CBCT Use and Knowledge among Lithuanian Dentists. J Oral Maxillofac Res. 2021;12(1): e2. doi: 10.5037/jomr.2021.12102.
41. Mauthe PW, Eaton KA. An investigation into dental digital radiography in dental practices in West Kent following the introduction of the 2006 NHS General Dental Services contract. Prim Dent Care. 2011;18(2):73-81. doi: 10.1308/135576111795162893.
42. Duckett LJ. Quantitative Research Excellence: Study Design and Reliable and Valid Measurement of Variables. J Hum Lact. 2021;37(3):456-463. doi: 10.1177/08903344211019285.
43. Jung YM. Data analysis in quantitative research. Handb Res Methods Heal Soc Sci. Singapore: Springer Singapore. 2019;(June):955–69. doi: 10.1007/978-981-10-5251-4_109.
44. Surdu S, Mertz E, Langelier M, Moore J. Dental Workforce Trends: A National Study of Gender Diversity and Practice Patterns. Med Care Res Rev. 2021;78(1_suppl):30S-39S. doi: 10.1177/1077558720952667.
45. Bhayat A, Chikte U. Human Resources for Oral Health Care in South Africa: A 2018 Update. Int J Environ Res Public Health. 2019 May 14;16(10):1668. doi: 10.3390/ijerph16101668.
46. Husic JB, Melero FJ, Barakovic S, et al. Aging at work: A review of recent trends and future directions. Int J Environ Res Public Health. 2020;17(20):7659. doi: 10.3390/ijerph17207659.
47. Ihle IR, Neibling E, Albrecht K, Treston H, Sholapurkar A. Investigation of radiation-protection knowledge, attitudes, and practices of North Queensland dentists. J Investig Clin Dent. 2019; 10:212374. doi: 10.1111/jicd.12374
48. Elmorabit N, Obtel M, Azougagh M, Marrakchi A, Ennibi OK. Development and validation of a questionnaire on radiation protection knowledge, attitudes, and practices among Moroccan dentists. J Appl Clin Med Phys. 2025;26(1): e14555. doi: 10.1002/acm2.14555.
49. Gillies RC, Quiñonez C, Wood RE, Lam EWN. Radiograph prescription practices of dentists in Ontario, Canada. J Am Dent Assoc. 2021;152(4):284-292. doi: 10.1016/j.adaj.2020.12.007.
50. Vural UK, Gökalp S. Diagnostic methods for dental caries used by private dental practitioners in Ankara. Niger J Clin Pract. 2017;20(3):382–7. doi: 10.4103/1119-3077.181360.
51. Sunilkumar AP, Parida BK, You W. Recent Advances in Dental Panoramic X-Ray Synthesis and Its Clinical Applications. IEEE Access. 2024;12(July):141032–51.
52. Almazrooa SA, Mansour GA, Alhamed SA, Ali SA, Akeel SK, Alhindi NA, et al. The Application of Teledentistry for Saudi Patients' Care: A National Survey Study. J Dent Sci [Internet]. 2021; 16:280–6. Available from: https://doi.org/10.1016/j.jds.2020.04.014
53. Noorsaeed AS, et al. Overview on Updates on Digital Dental Radiography. J. Pharm. Res. Int. 2021;33(59B):23-8. Available from: https://journaljpri.com/index.php/JPRI/article/view/5010.
54. Tallarico M. Computerization and Digital Workflow in Medicine: Focus on Digital Dentistry. Materials (Basel). 2020;13(9):2172. doi: 10.3390/ma13092172.
55. Iorgulescu, G, et al. Ethical and Medico-Legal Aspects Behind the Use of Digital Technologies in Dentistry. Rom J Leg Med. 2020;28(2):202–7. doi: 10.4323/rjlm.2020.202.
56. Nakajima I, et al. Empirical Study on Medical Information and Communication Technology System in Dentistry in Southeast Asia. Oral Health Care: Tokyo. doi: 10.5772/intechopen.101080.
57. Chérrez-Ojeda I, Vera C, Vanegas E, et al. The Use of Information and Communication Technologies in Latin American Dentists: A Cross-sectional Study from Ecuador. BMC Oral Health [Internet]. 2020;20(146):1–9. Doi: 10.1186/s12903-020-01137-z.
58. Kanani H, Khubchandani M, Dangore-Khasbage S, Pandey R. Teledentistry: A Comprehensive Review and Its Application in Pediatric Dental Care. Cureus. 2024;16(1):1–7.
59. Kumar A, Bhadauria HS, Singh A. Descriptive analysis of dental X-ray images using various practical methods: A review. PeerJ Comput Sci. 2021;7:e620. doi: 10.7717/peerj-cs.620.
60. Putra RH, Doi C, Yoda N, Astuti ER, Sasaki K. Current applications and development of artificial intelligence for digital dental radiography. Dentomaxillofac Radiol. 2022;51(1):20210197. doi: 10.1259/dmfr.20210197.

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Teaching of Digital Workflow in the Removable Partial Denture Undergraduate Curriculum: A Scoping Review

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ABSTRACT

Context

Digital technology is a rapidly advancing field in dentistry and the implementation of digital workflow in the dental curriculum is a vital part of modern education. To ensure that dental graduates are equipped for independent practice in the digital era, dental curricula must adapt to incorporate these technologies.

Aim

This scoping review explored the extent to which digital workflow is being implemented in the undergraduate removable partial denture (RPD) curriculum.

Methods and materials

A study-specific protocol was developed in accordance with the criteria for conducting a scoping review. Ten electronic databases (Web of Science, ScienceDirect, Scopus, EBSCOhost, Wiley Online Library, PubMed, the Cochrane Library, Medline, Embase, and OpenGrey) were systematically searched for English-language, full-text articles published between 2020 and 2025 to include recent and relevant literature specifically addressing RPD education. Studies were screened based on specific inclusion and exclusion criteria, and relevant data were extracted for analysis.

Results

A database search yielded 89 articles. After removal of 6 duplicates, 83 articles remained and were screened by title and abstract, resulting in the exclusion of 72 articles. Eleven full-text articles were assessed for eligibility, of which 6 were excluded. Ultimately, five articles met the inclusion criteria and were included in the final review. Implementation occurred in preclinical and clinical training, with variations in depth and year-level exposure. Response rates varied from 25% to 85%, affecting generalisability.

Conclusions

This scoping review identified limited evidence of the implementation of digital workflow within undergraduate RPD curricula. Given the small number of studies included, the findings reflect trends in the USA and MENA region and may not be generalisable to other contexts. A common theme across the studies was the identification of barriers to implementation, which included financial constraints, limited faculty training, and infrastructure limitations. Further research is required to determine current educational practices and support broader curriculum development.

Keywords

undergraduate curriculum, digital workflow, dental education, removable partial dentures, CAD/CAM dentistry.

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INTRODUCTION

Removable partial dentures (RPDs) remain an important treatment modality in the management of partial edentulism, a condition characterised by the absence of one or more natural teeth.[1] The prevalence of partial edentulism remains high and is influenced by increased life expectancy, an ageing population, and improved retention of natural dentition into older age.[2] A national survey conducted in the UK in 2023 demonstrated a trend toward greater tooth retention among older adults, with only a small percentage being completely edentulous.[3]

Despite significant advancements in digital dentistry, RPD teaching practices at many universities continue to rely predominantly on conventional workflows, with limited formal integration of digital technologies.[4] While foundational prosthodontic principles remain constant, digital design, materials, and fabrication methods have significantly altered clinical practice.[5] Digital workflow in dentistry refers to the integration of digital technologies in the fabrication of a dental prosthesis. In the context of removable partial dentures (RPDs), digital workflow may involve intraoral or laboratory scanning, virtual design of RPD frameworks and components using CAD software and digital fabrication of the final prosthesis via milling or three-dimensional (3D) printing. Digital workflow is increasingly influencing

clinical practice and dental education. Digital tools such as intraoral scanning, CAD, and 3D manufacturing are being incorporated into prosthodontic workflows, with the potential to improve efficiency, precision, and patient-centred care.[6,7,8] Adoption of digital workflow and 3D printing technologies has increased considerably over the past decade.[9] Consequently, dental curricula must evolve to reflect technological advancements and ensure graduates are adequately prepared to deliver modern oral healthcare.[10,11,12]

Digital workflow technologies may offer potential advantages in both clinical and educational contexts, including reduced laboratory procedures, decreased production time, and enhanced learning through interactive and visual teaching approaches.[4,7,13] However, implementation challenges remain, including financial costs, infrastructure requirements, faculty training, and the rapid pace of technological development.[5,14] These barriers contribute to variability in how digital workflow is incorporated into undergraduate dental curricula, particularly in the teaching of RPDs.

Although digital dentistry continues to expand rapidly, there is limited consolidated evidence describing the extent to which digital workflows are incorporated into undergraduate RPD education and how institutions are adapting to evolving clinical demands. This gap is particularly relevant within the South African context, where curriculum development must balance technological advancement with local resource considerations and public health priorities.

Therefore, this scoping review aimed to map the existing literature on the incorporation of digital workflow technologies within undergraduate RPD curricula, to describe how digital workflow is being taught, and to identify factors influencing its implementation. The findings are intended to provide evidence that may inform curriculum development in South African dental institutions, while acknowledging that direct application may not be possible due to difference in resources.

The review was guided by the question: *Is digital workflow included in the undergraduate RPD curriculum?*

METHODOLOGY

Study design and methodological framework

This study was conducted as a scoping review to explore the extent to which digital workflow technologies are integrated into undergraduate RPD curricula in dental education. The review was guided by the Joanna Briggs Institute (JBI) framework for evidence synthesis, which outlines a structured five-stage approach to scoping reviews. The JBI methodology was selected because it provides a rigorous framework for mapping emerging and heterogeneous literature and is particularly suited to reviews aiming to explore the breadth, nature, and characteristics of evidence rather than assess intervention effectiveness. [6,7]

The five stages of the JBI framework included: (1) identifying the research question; (2) identifying relevant studies; (3) study selection; (4) data charting and presentation; and (5) collating, summarising, and reporting the results (Table I).[6,7] The review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines.[7] In accordance with JBI guidance for scoping reviews, no formal methodological quality appraisal of the included studies was conducted, as the main aim was to map and synthesise the available evidence rather than evaluate the methodological rigour of the studies.[6,7]

Three investigators (NA, FK, and RA) were involved in the conceptualisation and design of the review.

Table I. Proposed methodology for the scoping review based on the JBI framework for evidence synthesis.[6,7]

1. Identifying the research question	Clarifying and linking the purpose and research question
2. Identifying relevant studies	Using a three-step literature search to balance feasibility with breadth and comprehensiveness
3. Study selection	Careful selection of the studies using a team approach and including all levels of evidence, as considered by the JBI levels of evidence
4. Presenting the data	Charting the data in a tabular and narrative format where applicable
5. Collating the results	Identifying the implications of the study findings for policy, practice, or research

Research question

Following refinement of the research objectives, the review sought to explore the integration of digital workflow technologies within undergraduate RPD curricula in dental education, including the extent of implementation, teaching approaches, perceived benefits, and challenges associated with digital workflow adoption.

Eligibility criteria

Inclusion: This review focused on studies published in full-text English between 1 January 2020 and 1 January 2025. This period was selected to include recent and relevant literature specifically addressing the integration of digital workflow in undergraduate removable partial denture education, as earlier studies predominantly focused on fixed prosthodontics.

Exclusion: Studies were excluded if they focused on other dental disciplines, exclusively referenced postgraduate education, non-educational clinical applications, publications outside the specified date range, or non-English language articles.

Information sources and search strategy

A comprehensive search was conducted across ten electronic databases: Web of Science, ScienceDirect, Scopus, EBSCOhost, Wiley Online Library, PubMed, the Cochrane Library, Medline, Embase, and OpenGrey.

Key terms were combined using Boolean operators to maximise sensitivity and specificity. An example search strategy included:

("Removable Partial Dentures" OR "Removable Partial Prosthesis" OR "RPD" OR "Removable Dental Prosthesis" OR "Removable Prosthodontics") AND ("Dental Curriculum" OR "Prosthodontic Education" OR "Dental Education" OR

"Clinical Dental Training" OR "RPD Education") AND ("3D Printing" OR "Digital Workflow" OR "CAD/CAM" OR "Digital Prosthodontics" OR "Digital Dental Education" OR "Digital Fabrication" OR "Digital Removable Prosthesis").

The search was limited to publications between 2020 and 2025 to ensure relevance of RPD-specific education.

Study selection

Two reviewers independently conducted the literature search and screening process according to predefined inclusion and exclusion criteria. Duplicate records were removed manually following database searches, with records reviewed to identify duplicates both within individual databases and across multiple databases prior to screening. Study selection was conducted in three stages: initial title screening, followed by abstract review, and subsequently full-text assessment for eligibility. Discrepancies between reviewers were resolved through discussion and consensus. A third reviewer acted as an adjudicator when agreement could not be reached; however, adjudication was not required.

Data extraction and charting

Data extraction was conducted independently by two reviewers using predefined data extraction criteria aligned with the objectives of the study. Extracted information included study characteristics, digital technologies utilised, educational approaches, key findings, phase of teaching and challenges/limitations.

Following independent extraction, reviewers met to compare findings and finalise extracted data through consensus. The third reviewer provided oversight where necessary.

Data analysis and presentation

The study selection process was documented using a PRISMA flow diagram (Fig. 1). Characteristics of included studies were analysed descriptively and synthesised narratively according to the objectives of the scoping review. Data was presented in tabular and narrative formats to provide an overview of digital workflow integration within undergraduate RPD education and to identify trends and gaps for dental curricula.

Results

The database search yielded a total of 89 records, of which 5 studies met the inclusion criteria following title, abstract, and full-text screening (Fig. 1). The included studies primarily consisted of survey-based research examining the implementation, teaching practices, and perceptions of digital workflow technologies in undergraduate dental education. Most of the included studies were conducted in the United States, with one study from the MENA region, reflecting a limited view of the growth of digital technologies in prosthodontic education.

Table II.

STUDY DETAILS					
Article title, journal, author & country of origin	**Methods and participants**	**Focus**	**Key findings**	**Phase of teaching**	**Challenges/ limitations**
Current Implementation of Digital Dentistry for Removable Prosthodontics in US Dental Schools International Journal of Dentistry Y. Ishida, Y. Kuwajima, T. Kobayashi, Y. Yonezawa, D. Asack, M. Nagai, H. Kondo, S. Ishikawa-Nagai, J. Da Silva, SJ. Lee USA Japan	Online survey (15 questions) sent to predoctoral schools (56 schools) and advanced graduate prosthodontics (52 schools) directors.	RPD-specific	CAD/CAM RPDs taught in 12.5% of predoctoral programmes; 25% used in clinical practice.	Preclinical: lecture/ demonstration Clinical: limited hands-on practice	Barriers: funding, resources, time, faculty proficiency, limited clinical opportunities.
Assessment of Digital Workflow in Predoctoral Education and Patient Care in North American Dental Schools Journal of Dental Education MC. Prager, H. Liss USA	35-question survey sent to 76 dental schools.	General CAD/ CAM	Digital technology widely introduced; however, varies across dental schools	Preclinical: lectures/ demos Clinical: exposure via patient care	Limited equipment; lack of faculty training; regional variability
Computer-aided Design/Computer-aided Manufacturing (CAD/CAM) Technology in the Undergraduate Dental Programmes in the MENA region *European Journal of Dental Education* Md. Sofiqul Islam, A. Al-Fakhri, MM. Rahman UAE	20-question online survey; 55 participants	General CAD/ CAM	Digital removable prostheses incorporated, but variable implementation	Preclinical: lectures/ demos Clinical: limited exposure.	Lack of faculty encouragement and support

STUDY DETAILS Article title, journal, author & country of origin	Methods and participants	Focus	Key findings	Phase of teaching	Challenges/ limitations
A survey on utilisation and barriers of digital removable prostheses in US dental education *Journal of Dental Education* H. Elkassaby, F. Touloumi, W. Auclair Clark, S. Jiang, A. Mahrous, J. Mainelli, M. Moghadam, C. Zemnick, R. Sadid-Zadeh USA	Survey directed to restorative chairs & prosthodontic programme directors; follow-up emails	Digital removable prostheses	Digital removable prostheses incorporated, but variable implementation	Preclinical: demonstrations Clinical: hands-on when available	Limited IT/ lab support, financial constraints, faculty proficiency
Pre-doctoral dental students' computer-aided design/computer-aided manufacturing-related education, knowledge, attitudes and behaviour: A national survey *Journal of Dental Education* FJ. Alhamed, GF. Neiva, S. Bak, E. Karl, MR. Ingelhart USA	National student survey; distributed via deans to 68 schools; SPSS analysis	General-CAD/CAM	65.6% received hands-on training; generally positive attitudes; senior students more experienced	Preclinical: lectures, small-groups demos, video demos Clinical: hands-on workshops, individual training across 4 years	Low response rate (25%); possible response bias; COVID-19 impact

RESULTS

Thematic synthesis of included studies

The five included studies were analysed thematically to explore patterns in the implementation and teaching of digital workflows within undergraduate RPD education. Thematic analysis identified five key areas: implementation of digital workflow for RPDs, extent of digital workflow teaching, response rates, emerging trends, and barriers to implementation.

RPD-specific Digital Workflow Implementation

Across the included studies, the implementation of digital workflow specifically for RPDs within undergraduate dental education was limited and inconsistent across institutions. Ishida et al.[15] assessed RPD-specific digital workflow, reporting that 12.5% of predoctoral programmes taught CAD/CAM RPDs, while 25% incorporated it into clinical practice, suggesting a disconnect between theoretical teaching and practical application.

The remaining studies primarily focused on general CAD/CAM education rather than RPD-specific applications. Elkassaby et al.[7] found that removable CAD/CAM technologies were introduced in both clinical and preclinical settings, but implementation varied across programmes, with approximately 29% of programmes reporting no use of digital removable prostheses. Prager et al.[8] reported widespread but variable incorporation of digital technologies across 54 dental schools, while Islam et al.[13] (MENA region, general CAD/CAM) noted in some cases students sought additional formal training privately due to limited institutional support. Alhamed et al. [14] reported hands-on experience for 65.6% of students, but the focus was on general CAD/CAM rather than RPD-specific applications.

Extent of digital workflow teaching

The included studies reported the incorporation of digital workflow into undergraduate dental education, within both preclinical and clinical training environments. However, the consistency and extent varied widely.

- Preclinical training: lectures, video demonstrations, small-group demonstrations.
- Clinical training: hands-on workshops, patient-based application.

Only Ishida et al.[15] directly assessed RPD-related teaching. For the studies reporting general CAD/CAM training, exposure to digital technologies included digital scanning, CAD, and 3D manufacturing, but it was not clearly linked to RPD fabrication.

Response rates

Where reported, the response rates to the surveys varied considerably. Alhamed et al. reported a response rate of 25% while Elkassaby et al. reported an 85% response rate; this variability may influence the reliability and generalisability of the findings.

Trends in current digital workflow integration

Current trends demonstrate a gradual increase in the inclusion of digital dentistry, particularly CAD/CAM technologies, within undergraduate dental curricula. All studies reported some degree of exposure to digital scanning and manufacturing; however, access, type of training and implementation varied significantly across institutions and geographic regions.

Barriers to digital workflow implementation

Several recurring barriers to the integration of digital workflow technologies were identified across the studies. Financial constraints associated with equipment acquisition and maintenance were among the most frequently reported challenges.[7,14] Limited faculty proficiency and insufficient training were also commonly cited as barriers to effective curriculum implementation.[8,13] Additionally, shortages of adequately trained IT and laboratory personnel were reported as operational challenges.[6] Time limitations within existing curricula further restricted the integration of digital modules, and disruptions related to the COVID-19 pandemic were noted as influencing teaching delivery and consistency.[13]

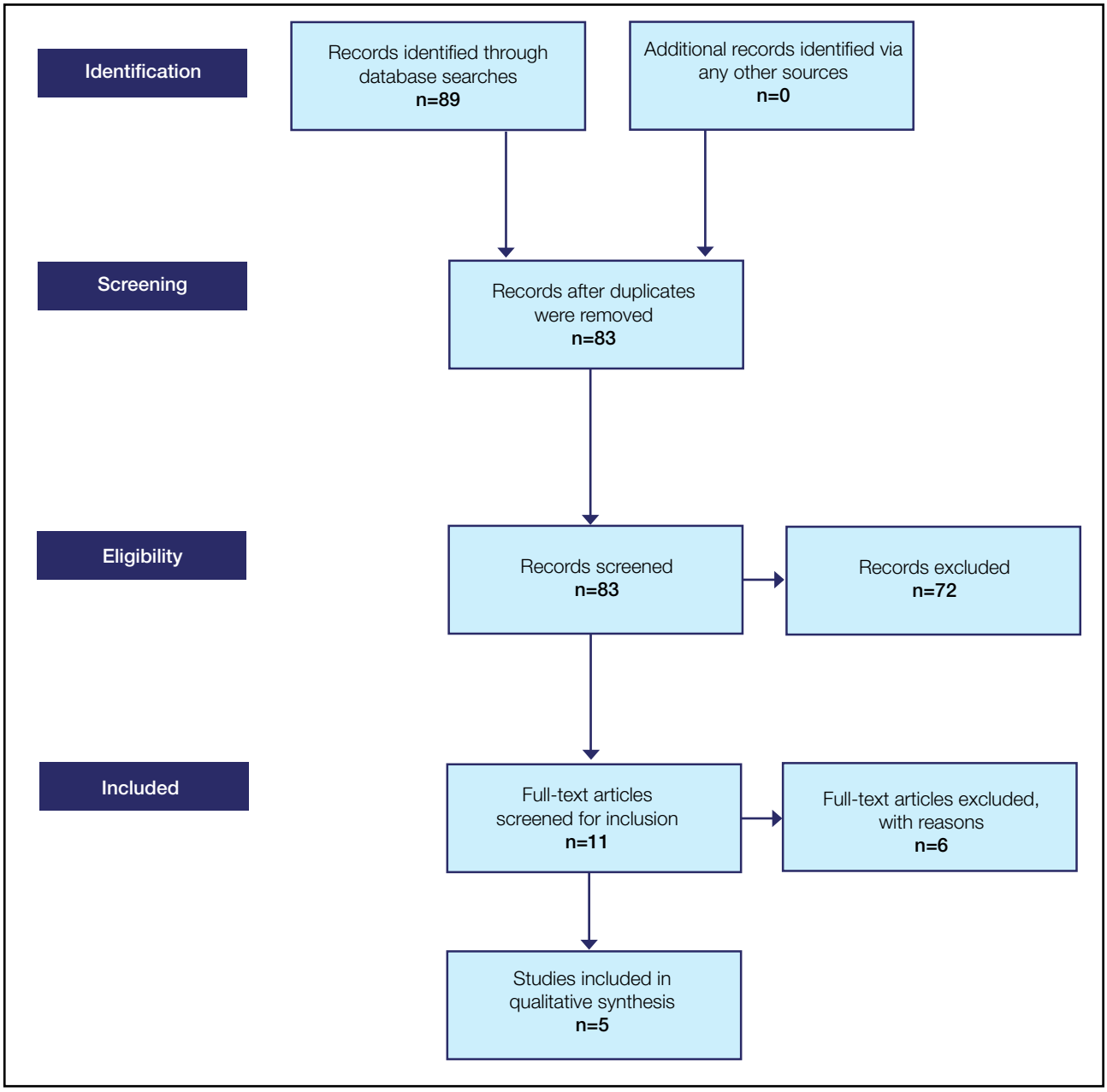

Figure 1: PRISMA Flow Chart for scoping review of undergraduate teaching of digital workflow in the removable partial denture curriculum[10]

DISCUSSION

This scoping review explored the extent to which digital workflow technologies are integrated into undergraduate removable partial denture (RPD) education.

The findings indicate that while digital workflow is increasingly recognised as important in dental education, its implementation within RPD education remains limited and inconsistent. For example, Ishida et al. reported that only 12.5% of predoctoral programmes formally taught CAD/CAM fabrication techniques, with digital RPDs used clinically in only 25% of programmes. Similarly, Elkassaby et al. reported that a group of institutions had not implemented any form of digital RPD utilisation, highlighting the uneven adoption of these technologies.

Across the included studies, digital workflow was most introduced through preclinical and clinical training; however, the extent of integration and opportunities for hands-on learning differed considerably between the institutions. While Alhamed et al. reported that 65.6% of students had received hands-on CAD/CAM exposure and generally demonstrated positive attitudes toward digital technologies, these findings were derived from a single national survey study and were not specific to RPD fabrication. This reinforces the finding that exposure to digital workflow does not necessarily translate into structured RPD-specific training.

A key finding was the disconnect between the identification of digital dentistry as an essential component of modern practice and its practical inclusion within undergraduate RPD education. Although students and faculty members generally reported exposure to CAD/CAM technologies and digital design principles, formal training specific to digital RPD fabrication remained limited. This suggests that while digital dentistry is being introduced broadly within curricula, its application within

removable prosthodontics is still developing. Compared to fixed prosthodontics, where CAD/CAM integration is more widespread, RPD-specific digital training appears to lag, potentially due to differences in resource availability and faculty familiarity. Although direct comparisons were not evaluated within this study, the lower reported rates of RPD-specific integration support this interpretation.

The included studies also highlighted common implementation approaches, including didactic teaching, small group demonstrations, and clinical exposure. However, the variability observed across institutions, including differences in reported equipment availability, faculty proficiency, and laboratory support, suggests that implementation is largely dependent on institutional resources rather than standardised curriculum requirements. For example, Ishida et al. and Prager and Liss identified funding and faculty training limitations as major barriers, while Elkassaby et al. highlighted insufficient IT and laboratory support. The MENA-region study further highlighted limited faculty encouragement as a major barrier.

It is important to note that none of the included studies reported clear accreditation requirements for digital RPD training. The absence of accreditation standards may contribute to differences in curriculum design and student exposure to digital RPD training. Establishing clear guidelines may help institutions implement more consistent digital workflow training, ensuring dental graduates are adequately prepared for private practice.

Several recurring barriers were identified across the studies. Financial constraints associated with equipment acquisition and maintenance were among the most frequently reported challenges. Limited faculty training and confidence in digital technologies were also commonly cited, emphasising the need for professional development initiatives to support curriculum transformation. Operational challenges, including insufficient IT and laboratory support, as well as time limitations within already dense curricula, further restricted integration efforts. Furthermore, the reliance on survey-based evidence indicates that much of the current understanding of digital workflow education is based on institutional self-report rather than objective curriculum evaluation.

Despite these challenges, attitudes towards digital workflow technologies were generally positive among students and faculty, with recognition of their relevance to contemporary dental practice. However, a gap remains between institutional support for digital innovation and its consistent delivery within undergraduate programmes. This highlights the need for structured curriculum planning that balances foundational prosthodontic principles with evolving technological competencies.

LIMITATIONS

The findings of this review should be interpreted considering certain limitations.

First, the small number of included studies, all of which were survey-based, limits the depth and strength of available evidence.

Second, the included studies demonstrated substantial differences in study design, response rates, participant groups and terminology used to describe digital workflow, making direct comparisons across the studies difficult.

Third, the review was restricted to English-language publications within a defined time frame. This date range was selected to report on current literature specific to digital workflow in removable prosthodontics, as earlier studies predominantly focused on fixed prosthodontics. However, relevant studies published outside of this timeframe or in other languages may have been excluded.

Fourth, no formal quality assessment of the included studies was performed. Due to this study being a scoping review, the focus was on reporting available evidence rather than evaluating study quality.

Finally, most of the studies focused on findings in the USA, with only one study conducted in the MENA region. Therefore, the findings reflect experiences in those regions and may not be generalise to other countries, including South Africa, where differences in resources may influence the integration of digital workflow technologies.

Finally, several studies reported low response rates, therefore limiting generalisability.

RECOMMENDATIONS

Future research should focus on evaluating educational outcomes associated with digital workflow training in removable prosthodontics and developing standardised frameworks for integrating digital technologies into undergraduate curricula. Longitudinal and mixed-methods studies would provide valuable insight into how digital workflow education influences clinical competence and graduate readiness.

Overall, while digital workflow is increasingly recognised as an essential component of contemporary prosthodontic education, its integration into undergraduate RPD curricula remains uneven. The findings suggest that addressing barriers related to infrastructure, faculty training, and curriculum design may be necessary to ensure that graduates are equipped with the skills required for modern dental practice.

CONCLUSION

This scoping review aimed to explore the extent to which digital workflow is implemented in the undergraduate RPD curriculum.

The findings suggest that while digital workflow is being introduced within undergraduate programmes, structured RPD-specific digital workflow training remains limited and inconsistently implemented. Evidence from the included studies indicates that exposure to CAD/CAM systems does not necessarily indicate that there is formal training in digital RPD fabrication. Implementation is largely dependent on institutional resources, including faculty expertise and infrastructure availability. Overall, the current literature reflects growing recognition of the importance of incorporating digital workflows into prosthodontic education; however, there is uneven integration within the undergraduate RPD curriculum. These findings highlight the need for increased attention to be given to the role of digital technologies in removable prosthodontic education.

AUTHOR CONTRIBUTIONS

Conceptualisation: RA
Conceived and designed the Protocol: RA
Completed the searches using a well-formulated strategy: NA, FK, RA.
Study Eligibility and Data Extraction Completed: NA, FK, RA.
Manuscript Writing: NA, FK. RM
Edited Drafts: NA, FK, RA, RM. Final Draft Check: NA, FK, RA, RM.

REFERENCES

1. Manandhar P, Ranjit R, Tuladhar SL, Bhandari A. Prevalence of partial edentulism among patients visiting a tertiary health care center in the Western Region, Nepal. J Gandaki Med Coll Nepal. 2021; 14: 93-9. https://doi.org/10.3126/jgmcn.v14i2.38719
2. Kim JJ. Revisiting the removable partial denture. Dent Clin North Am. 2019; 63: 263-78. https://doi.org/10.1016/j.cden.2018.11.007
3. Office for Health Improvement & Disparities (2025) Adult Oral Health Survey 2023: Clinical Oral Health. GOV.UK. Available at: https://www.gov.uk/government/statistics/adult-oral-health-survey-2023/clinical-oral-health (Accessed: 10 February 2026).
4. Mahrous A, El-Kerdani T. Teaching the design and fabrication of RPD frameworks with a digital workflow: a preclinical dental exercise. MedEdPORTAL. 2020; 16: 1041-5.
5. Fernandez MA, Nimmo A, Behar-Horenstein LS. Digital denture fabrication in pre- and postdoctoral education: a survey of U.S. dental schools. J Prosthodont. 2016; 25: 83-90. https://doi.org/10.1111/jopr.12287
6. Daood U, Sidhu P, Jamayet N, et al. Current and future trends in the teaching of removable partial dentures in dental schools in Malaysia: a cross-sectional study. J Dent. 2022; 124: 104225. https://doi.org/10.1016/j.jdent.2022.104225
7. Elkassaby H, Touloumi F, Auclair W, Jiang S, Mahrous A, Mainelli. A survey on utilization and barriers of digital removable partial prostheses in US dental education. J Dent Educ. 2023; 87: 1746-53.
8. Prager M, Liss H. Assessment of digital workflow in predoctoral education and patient care in North American dental schools. J Dent Educ. 2020; 84: 350-7.
9. Pillai S, Upadhyay A, Khayambashi P, et al. Dental 3D-printing: transferring art from the laboratories to the clinics. Polymers (Basil). 2021; 13: 1-25. https://doi.org/10.3390/polym13010157
10. Almufleh B, Arellano A, Tamimi F. Patient-reported outcomes and framework fit accuracy of removable partial dentures fabricated using digital techniques: a systematic review and meta-analysis. J Prosthodont. 2023; 33: 626-36. https://doi.org/10.1111/jopr.13786
11. Schlenz MA, Michel K, Wegner K, Schmidt A, Rehmann P, Wöstmann B. Undergraduate dental students' perspective on the implementation of digital dentistry in the preclinical curriculum: a questionnaire survey. BMC Oral Health. 2020; 20: 1-10. https://doi.org/10.1186/s12903-020-01071-0
12. McGleenon EL, Morison S. Preparing dental students for independent practice: a scoping review of methods and trends in undergraduate clinical skills teaching in the UK and Ireland. Br Dent J. 2021; 230: 39-45. https://doi.org/10.1038/s41415-020-2505-7
13. Islam MS, Al-Fakhri, Rahman MM. Computer aided design/computer aided manufacturing (CAD/CAM) technology in the undergraduate dental programs in the MENA region. Eur J Dent Educ. 2024; 28: 142-7.
14. Alhamed FJ, Neiv GF, Bak S, Karl E. Pre-doctoral dental students' computer-aided design/computer-aided manufacturing-related education, knowledge, attitudes and behaviour: a national survey. J Dent Educ. 2023; 87: 562-71.
15. Ishida Y, Kuwajima Y, Kobayashi T, Yonezawa Y, Asack D, Nagai M. Current implementation of digital dentistry for removable prosthodontics in US dental schools. Int J Dent. 2022; 2022: 7331185. https://doi.org/10.1155/2022/7331185

Comparison between immediate and conventional implant loading for fixed and removable prosthesis: A Scoping review

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ABSTRACT

A comparison between immediate and early, versus conventional dental implant loading was explored for this scoping review. Identifying whether one loading protocol is superior to the other or if one offers more success with treatment and patient satisfaction can guide clinicians with choice of implant loading system.

Method

An adapted version of the Arksey and O'Malley six step framework for scoping reviews was followed, and which includes identifying the research question, identifying the relevant studies, study selection, charting the data, collating, summarizing, and reporting the results and consultation. A literature search was conducted with refined eligibility criteria using scientific electronic databases such as PubMed, Springer, Cochraine library, Elsevier, Wiley, and Academia for the period ranging from 2002-2024. Data was synthesized, analyzed and narratively reported in themes.

Results

From the total number of records identified (N=190), only 35 full text articles were included for the qualitative synthesis. Factors such as survival and success rates of implants, marginal bone loss, esthetics and patient satisfaction are similar and comparable for immediate, early and conventional dental implant loading systems. The success with using these loading systems is dependent mainly on primary stability, implant stability quotient and the insertion torque value.

Conclusion

This review provided evidence that *immediate, early and conventional* dental loading may be used as successful treatment options irrespective of whether a fixed or removable prostheses is placed.

Keywords

immediate loading,early laoding, conventional loading, primary stability, implant success

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1. Dr CE. Palanyand – Contributed to Conception, Protocol, Data collection and Analysis and Manuscript preparation and manuscript finalization (65%)
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INTRODUCTION

Edentulism poses an impact on oral and general health as well as quality of life as well, affecting not only mastication but affects the patient psychologically and socially.[1] Dental implants are widely used as an alternative to conventional removable dentures for replacing missing teeth, even though it is more expensive.[2-3] This is due to implants offering patients a better sense of confidence and quality of life, being a more predictable procedure with a higher success rate and relatively less complications compared to removable dentures.[2]

Researchers have identified many factors that are indicative of the successful performance of dental implants, one of which is biocompatibility.[4-5] It does not only involve the compatibility of the material with the tissue but also the ability to perform a specific function meaning that biocompatibility is not only depedant on the physical, chemical and mechanical properties of the material but the application of the material as well. The biocomptibilty of the materials in dental implants is assessed by the interactions between the implant and the tissue and is used as a measure for osseointegration.

The other factors associated with implant success in all loading protocols identified in the literature include biomaterial composition, implant design, biochemical factors, surface characteristics and bone quantity and quality, surgical technique and the medical status of the patient which is described below in Table 1.[4-5]

Three different types of surgical implant loading systems used and described include:

i. *Immediate loading (IL):* designated as the process whereby a prosthesis is attached to the implant within **24 hours** and it is a one stage surgical procedure,[6-8]
ii) *Early loading (EL):* referred to as the loading time when a prosthesis is attached within the **1 week** and 2 months after implant placement,[9-10] and
iii) *Conventional or Delayed loading (CL or DL):* which differs from both immediate and early loading as the prosthesis is only attached after a healing period of **3-6 months.**[6, 11]

Table 1: Factors associated with implant success in all loading protocols

Bicompatibilty properties	Individual reasons related to biocompatibility that impact success of implants
Bio materials	Titanium and bio-cermaic materials are widely and commonly used in fabrication of dental implants due to its high compatibility with hard tissue and living bone, titanium has a sufficient amount of strength and stiffness
Implant design	Length and diameter - influences stress distribution at the bone implant interface, Implant diameter is based on bone quality and quantity to achieve optimal stability, this is also important for stress distribution. Geometry of the influences the interaction between bone and the implant, the surface area, distribution of forces to the bone and stability. Thread of the has an influence on primary stability, enlarges implant surface area, aids in distributing forces evenly and increases the surface area at the bone implant interface
Biochemical factors	Dental implants are anchored in the bone by mechanical interlocking , fibro-osseous retention and osseointegration, mechanical interlocking is associated with implant shape, surface irregularies and roughness, holes or grooves and thread type and number
Surface characteristics	When a material is placed in the body, a biological response will be mediated by the interaction of the implant through its surface. When cells and biomaterials meet, information is exchanged leading to remodeling and activation of specific genes. The first response is the absorption of specific proteins , lipids , ions and sugars allowing activation of cell mechnaims to either accept or reject the implant by determing which and what number of cells will populate the surface. A high percentage of bone to implant contact is necessary to create sufficien anchorage of the implant which is required for osseointegration.
Bone quality and quantity	Bone quality- structural and mineral content affects success or failure of an implant, success rate of the implant is thought to be depedant on the volume quality of surrounding bone. Bone quantity-this is related to bone density Knowing the type of bone present in the maxilla or mandible aids in a better understanding of bone quality or quantity. This is important when planning a treatment strategy
Surgical technique	Surgical techniques should enhance primary stability of the implants.In order to minimize sacrificing bone the osteotome technique was introduced, piezoelectric bone surgery claims to be superior to conventional surgical methods as thos surgery suggests improved precision, selective cutting action, minimal damage ti the nerves and blood vessels , reduced bleeding and absence of overheating.
Medical status	Healther patients will tend to have a higher success rate and certain conditions may increase or exacerbate failure of implant treatment.

Patients view conventional loading as a disadvantage as treatment time is extended and patient discomfort is prolonged. Conventional loading is indictated dependent on the quality and quantity of bone, the number of implants required, the length of the implant and insertion value as this affects primary stability which is a measure of implant successit is also based on what the clinican decides is the best treatment strategy. It is a two-stage technique and the rationale for conventional loading is to ensure that the implant remains in an undisturbed environment throughout the healing phase.[12]

The structural and functional connection between the implant and bone, once loaded, is a measure of osseointegration.[5] Osseointegration is the process of attachment of implants placed in bone, irrespective of the loading system used, and is defined as the direct connection of living bone with the surface of an implant subjected to a functional load. It is a time dependent healing process where clinically asymptomatic rigid fixation of alloplastic materials is achieved and maintained.[13]

Stability of implants are addressed on 3 different levels:
- Primary stability, which is dependent on mechanical engagement with compact bone is a key factor in the success when using the IL system,
- Secondary stability offers biological stability through bone regeneration and remodeling and,
- Tertiary stability is discussed as the maintenance of osseointegration.[11, 14]

Prosthetic factors for implant success are dependent on osseointegrated dental implants providing a stable base for restoration of function and esthetics in completely edentulous patients.[15]

Implant stability may be quantified which makes determining this oucome measurable. The insertion torque value (ITV) of implants, the resonance frequency analysis (RFA), and implant stability quotient (ISQ) measures different aspects of stability. ISQ measures the axial stability and ITV measures rotational stability of implants, and together these factors aid a better understanding of primary stability.[16]

Implant success rate ranges between 92-98% and implant loss ranges between 1-10% (56,57,58) but it is important to be aware of the types of complications which may occur with treatment and how the different forms of treatment or loading systems impact on this. Implant treatments, irrespective of which loading systems are used, are expensive procedures. Thus, failure of these can be very disheartening for the patient. Practitioners must therefore ensure patients are offered the treatment procedures with the best outcomes for placing implants. Therefore, the aim of this scoping review (ScR) was to compare immediate and early with conventional dental implant loading when a fixed or removable prosthesis is placed to assess which implant system is superior to the other independent on the occlusal scheme.

METHODOLOGY

This ScR was conducted using the adapted version of the Arksey and O'Malley six step framework which includes identifying the research question, searching for relevant studies, selecting the studies, charting the data, collating, summarizing, and reporting the results and consultation.[17]

Identification of the research question

The research question for this scoping review was as follows:

How do the procedures of immediate and early compare with conventional dental implant loading that is used on adults requiring implants for fixed or removable prostheses?

This question was formulated using the following guidelines:[18]

- Population (P)- refers to the adult patient requiring implants,
- Concept (C)- the dental implant loading protocol (immediate and early vs conventional) and
- Context (C)- implants placed in the maxillary and/ or the mandibular arches globally.

The outcomes for the ScR were divided into:

- primary which compares immediate and early to conventional dental implant loading
- secondary which investigates implant stability, bone quality and quantity, marginal bone loss, clinical parameters, and patient satisfaction.

Identifying the relevant studies

A search strategy was developed and used in the following online databases PubMed, Elsievier , Springer, Wiley, Cochrane library and Academia. Keyword combinations and synonyms using Boolean operators were used to develop the following broad search strategy:

(Conventional implant loading OR delayed implant loading) AND (early implant loading) AND (immediate implant loading) AND (removable prostheses OR dentures) AND (fixed dental prothesis OR single crowns OR bridges) AND (marginal bone loss OR esthetics OR patient satisfaction OR bone quality OR bone quantity) AND (2002- June 2024).

Study selection

A 3-step screening process was utilized where titles and abstracts were initially screened independently by the two reviewers (CP and SK) and the relevant articles identified and included for full review. Mendeley, a reference management application system, was used for these steps: relevant articles were exported from databases and saved. Then, following the necessary steps, duplicates were eliminated via Mendeley, and abstracts and full text articles reviewed for inclusion.

With reference to the inclusion/ exclusion criteria set for this ScR, articles published in English during the period 2002-2024 and with different study designs (randomized or non-randomized controlled trials, surveys or observational studies) were considered. In addition, adult patients receiving a fixed or removable prosthesis with implants were included. All animal studies were excluded from this scoping review.

Charting the data

The principal researcher charted the data following the inclusion criteria from the included articles and based it on the source (authors, country, date published), methods (sample

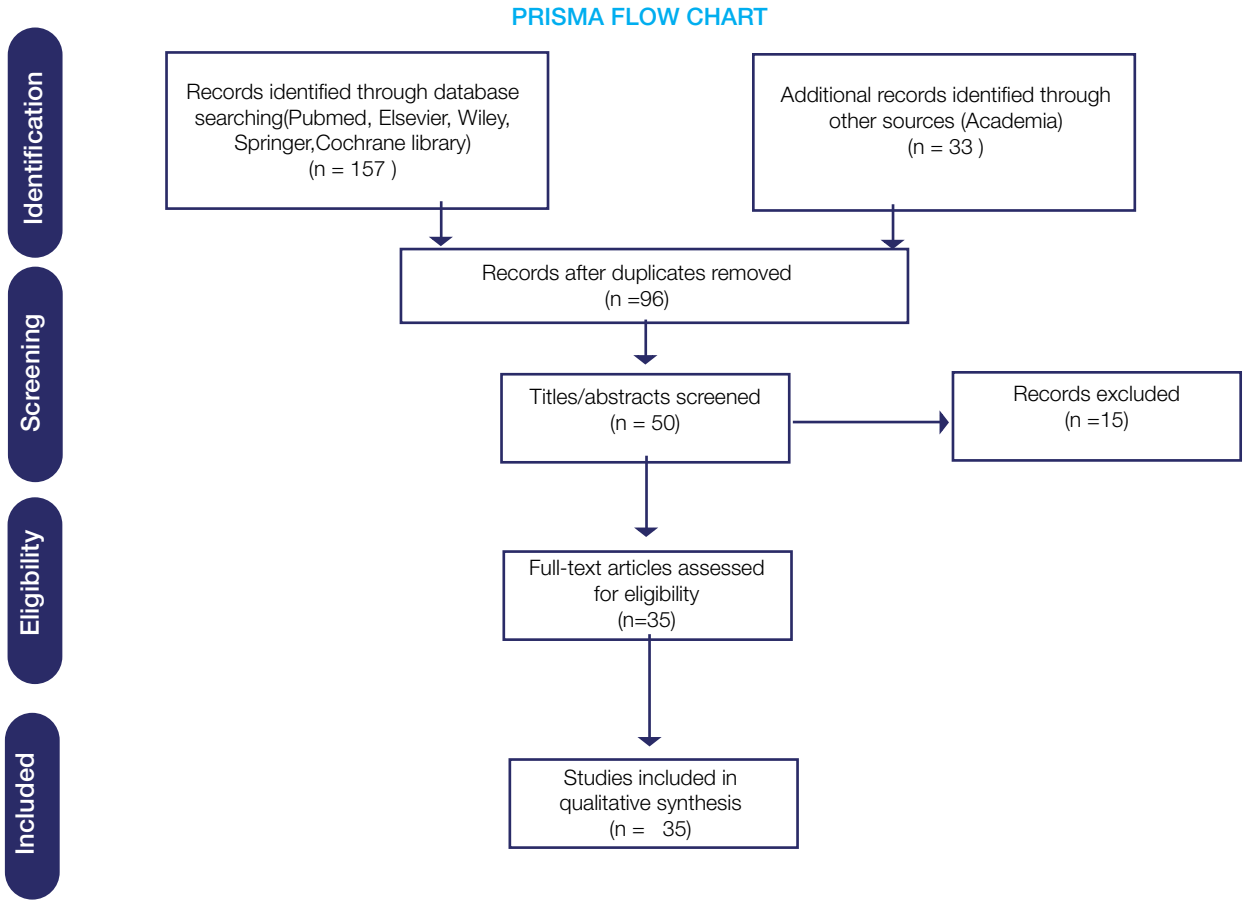

Figure 1: PRISMA Flow chart of database searches for the Scoping Review

Table 2: Characteristics of included studies

Study details	Method	Sample size	Number of implants placed	Maxilla or mandible
Author, year,				
Papaspyridakos P, Chun-Jung C et al, 2014	Systematic review and meta-analysis	62 studies ,8 on early loading, 45 on immediate laoding, 11 on conventional loading	2695	Maxilla and mandible
Windael S, Vervaeke S et al, 2018	Prospective clinical study	21 patients	105 placed with immediate loading	Mandible
Weerapong K, Sirimongkolwattana S et al, 2018	Randomized clinical trial (RCT)	46 patients	46 implants placed , 23 short implants and 23 conventional implants	Mandible
Kern M, Att W et al, 2018	RCT	158 patients	81 immediate loading, 77 conventional loading	Mandible
Benic GI, Mir-Mari J et al, 2014	Systematic review and meta-analysis	10 RCT comparing immediate and conventional loading and 1 comparing immediate and early loading	597	Maxilla and mandible
Kutkut A, Rez M et al, 2019	RCT	20	40 implant placed, 20 immediate loading and 20 conventional loading	Mandible
Kim HS, Cho HA et al, 2018	Retrospective study	52 patients	370 implants placed	Maxilla and mandible
Ter Gunne LP, Dikkes B et al, 2016	Prospective randomized clinical trial	26 patients	26 implants placed, 15 immediate loading and 11 early loading	Mandible
Alfadda SA, Chvartszaid, et al, 2019	RCT	42 patients	not specified but patients were divided into 20 for immediate loading and 22 for conventional loading	Mandible
Koirala DP, Singh SV, et al, 2016	Pilot comparative clinical sttudy	80	not specified but patients were divided into 40 immediate loading and 40 conventional loading	Mandible
Nicolau P, Guerra F et al, 2018,	RCT	56 patients	72 implants, 33 immediate loading and 39 early loading	Maxilla and mandible
Salman A, Thacker S et al, 2019	RCT	23	not specified but patients were divived into 12 for immediate loading and 11 for conventional loading	Mandible
Cordaro L, Torsello F et al, 2009	Systematic review	19 articles, 9 on immediate loading , 8 on early loading and 2 comparing immediate and early loading		Mandible
Schwarz S, Sanz-Martin et al, 2016	Review , consensus report	2 systematic reviews used	not specified	Maxilla and mandible
Reis R, Nicolau P et al, 2019	RCT	24 patients	48 implants placed	Residual mandibular ridge
Helmy MHED, Alqutaibi AY et al, 2017	Systematic review and meta-analysis	7 Rct's were used	336 implants, collectove number from all the RCT'S	Mandible
Kokovic V, Jung R et al, 2014	RCT	12	72 self-tapping implants placed	Mandible
Barewal R, Stanford C et al, 2012	RCT	40 patients	40 implants placed	Maxilla and mandible

Table 2: continued

Study details	Method	Sample size	Number of implants placed	Maxilla or mandible
Raghoebar G, Friberg B et al, 2003	Prospective multicentre clinical trial	83 patients	170 implants placed	Mandible
De Smet E, Duyck J et al, 2007	Prospective clinical trial	30	50 implants placed	Mandible
Schrott A, Riggi-Heiniger M et al, 2014	Systematic review and meta-analysis	24 publications used		Mandible
Schimmel M, Srinivasan M et al, 2014	Systematic review and meta-analysis	58 studies used		Maxilla or mandible
Strietzel FP, Karmon B et al, 2011	Retrospective study	25 patients	283 implants placed	Maxilla and mandible
Jokstad A, Alkumru, 2013	RCT	35 patients	140 implants placed	Mandible
Alsabeeha N, Atieh M et al, 2010	Systematic review and meta-analysis	10 studies used		Mandible
Moraschini V, Porto Barboza E, 2015	Meta- analyis of RCT	27 articles used		Mandible
Yildiz P, Zortuk M et alm 2018	RCT	33 patients	18 implants placed	Maxilla
Abunabi A, Morris M et al, 2019	Systematic review	4 trials used		Maxilla
Zhang S, Wang S et al, 2017	Meta- analyis	29 studies used		Maxilla and mandible
Huynh-Ba g, Oates TW, et al, 2018	Systematic review	9 studies used		Maxilla or mandible and partially edentulous areas
Sanz- Sanchez I, Sanz-Martin I et al , 2014	Systematic review			Maxilla or mandible
Dos Reis RJ, Calha N et al, 2019	RCT	24		Mandible
Atieh MA, Atieh AH et al, 2009	Systematic review and meta-analysis	5 trials		Maxilla or mandible
Zembic A, Glauser R et al, 2009	RCT	11 patients	51 implants placed	Maxilla or mandible
Nkenke E, Fenner M, 2006	Review of literature	38 papers		Maxilla and the mandible

size, study designs), study details (number of implants, implant system, location of the implant, implant length type of fixed/ removable prosthesis), participant information, study outcomes, conclusion and limitations.

Collating, summarizing, and reporting the result

Themes, identified from the literature were created and results of the ScR synthesized accordingly and the outcomes were narratively reported.

Results

Ethics approval was obtained from the institutional ethics board, where it was considered as a low risk study (BMREC No: BM20/1/6).

Demographics of included publications

The databases search identified 118 pubmed, 15 Elsievier, 16 Wiley, 7 Springer , 33 Academia and 1 from the Cochrane library which resulted in190 records. Once duplications (N=94) were eliminated using Mendeley, the remaining 96 records' titles and abstracts were screened further using criteria set for inclusion. After elimination of the studies that did not meet the inclusion criteria, only 35 full-text records were identified as eligible for this ScR (Figure 1).

Characteristics of Included studies (Table 2)

Studies investigating the success and comparability of the different implant loading systems were conducted in different parts of the world as seen with all included studies. All included studies are tabulated in Table 2. Most studies (N=27) were completed in 1st world countries where implants are placed more often, and only one study was conducted in Africa.[19] The study designs for the included studies were varied, indicating the differing qualities of research completed. Some were primary research studies for example, randomized controlled clinical trials (RCT) (N=14).[9, 14, 16, 20-37]

Others were secondary studies, such as systematic reviews (SR) (N=7),[1,10, 19, 38-41] and 3 were SRs with a meta-analysis,[42-44] 1 had completed a meta-analysis only,[45] and 2 unstructured reviews of the literature were also included.[46-47]

The sample sizes varied per study in terms of number of patients, number of implants placed per jaw and number of jaws that were included in the study. Only 2 studies investigated placement of implants in the maxilla, and a few where implants were placed in both the mandible and maxilla (N=13).[10,16,25,29,33-34,37,40-42,44-45,47] The majority (N=20) of records, however, discussed implants placed in the mandible only.[9,14,19,20-24,27-28,30–32,35-36,38-39,43,46]

Outcomes of Included studies (Tables 3 and 4)

The outcomes are presented in themes which were decided based on information deemed most relevant to the subject at hand. These themes focused on all 3 dental loading protocols and factors contributing to implant success (implant stability, bone quality and quantity, marginal bone loss), patient satisfaction and esthetic outcomes. Results are tabulated into two decades (Tables 3 and 4). Table three includes outcomes from 2002- 2012 and table four includes outcomes from 2013-2024.

Table 3: Outcomes of the included studies for the period 2002-2012

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Cordaro L, Torsello F et al, 2009	Italy	Evaluating the predictability of EL and IL in the posterior mandible	**Positive outcome:** IL good survival rates
Barewal R, Stanford C et al, 2012	Iowa	Comparing stability of dental implants placed IL, EL and CL.	**Positive outcome:** IL, EL , CL no difference in bone level, minimum ITV and ISQ required,
Raghoebar G, Friberg B et al, 2003	Sweden	Implant survival and peri-implant conditions around endoosseous implants inserted in one stage surgery	**Positive outcome:** implant survival. Patient satisfcation:good function and esthetic.
De Smet E, Duyck J et al, 2007	Belgium	Implant outcome of IL, EL and CL/DL of implants in the edentulous mandible	**Positive outcome:** EL comparable to CL, good survival rate
Strietzel FP, Karmon B et al, 2011	Berlin, Germany	Treatment of implant prosthetic rehabilitation with implants in the edentulous maxilla and mandible in IL with fixed prosthesis.	**Positive outcome:** IL good survival rates
Alsabeeha N, Atieh M et al, 2010	New Zealand	Evaluate evidence of all randomized and non-randomized trials comparing IL, EL and CL protocols for mandibular implant over-dentures.	**Positive outcome:** Implant survival
Abunabi A, Morris M et al, 2019	Brazil	Comparing IL vs EL AND DL on implant supported maxillary complete dentures	**Patient satisfaction:** chewing, swallowing, ease of OH, esthetics, OHRQoL, BOP, Plaque and probing depth, Implant success, Prosthesis success and survival **Negative outcomes:** marginal bone loss, occurrence of mucositis and peri-implantitis Biomechanical complications: screws loosening or fractured prosthetic components.
Zembic A, Glauser R et al, 2009	Switerland	Testing whether IL implants exhibit the same survival and complication rates as EL implants.	**Positive outcome:**Implant survival rates
Nkenke E, Fenner M,2006	Germany	Comparing implant survival and success rates for IL and CL implants based on the highest level of evidence for these 2 clinical approaches.	**Positive outcome:**Implant survival and success

Table 4: Outcomes of included studies for the period 2013-2024

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Papaspyridakos P, Chun-Jung C et al, 2014	Boston	Investigate effect IL compared to EL and CL with fixed implant prosthesis	**Positive outcome:** IL implant success compared to EL and CL.
Windael S, Vervaeke S et al, 2018	Belgium	Long term clinical outcome of IL in an edentulous mandible	**Positive outcome:** IL high implant survival after 10 years
Weerapong K, Sirimongkolwattana S et al, 2018	Thailand	Compare IL of short implants (6mm) and standard implants(10mm) in a single md molar tooth	**Positive outcome:** IL of short implants comparable to coventional length implants, implant survival
Kern M, Att W et al, 2018	Germany	Investigate the survival of a single implant in the edentulous mandible retained by a complete denture and that it is not compromised by IL	**Negative outcome:** IL lower survival rate after 2 yearswith single midline implants. Positive outcome: CL better survival
Benic GI, Mir-Mari J et al, 2014	Switerland	IL single crowns renders different clinical results to EL and CL with respect to primary stability, marginal bone loss, stability of peri-implant survival rate, esthetics and patient satisfaction.	**Positive outcome:** IL and CL implant survival, minimal marginal bone loss, no effect on papilla level. Patient satisfcation: good esthetics
Kutkut A, Rez M et al, 2019	Kentucky	Comparing survival of implants IL with mandibular overdenture using 2 locator attachments vs DL, clinically and radiographically comparing peri-implant response around implants IL vs DL with mandibular complete over dentures.	**Positive outcome:** implant survival , implant stability, ISQ, minimal marginal bone loss, keratinized mucosa, modified GI and PI,
Kim HS, Cho HA et al, 2018	Korea	Evaluate full arch rehabilitation of patients with IL implants assessing cumulative implant survival rate, risk factors for implant failure and patient satisfaction.	**Positive outcome:** implant survival good with IL and CL after 7 years. Patient satisfaction:chewing ability, esthetics
Ter Gunne LP, Dikkes B et al, 2016	Amsterdam	Compare clinical and radiographic outcomes between EL and IL implants in support of mandibular over dentures.	**Positive outcome:** IL comparable to CL, implant. survival. Technical outcome: prosthesis survival.
Alfadda SA, Chvartszaid, et al, 2019	Toronto, Canada	The long term prognosis and complications of 4 IL and CL implants for mandibular fixed prosthesis, asses peri-implant changes in bone level	**Positive outcome:** IL comparable to CL after 10 years, implant survival
Koirala DP, Singh SV, et al, 2016	India	Evaluate and compare clinical outcomes of IL implants with CL implants using the EL protocol	**Positive outcome:** implant success.
Nicolau P, Guerra F et al, 2018,	Portugal	Measuring change of crestal bone level on day of surgery and 10 years in the IL and EL group. Evaluate implant survival after 10 years between the maxilla and the mandible	**Positive outcomes:** IL and EL good long term results , survival rates high for IL and EL
Salman A, Thacker S et al, 2019	Conneticut	Evaluate radiographic bone level change between IL and DL two unsplinted implants supporting a locator-retained mandibular over denture, compare implant survival rates, prosthetic outcomes and clinical parameters between the two groups.	**Positive outcome:**IL and CL showed comparable results after 5 years

Table 4: Continued

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Cordaro L, Torsello F et al, 2009	Italy	Evaluating the predictability of EL and IL in the posterior mandible	Positive outcome: IL good survival rates
Schwarz S, Sanz-Martin et al, 2016	Spain, Germany, Switerland	To critically asses evidence on clinical outcomes of IL vs CL in the edentulous region	Positive outcome:IL and CL good survival rates. Biomechanical complication: implant location, type of restoration and number of implants can influence implant loss.
Reis R, Nicolau P et al, 2019	Portugal	Comparing clinical and radigraphic clinical outcomes of IL vs EL with two splintered narrow diameter implants for mandibular over dentures in residual ridges	Positive outcome: implant survival in IL and EL after 3 years. Negative outcome: crestal bone level changes after 3 years
Helmy MH, Alqutaibi AY et al, 2017	Egypt	Evaluating the similarity between IL and EL protocols and if they have similar outcomes related to implant failure and peri-implant marginal bone loss in patients requiring unsplinted two implant supported over dentures.	Positive outcome:IL and CL good suvival rates
Kokovic V, Jung R et al, 2014	Zurich	Comparing IL and EL clinical results of self tapping implants in the posterior mandible	Postitive outcome : implant survival, minimal marginal bone loss
Schrott A, Riggi-Heiniger M et al, 2014	Boston	Present, analyze and summarize clinical and scientific evidence in partially edentulous patients with extended edentulous sites, identify criteria associated with loading protocols.	Positive outcome: IL comparable to EL and CL, good survival rates, minimum ISQ, ITV required
Schimmel M, Srinivasan M et al, 2014	Switerland	Testing the hypothesis that IL protocol for implant supported over dentures shows 1 year survival rates similar to that of EL and CL.	Postive outcome: implant survival.
Jokstad A, Alkumru, 2013	Norway, Canada	Appraise clinical outcomes following loading of 4 implants in the mental foramina area in the mandible with a full- arch fixed dental prosthesis converted from the pre-existing denture of the patient with IL	Positive outcome:IL good survival rate. Biomechanical outcome: full arch fixed dental prostheis converted from pre-existing denture showed good results after 5 years
Moraschini V, Porto Barboza E, 2015	Brazil	Comparing implant survival, marginal bone loss, any complications of IL and CL of single implants inserted in the posterior mandible.	Positive outcome: implant survival. Negative outcome: marginal bone loss.
Yildiz P, Zortuk M et alm 2018	Turkey	Comparing pink esthetic score (PES) outcomes after 1 year follow -up of IL and LL/CL after implant restoration of a single tooth in the anterior maxilla.	Patient satisfaction: IL and CL good esthetics
Abunabi A, Morris M et al, 2019	Brazil	Comparing IL vs EL AND DL on implant supported maxillary complete dentures	Patient satisfaction: chewing, swallowing, ease of OH, esthetics, OHRQoL, BOP, Plaque and probing depth, Implant success, Prosthesis success and survival Negative outcomes: marginal bone loss, occurrence of mucositis and peri-implantitis Biomechanical complications: screws loosening or fractured prosthetic components.

Table 4: Continued

Study details	Author country affiliation	Aims/objectives	Outcomes
Author, year,			
Zhang S, Wang S et al, 2017	China	Compare clinical and radiographic outcomes between IL, EL and CL using indexes implant failure rate, marginal bone levels and changes and ISQ. Investigate impact of loading protocols CL and EL, implant locations, implant number per patient, type of prostheses, loading concept and follow-up time meta-analysis.	Positive outcome:implant success
Huynh-Ba g, Oates TW, et al, 20 18	Texas, Baltimore	Comparing IL , EL and CL in terms of patient reported outcomes	Patient satisfaction: IL positive impact on oral health realated quality of life
Sanz- Sanchez I, et al , 2014	Spain	Assess if IL achieves comparable clinical outcomes when compared to CL depending on the type of restoration used to rehabilitate the edentulous area.	Negative outcomes: IL implant failure was greater than compared to CL, IL less crestal bone resorption during healing. Postive outcome: implants survival was still good . Patient satisfcation: IL improved function and comfort
Dos Reis RJ, Calha N et al, 2019	Portugal	Comparing radiographic and clinical outcome of IL and EL with two-splinted narrow-diameter implants for mandibular implant over-dentures in a thin non-augmented residual ridge	Positive outcome:IL and EL good implant survival rates after 3 years

1. Dental loading protocols and implant success

The articles (N=35) included for this ScR compared IL to CL/ DL, EL to CL/ DL and all three (IL, EL, CL) loading protocols to understand what factors contributes to the success of implants placement and the method used to do this. A systematic review conducted by Abdunabi *et al*, 2019 compared IL to EL and CL on an implanted supported maxillary complete denture.[1] This SR found that the IL system is as effective as the EL and the CL ones. There was no difference in survival rates of the implants or the prosthesis.

Results from 2 different RCTs with a follow-up period of 10 years, indicated similar results as the study by Abdunabi *et al* (2019). The 1st RCT compared IL to CL of a mandibular implant supported fixed prosthesis and reported no differences between these 2 implant loading protocols.[22] In this RCT, an insertion torque of >35Ncm to achieve primary stability was highlighted, thus 4 implants were placed to support the mandibular prosthesis. The 2nd RCT, by Nicolau *et al*, (2018), determined long-term performance of chemically modified sandblasted, large-grit and acid etched surface (SLActive) implants following IL or EL protocols in the posterior maxilla or mandible. It was reported that there was a high implant survival rate and total change in crestal bone level (from -1.05±1.06mm) between delivery and final prosthesis after the 10-year follow-up.

A 3-year follow-up study conducted by Ter Gunne *et al* (2018) compared clinical as well as radiographic outcomes between IL and CL implants in the support of a mandibular overdenture.[9] Implant stability was good and insertion torque of 35 Ncm was achieved, no prosthesis was lost, no prosthetic complications reported and the mean bone loss was 0.35±0.63mm for IL and 0.31±0.96mm for CL.[9]

Cordaro *et al*. conducted a systematic review evaluating the predictability of immediate loading (IL) and early loading (EL) protocols in the posterior mandible. The findings support the use of IL and EL protocols with microroughened dental implants in partially edentulous posterior mandibles, provided that modifying risk factors are absent. Clinical outcomes suggest that both protocols are viable within a 6–8 week healing period and can be applied successfully in most posterior mandibular cases, whether for single crowns or fixed dental prostheses. The review further reported no significant changes in peri-implant bone levels, indicating predictable stability of the peri-implant environment when these protocols are followed [46].

2. Clinical factors contributing to implant success

Factors contributing to implant success included primary stability, insertion torque, marginal bone loss, the number of implants inserted and the arch location of the implants.
An implant stability quotient (ISQ) clinically ranging between 55-80 is an indication of implant stability.[23,49-50] A study conducted by Kim *et al*, 2018 evaluated cumulative survival rate (CSR) looking at risk factors for implant survival and patient satisfaction.[33] The 7-year CSR was 0.989 for IL and 0.986 for DL.[33] This study indicated that the differences in CSR was dependant on the length of the implant making it the key factor for maximum strength for primary stability.[33]

It was also identified that the ITV had to be within the range of 20-35Ncm for initial primary stability, to allow a stable platform for a prosthesis whether fixed or removable.[21-22,35] This ITV and RFA gives a clinical, non-invasive measurement of implant and bone stiffness.[16,48]

In terms of marginal bone loss, included studies indicated that although there is a minor discrepancy there is no

statistically significant difference between IL and CL implant systems.[1,32,39] Mean marginal bone loss after 3 years was found to be 0.22mm, whilst the mean ITV at implant placement differed according to the bone type:

- Type 1 bone is when bone is homogenous with very thick cortical bone and
- Type 2 bone has a thick layer of cortical bone that surrounds a core of dense trabeculae bone and the ITV for both these types were 32Ncm,
- Type 3 bone is described as having a thin layer of cortical bone with dense trabeulaue bone and has good strength its ITV is recorded as 17Ncm which is half the previous types whilst,
- Type 4 bone has very thin corticol bone with low-density trabecular bone and is of poor strength with the lowest ITV at 10Ncm.[16]

This showed a significant difference in bone loss and that ITV is a good objective measure for bone type. The ITV for bone types 1 and 2 fit well within the recommended range and thus meet the standard required. Ideally, however, these bone types should also have a RFA of 60 before an implant is recommended to be placed.[1,16,32,39] The initial high ITV preferred was >35Ncm and an ISQ value of > 60 before considering an implant for IL to EL protocols.[1,16,32,39] It was also found that an ITV of 20 Ncm may be an important threshold determinant in IL of single tooth implants in the posterior region.[16]

3. Patient satisfaction and esthetics

The parameters used to asses patient satisfaction was comfort, esthetics, functionality and the ability to taste. A study by (Kim *et al*, 2018) evaluated implant success and patient satisfaction of IL systems in completely edentulous arches.[33] It was found that only the length of the implant affected the implant failure rate and that after 1.5 -7 years after implant placement, patient satisfaction was still high.[33] Similarly, 2 other studies investigated patient satisfaction was reported that patients preferred a fixed functional denture and IL was more satisfying than EL.[1,40] IL and immediate placement in a single tooth edentulous space seems to have a positive impact and these studies concluded that protocol selection is based on what the patients' preference is as well as the practitioner's skills.[1] A study by Nicolau *et al*, 2018 found patient sastisfaction was high for both IL and EL.[25] A restrospective study by Kim *et al*, 2018 did not only evaluate CSR but patient satisfaction and it was found that irrespective of the length of time following implant placement, there was a high degree of patient satisfaction for both IL and CL.[33]

Yildez, P *et al*, (2018) evaluated patient esthetics after 1 year with a small study sample (N=33) and compared IL (N=18 implants) to CL (N=15 implants) systems.[26] The pink esthetic score (PES) was determined, and it was found that there was no significant difference with these values between the IL and CL groups.[26] This was an indication that IL does not have a negative effect on the esthetics.[26]

DISCUSSION

The research question for this scoping review was to compare immediate and early to conventional dental loading and the supporting evidence/ outcomes were quite clear about these being comparable. Findings observed in this review mirrors previous studies which examined the success of immediate and conventional dental implant loadings. Similarities were reported by the different researchers regarding the success of IL and CL or DL loading protocols.[21-22,27,41,44,51]

This Scoping Review (ScR) provided evidence that immediate, early, and conventional dental implant loading are all viable treatment options. This finding aligns with the existing literature on implant success and highlights key contributing factors, including implant design, the number of implants placed, biomechanical considerations, surface characteristics, and the quality and quantity of the bone, all of which play a critical role in treatment outcomes..[4-5,52-53]

Critical factors such as primary stability, implant stability quotient, bone quality and quantity in either dental arch, marginal bone loss, implant design and number of implants were irdentified as necessary for the survival and success of implants. Marginal bone loss (MBL) was included in the investigations for both IL and CL dental implants systems and recorded as a measurement of success. The outcomes of included studies were in agreement with these outcomes of stability and provided guidelines such as the range and values for ITV, RFA and ISQ to gauge for placing implants using IL and EL systems .[21-23,35,49-50] Other researchers were also in agreement with these findings, indicating that if IL implants are placed, and primary stability or the ITV is greater than 30Ncm, success rates could be as excellent as 95%.[22]

Primary stability is highlighted by several researchers as the single most important factor relating to the success of the implant. This is in agreement with the evidence that states, to achieve optimal osseointegration functional loading should be done on an immobile implant, to determine primary stability in immediate dental loading.[54] Similarly, Yildiz *et al*, 2018 found no differences in IL and CL regarding esthetics and suggested that immediate non-occlusal loading should be performed according to a specific protocol with attention to primary stability.[26]

Even though these two protocols showed that they are comparable, results of a study conducted by Kern *et al*, 2018 indicated that CL of dental implants is still the most used and offered dental loading protocol.[20] This is mostly due to the fact CL has been studied more extensively and more research is available with this treatment protocol, and it is also not as demanding a procedure as the IL system.[20,46] There was only one study indicating that failure with IL was greater than with CL.[41]

Regarding surface characteristics of an implant evidence supports loading of microroughened dental implants in the partially edentulous posterior mandible at 6-8 weeks in the absence of factors such as fresh extraction sockets, guided bone regeneration and short implants.[46] Authors suggested that loading within 6-8 weeks could be considered for a majority of clinical situations in the posterior mandible with either single crowns or fixed dental prosthesis, making the IL system a viable option.[46] Their evidence also suggests that chemically modified surfaces of an implant loaded within 4-5 weeks shows a good survival rate regardless of the type of bone it is placed in, again favoring a IL system.[46] Marginal bone loss was considered comparable in IL and CL or DL dental implant systems indicated via the radiographic analysis. [21,16,46]

Differences in CSR is dependent on the length of the implant which is associated with a higher survival rate and

it is a measure of a reduction in bone stress irrespective of bone quality, but improving stability and thus success of implants placed.[33] This outcomes definitely impacts on patients' satisfaction, regardless of age, length of implant or loading system used. It is suggested that a patient-centered treatment approach be adopted as these are measures of patient satisfaction and aesthetics. These should be evaluated together with implant survival rate, marginal bone loss and peri-implant tissue responses.[33]

CONCLUSION

Immediate, early and conventional dental loading can be used as successful and viable treatment options.

Survival and success rates, marginal bone loss, esthetics and patient satisfaction are similar and comparable in immediate, early and conventional dental implant loading whether there is a fixed or a removal prothesis.

Even though the literature span is over two decades there are no significant differences.

Limitations

- The literarure for this scoping review was conducted between 2002-2024 so very little primary research was conducted and available thus a true measure of IL or EL systems outcomes were not available.
- These studies used standard radiographs to measure marginal bone loss and no other advanced measurement such as Cone beam computed tomography (CBCT) was used. This could have affected the results provide with marginal bone loss.
- Even though studies spoke briefly on the medical status of patients, there was evidence lacking on how this affects the success of implants placed and the different protocols as discussed. Certain medical conditions can affect the periodontium which could in effect affect the prognosis of the implant. Newer literature speaks a lot more what the long effect could be on the survival of the implant itself.
- There are not many long-term follow-up studies (10 years or more), which could provide stronger evidence related to the success of implants or assessing factors such marginal bone loss possibly differing over time and assessing peri-implant soft tissue not just after 12 months. It is therefore suggested the short-term study results be interpreted with caution. Newer literature has a few more long term studies but is based more in immediate and conventional dental loading specifically.
- Some of the sample sizes were small, or poorly reported and as such resulted in a cautious approach to interpreting the results.

Recommendations

- Primary research investigating and producing new knowledge related to IL and EL systems .
- Comparing marginal bone on standard radiographs and CBCT.
- Conducting studies with larger samples and over a longer period and with clinical application.
- Addressing more studies possibly based on the occlusal scheme.

AUTHORSHIP

CP: Contributed to Conception, Protocol, Data collection and Analysis and Manuscript preparation and manuscript finalization (65%)

SK: Contributed to Protocol, Data Analysis and Manuscript preparation and manuscript finalization (35%)

CONFLICT OF INTEREST

The authors declare no conflict of interest

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DATA AVAILABILITY STATEMENT

1. The datasets generated during and/or analysed during the current study are available from the corresponding authors on reasonable request.
2. Data generated or analysed during this study are included in this published article.

REFERENCES

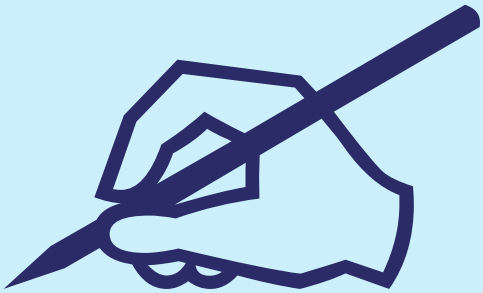
1. Abdunabi A, Morris M, Nader SA, De Souza. Impact of immediately loaded implant supported maxillary full-arch dental prostheses: a systematic review. J Appl Oral Sci. 2019, 27: e20180600
2. Khang Hong DG, Oh JH. Recent advances in dental implants. Maxillofac Plast Reconstr Surg. 2017, 39(1): 33. Published online 2017 Nov 5. doi: 10.1186/s40902-017-0132-2
3. Oshida Y, Tuna EB, Aktören O, Gençay K. Dental Implant Systems. Int. J. Mol.Sci. 2010, 11(4): pp.1580-1678. doi.org/10.3390/ijms11041580
4. Ratner BD. The biocompatibility of implant materials. Published in: Host Response to Biomaterials, 2015, Chapter 3: pp.37-51. Academic Press. https://doi.org/10.1016/B978-0-12-800196-7.00003-7
5. Gaviria L, Salcido JP, Guda T, Ong JL. Current trends in dental implants. J Korean Assoc Oral Maxillofac Surg. 2014, 40(2): pp. 50-60
6. Lee, J. H., Frias, V., Lee, K. W., & Wright, R. F. Effect of implant size and shape on implant success rates: a literature review. The Journal of prosthetic dentistry, 2005, 94(4): pp. 377–381. https://doi.org/10.1016/j.prosdent.2005.04.018
7. Palmer R. Introduction to dental implants. British Dental Journal. 1999, 187: pp. 127-132
8. Gulsahi A. Bone Quality Assessment for Dental Implants, Implant Dentistry - The Most Promising Discipline of Dentistry, 2011, Prof. Ilser Turkyilmaz (Ed.), ISBN: 978-953-307-481-8, InTech
9. Ter Gunne, L. P., Dikkes, B., Wismeijer, D., & Hassan, B. Immediate and Early Loading of Two-Implant-Supported Mandibular Overdentures: Three-Year Report of Loading Results of a Single-Center Prospective Randomized Controlled Clinical Trial. The International journal of oral & maxillofacial implants, 2016, 31(5), 1110–1116. https://doi.org/10.11607/jomi.4561
10. Papaspyridakos, P. et al. 'Implant Loading Protocols for Edentulous Patients with Fixed Prostheses: A Systematic Review and Meta-Analysis', The International Journal of Oral & Maxillofacial Implants, 2014, 29(Supplement), pp. 256–270. doi: 10.11607/jomi.2014suppl.g4.3.
11. Tettamanti L, Andrisani C, Bassi MA, Vinci R, Silvestre-Rangil J, Tagliabue A. Immediate loading implants: review of the critical aspects. Oral Implantol, 2017, 27;10(2):pp.129-139.
12. Elias CN, Factors affecting the success of dental implants. Published in: Implant Dentistry - A Rapidly Evolving Practice. 2011. Pp.320-331(www.intechopen.com)
13. Parithimarkalaignan S, Padmanabhan TV. Osseointegration:An Update. J Indian Prothodont Soc. 2013,13(1): pp. 2-6
14. Weerapong K, Sirimongkolwattana S, Sastraruji T, Khongkhunthian P. Comparative study of immediate loading on short dental implants and conventional dental implants in the posterior mandible: A randomized clinical trial. Int J Oral Maxillofac Implants 2019, 34(1): pp.141–149. doi: 10.11607/jomi.6732. Epub 2018 Dec 5. PMID: 30521662.
15. Montero J. A Review of the Major Prosthetic Factors Influencing the Prognosis of Implant Prosthodontics. Journal of clinical medicine, 2021, 10(4): 816. https://doi.org/10.3390/jcm10040816
16. Barewal, R. M., Stanford, C., & Weesner, T. C. A randomized controlled clinical trial comparing the effects of three loading protocols on dental implant stability. The International journal of oral & maxillofacial implants, 2012, 27(4): 945–956. http://www.ncbi.nlm.nih.gov/pubmed/22848898.
17. Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review of scoping reviews: advancing the approach and enhancing the consistency. Res Synth Methods. 2014, 5(4): pp. 371-85. doi: 10.1002/jrsm.1123.
18. Baumann. How to use the clinical medical subject headings (MeSH). International journal of Clinical Practice. 2016, 70(2): pp.171-174
19. Helmy, M. H. E. D. et al. 'Effect of implant loading protocols on failure and marginal bone loss with unsplinted two-implant-supported mandibular overdentures: systematic review and meta-analysis', International Journal of Oral and Maxillofacial Surgery, 2018, 47(5): pp. 642–650. https://doi.org/10.1016/j.ijom.2017.10.018
20. Kern, M. et al. 'Survival and Complications of Single Dental Implants in the Edentulous Mandible Following Immediate or Delayed Loading: A Randomized Controlled Clinical Trial', Journal of Dental Research, 2018, 97(2), pp. 163–170. doi: 10.1177/0022034517736063.
21. Kutkut, A. et al. 'Immediate loading of unsplinted implant retained mandibular overdenture: A randomized controlled clinical study', Journal of Oral Implantology, 2019, 45(5): pp. 378–389. doi: 10.1563/aaid-joi-D-18-00202.
22. Alfadda SA, Chvartszaid D, Tulbah HI, Finer Y. Immediate versus conventional loading of mandibular implant-supported fixed prostheses in edentulous patients: 10-year report of a randomised controlled trial. Int J Oral Implantol. 2019,12(4): pp. 431-446.
23. Kokovic V, Jung R, Feloutzis A, Todorovic VS, Jurisic M, Hämmerle CH. Immediate vs. early loading of SLA implants in the posterior mandible: 5-year results of randomized controlled clinical trial. Clin Oral Implants Res. 2014, 25(2): pp.e114-9. doi: 10.1111/clr.12072. Epub 2012 Dec 21. PMID: 23278375.
24. Dos Reis RJ, Calha N, Messias A, Guerra F, Nicolau P. Immediate vs early loading of

mandibular overdentures 3-year follow-up of a RCT. Clinical oral implants research. 2019, (30): pp. 26-28.

25. Nicolau, P. et al. '10-year outcomes with immediate and early loaded implants with a chemically modified SLA surface', Quintessence International, 2019, 50(2): pp. 114–24. doi: 10.3290/j.qi.a41664.
26. Yildiz, P. et al. 'Esthetic outcomes after immediate and late implant loading for a single missing tooth in the anterior maxilla', Nigerian Journal of Clinical Practice, 2018, 21(9), pp. 1164–1170. doi: 10.4103/njcp.njcp_17_18
27. Salman, A. et al. 'Immediate versus delayed loading of mandibular implant-retained overdentures: A 60-month follow-up of a randomized clinical trial', Journal of Clinical Periodontology, 2019, 46(8): pp. 863–871. doi: 10.1111/jcpe.13153.
28. Jokstad, A. and Alkumru, H. 'Immediate function on the day of surgery compared with a delayed implant loading process in the mandible: A randomized clinical trial over 5 years', Clinical Oral Implants Research, 2014, 25(12): pp. 1325–1335. doi: 10.1111/clr.12279.
29. Zembic´ A, Glauser R, Khraisat A, Ha¨mmerle CHF. Immediate vs. early loading of dental implants: 3-year results of a randomized controlled clinical trial. Clin. Oral Impl. Res. 2010, 21: 481–489. doi10.1111/j.1600-0501.2009.01898.x
30. Reis, R. J. A. Dos et al. 'Immediate vs early loading of mandibular overdentures - 3-year follow-up of a RCT', Clinical Oral Implants Research, 2019, pp. 29–29. doi: 10.1111/clr.47_13508.
31. Windael, S. et al. 'Ten-year follow-up of dental implants used for immediate loading in the edentulous mandible: A prospective clinical study', Clinical Implant Dentistry and Related Research, 2018, 20(4): pp. 515–521. doi: 10.1111/cid.12612.
32. De Smet E, Duyck J, Vander Sloten J, Jacobs R, Naert I. Timing of loading--immediate, early, or delayed--in the outcome of implants in the edentulous mandible: a prospective clinical trial. Int J Oral Maxillofac Implants. 2007, 22(4): pp. 580-594.
33. Kim, H. Sung et al. 'Implant survival and patient satisfaction in completely edentulous patients with immediate placement of implants: A retrospective study', BMC Oral Health, 2018, 18(1), pp. 1–9. doi: 10.1186/s12903-018-0669-1.
34. Strietzel FP, Karmon B, Lorean A, Fischer PP. Implant-prosthetic rehabilitation of the edentulous maxilla and mandible with immediately loaded implants: preliminary data from a retrospective study, considering time of implantation. Int J Oral Maxillofac Implants. 2011, 26(1): pp.139-147.
35. Koirala, D. P. et al. 'Early loading of delayed versus immediately placed implants in the anterior mandible: A pilot comparative clinical study', Journal of Prosthetic Dentistry, 2016, 116(3): pp. 340–345. doi: 10.1016/j.prosdent.2016.02.011.
36. Raghoebar, G. M. et al. '3-Year prospective multicenter study on one-stage implant surgery and early loading in the edentulous mandible', Clinical Implant Dentistry and Related Research, 2003, 591): pp. 39–46. doi: 10.1111/j.1708-8208.2003.tb00180.x.
37. Schwarz F, Sanz-Martín I, Kern JS, Taylor T, Schaer A, Wolfart S, Sanz M. Loading protocols and implant supported restorations proposed for the rehabilitation of partially and fully edentulous jaws. Camlog Foundation Consensus Report. Clin Oral Implants Res. 2016, 27(8): pp. 988-92. doi: 10.1111/clr.12736. Epub 2016 Jan 8. PMID: 26748679; PMCID: PMC5064627.
38. Schrott, A. *et al.* 'Implant Loading Protocols for Partially Edentulous Patients with Extended Edentulous Sites—A Systematic Review and Meta-Analysis', The International Journal of Oral & Maxillofacial Implants, 2014, 29(Supplement), pp. 239–255. doi: 10.11607/jomi.2014suppl.g4.2.
39. Alsabeeha, N., Atieh, M. and Payne, A. G. T. 'Loading protocols for mandibular implant overdentures: A systematic review with meta-analysis', Clinical Implant Dentistry and Related Research, 2010, 12(Suppl 1), e28-e38. https://doi.org/10.1111/j.1708-8208.2009.00152.x
40. Huynh-Ba, G. Oates, TW. and Williams, MAH. 'Immediate loading vs. early/conventional loading of immediately placed implants in partially edentulous patients from the patients' perspective: A systematic review', Clin Oral Implants Res, 2018, 29, pp. 255–269. doi: 10.1111/clr.13278.
41. Sanz-Sanchez I, Sanz-Martın I, Figuero E, Sanz M. Clinical efficacy of immediate implant loading protocols compared to conventional loading depending on the type of the restoration: a systematic review. Clin. Oral Impl. Res. 00, 2014, 1–19. doi: 10.1111/clr.12428
42. Benic, G., Mir-Mari, J. and Hämmerle, C. 'Loading Protocols for Single-Implant Crowns: A Systematic Review and Meta-Analysis', The International Journal of Oral & Maxillofacial Implants, 2014, Suppl 4: pp. 222–238. doi: 10.11607/jomi.2014suppl.g4.1.
43. Moraschini, V. and Porto Barboza, E. 'Immediate versus conventional loaded single implants in the posterior mandible: A meta-analysis of randomized controlled trials', International Journal of Oral and Maxillofacial Surgery, 2016, 7: pp. 85–92. doi: 10.1016/j.ijom.2015.07.014.
44. Atieh MA, Atieh AH, Payne AG, Duncan WJ. Immediate loading with single implant crowns: a systematic review and meta-analysis. Int J Prosthodont. 2009, 22(4):378-87. PMID: 19639076.
45. Zhang, S., Wang, S. and Song, Y. 'Immediate loading for implant restoration compared with early or conventional loading: A meta-analysis', Journal of Cranio-Maxillofacial Surgery, 2017, 5: pp. 793–803. doi: 10.1016/j.jcms.2016.05.002
46. Cordaro L, Torsello F, Roccuzzo M. Implant loading protocols for the partially edentulous posterior mandible. Int J Oral Maxillofac Implants. 2009;24 Suppl: pp. 158-168.
47. Nkenke E, Fenner M. Indications for immediate loading of implants and implant success. Clin. Oral Imp. Res. 17 (Suppl. 2), 2006: pp. 19–34
48. Schimmel, M. *et al.* 'Loading protocols for implant-supported overdentures in the edentulous jaw: a systematic review and meta-analysis', Int J Oral Maxillofac Implants, 2014, 29: pp. 271–286.
49. Sennerby, L. and Gottlow, J. Clinical outcomes of immediate/early loading of dental implants. A literature review of recent controlled prospective clinical studies. Australian Dental Journal 2008, 53 Suppl 1: pp. S82–S88. https://doi.org/10.1111/j.1834-7819.2008.00045.x
50. Bornstein MM, Hart CN, Halbritter SA, Morton D, Buser D. Early loading of non-submerged titanium implants with a chemically modified sand-blasted and acid-etched surface: 6-month results of a prospective case series study in the posterior mandible focusing on peri-implant crestal bone changes and implant stability quotient (ISQ) values. Clin Implant Dent Relat Res. 2009, 11(4): pp. 338-47
51. Chen J, Cai M, Yang J, Aldohohrah T, Wang. Immediate vs early or conventional loading dental implants with fixed: A Systematic review and meta-analysis of randomized controlled clinical trials. J Prosthetic Dent 2019, 122: pp. 516-36
52. Misch, Carl E. et al. Consensus Conference Panel Report: Crown-Height Space Guidelines for Implant Dentistry—Part 2. Implant Dentistry 2006, 15(2): pp. 113-121, DOI: 10.1097/01.id.0000217907.18396.18
53. Morton D, Wismeijer D, Chen S, Hamilton A, Wittneben J, Casentini P, et al. Group 5 ITI Consensus Report: Implant placement and loading protocols. Clinical Oral Implants Research 2023, 34(526): pp. 349-356. https://doi.org/10.1111/clr.14137
54. Gapski, R., Wang, H. L., Mascarenhas, P., and Lang, N. P. Critical review of immediate implant loading. Clinical oral implants research, 2003, 14(5): pp. 515–527. https://doi.org/10.1034/j.1600-0501.2003.00950.x
55. Esposito M, Hirsch J-M, Lekholm U, Thomsen P: Biological factors contributing to failures of osseointegrated oral implants. (II) Etiopathogenesis. Eur J Oral Sci 1998; 106: 721–764. © Eur J Oral Sci, 1998
56. Chrcanovic, B.R., Albrektsson, T. and Wennerberg, A., 2014. Reasons for failures of oral implants. Journal of oral rehabilitation, 41(6), pp.443-476.
57. Howe M.S, Keys W, Richards D., Long term(10- year) dental implant survival:A systematic review and sensitivity meta-analysis. Journal of Dentistr 84 (2019)9-21
58. Chatzopoulos G.S, Wolff L.F., Dental implant failure and factors associated with treatment outcome: A retrospective study. Journal of Stomatology oral and maxillofacial surgery 124(2023)101314

CPD questionnaire on page 216

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 (April 2026)

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

1. FRACTURE RESISTANCE OF ENDOCROWNS PRODUCED BY 3D PRINTING AND – CAD-CAM BLOCKS: A COMPARATIVE ASSESSMENT

Endocrown is a restoration design based on the principle of minimally invasive dentistry for endodontically treated teeth[1]. Endocrown restorations are monoblock restorations that achieve macromechanical retention from the pulp chamber and micromechanical retention through adhesive cementation. Endocrowns are particularly recommended for short, curved, calcified, or structurally damaged roots in molar teeth and in cases with significant coronal tissue loss or limited interocclusal space. Advances in CAD/CAM technology have led to the increased preference for endocrowns by enabling the rapid and accurate fabrication of precision restorations. However, the success of endocrowns hinges on material selection, as diverse options—ranging from ceramics to composites and hybrids—exhibit varying mechanical, optical, and biological properties under occlusal loads. Comparing these materials is crucial for optimizing clinical outcomes, especially amid evolving CAD/CAM and 3D-printing technologies that expand fabrication possibilities.

Common Endocrown materials include glass ceramics, lithium disilicate, resin nanoceramics, leucite-reinforced ceramics, and emerging printable resins. Leucite-reinforced glass ceramics (e.g., G-Ceram blocks for LRC-NF group) offer excellent aesthetics and polish ability but demonstrate lower fracture resistance, often failing first in non-ferruled designs due to brittleness under load. Lithium disilicate (e.g., Tessera blocks for LDS-NF) provides superior strength (up to 400 MPa flexural) and retention, with studies showing higher tensile forces post-thermocycling compared to hybrids; however, it risks catastrophic fractures without adequate ferrule. Resin nanoceramics (e.g., CERASMART for RNC-NF) balance elasticity (mimicking dentin) with repairability, yielding restorable failure modes and resistance above chewing forces (~150-250 N), making them forgiving in high-stress posterior regions.

Hybrid composites and 3D-printable resins (e.g., Crowntec for PRM-NF) further diversify options, with the latter enabling additive manufacturing for precise fit and cost-efficiency. Intact teeth as controls consistently outperform restorations, underscoring the need for materials that approximate natural biomechanics. Recent 2026 in vitro data reveal LRC-NF as weakest, while RNC-NF, LDS-NF, and PRM-NF cluster similarly, all exceeding physiological demands but varying in failure patterns—adhesive for resins, cohesive for ceramics.

Ferrule vs. Non-Ferrule Designs

The ferrule effect—defined as a 1.5-2 mm band of healthy coronal tooth structure encircling the restoration—has long been debated in endocrown design, particularly for non-ferruled (NF) preparations like those in LRC-NF, RNC-NF, LDS-NF, and PRM-NF groups. Recent 2026 in vitro studies reveal that ferrule presence offers minimal enhancement to fracture resistance in adhesively bonded endocrowns, with non-ferrule groups still surpassing physiological chewing forces (~150-250 N) despite lower overall loads compared to controls. Ferruled counterparts (e.g., LRC-F) showed no statistically significant superiority ($P > .05$), attributing this to modern hybrid materials' elasticity and pulp chamber retention, which distribute stress effectively even without peripheral dentin support.

These challenges traditional post-and-core dogma, favouring conservative NF endocrowns in moderately damaged molars, provided adhesion protocols are optimized. Clinically, NF designs reduce chair time and tooth sacrifice, ideal for South African public health contexts under NHI constraints.

Comparative Performance Metrics

Material Group NF= non-ferruled F= ferruled	Flexural Strength (MPa)	Fracture Load (N) Example	Failure Mode	Key Advantage
LRC-NF (G-Ceram) LRC=Leucite-reinforced glass ceramics	~150-200	Lowest (~800-1000)	Catastrophic	Aesthetics
RNC-NF (CERASMART) RNC= Resin nanoceramics	~200-250	~1500-2000	Restorable	Repairable
LDS-NF (Tessera) LDS= Lithium disilicate	~400	~1800-2200	Cohesive	Retention
PRM-NF (Crowntec) PRM= Hybrid composites and 3D-printable resins	~150-200	~1600-1900	Adhesive	Cost-effective
Control (Intact)	N/A	>2500	N/A	Benchmark

Hekimoğlu et al (2026) [1] reported on an invitro the study that sought to compare the fracture resistance of LRC, resin nanoceramic (RNC), lithium disilicate ceramic (LDS) blocks, and printable resin used for endocrowns manufacturing on mandibular molars. Two hypotheses were tested in this study: The first null hypothesis states that there is no significant difference in the fracture resistance of endocrown restorations fabricated from different materials; the second null hypothesis suggests that the presence of a ferrule does not have a significant effect on the fracture resistance of these restorations.

Materials and methods

108 mandibular molars that were extracted for periodontal reasons, with homogeneous dimensions and free of fractures, cracks, or caries, were used. Root canals were prepared using the ProTaper Next rotary file system. The mesial canals were sequentially enlarged with files X1 and X2, while the distal canals were prepared using files X1, X2, and X3. Root canal was obturated with gutta-percha points and epoxy resin sealer using the lateral compaction technique. Then canal orifices were sealed with flowable composite resin.
A periodontal ligament simulation was performed for all specimens using a polyether impression material with a thickness of 0.2–0.3 mm. To simulate the bone level, the specimens were embedded in standardized polymethyl methacrylate blocks up to 1 mm below the cementoenamel junction (CEJ).

For the preparation of the ferrule (F) group teeth, the crowns were sectioned 1 mm above the cemento-enamel junction under water cooling. Subsequently, adhering to the principles of endocrown preparation, a circumferential shoulder-type finish line with a width of 1 mm and a pulp chamber with a depth of 2 mm were prepared (Fig. 1). In the ferrule group, the remaining coronal wall thickness was standardized between 1 and 1.5 mm to ensure uniformity and adequate structural support. For the preparation of the non-ferrule (NF) group teeth, the crowns were removed at the cemento-enamel junction under water cooling, and a pulp chamber with a depth of 2 mm was prepared.

Fig1: a) Preparation of non ferrule specimens, **b)** Cementation of endocrowns in specimens non ferrule, **c)** Ferrule group specimens and endocrowns before cementation, **d)** Preparation of ferrule specimens, **e)** Cementation of endocrowns in specimens ferrule, **f)** Etching of the specimens with 37% orthophosphoric acid, **g)** Etching of the LDS restoration with 5% hydrofluoric acid

The digital impressions of the prepared specimens were obtained using an intraoral scanner (Cerec Primescan, Sirona). The digital data were then exported into the inLab CAD software. The occlusal form and anatomy of the restorations were determined based on the right mandibular first molar model available in the software database. All restorations were designed such that the distance between the cusp tip and the restoration margin ranged from 5.5 to 6 mm, and the distance between the central fossa and the pulpal floor ranged from 3.5.

Subsequently, to achieve an equal distribution of teeth among the groups, specimens with ferrules and non-ferrules were separately randomized, and 108 teeth were divided into nine groups, with the average surface areas of each group as close as possible.

Specimens with 1-mm shoulder-type ferrules were divided into four groups according to the restorative material used for endocrown fabrication;

- **Group LRC -F:** Endocrowns manufactured from LRC blocks (G Ceram)
- **Group RNC-F:** Endocrowns manufactured from RNC blocks (Cerasmart)
- **Group LDS-F:** Endocrowns manufactured from LDS blocks (Tessera)
- **Group PRM-F:** Endocrowns were manufactured using a 3D printer with PRM (Crowntec)

Specimens with non-ferrule were divided into four groups according to the restorative material used for endocrown fabrication;

- **Group LRC-NF:** Endocrowns manufactured from LRC blocks (G Ceram)
- **Group RNC-NF:** Endocrowns manufactured from RNC blocks (Cerasmart)
- **Group LDS-NF:** Endocrowns manufactured from LDS blocks (Tessera)
- **Group PRM-NF:** Endocrowns were manufactured using a 3D printer with PRM (Crowntec)
- **Group Control:** Intact teeth

Restorations were fabricated using a CEREC MCX milling unit (Dentsply Sirona) for the LRC, LDS, and RNC blocks. After milling, LDC and LRC restorations were glazed using a calibrated furnace (Speedfire, Dentsply Sirona). 5% hydrofluoric acid was applied to the bonding surfaces of LDS and LRC restorations for 60 s to achieve surface conditioning according to the manufacturer's instructions. Following the etching procedure, a silane agent was applied to the treated surfaces and allowed to dwell for 60 s.

After milling, RNC restorations were glazed with a resin composite glaze. After the glazing process, the cementation surface of the RNC restorations was roughened with 30 µm silica-modified aluminum oxide particles (Rocatec Soft, 3 M Oral Care; St Paul, MN, USA) perpendicular to the surface from a distance 10 mm during 10 s with 30 psi pressure according to the manufacturer's instructions.

PRM restoration was fabricated using an Asiga Max 3D printer (Asiga). The fabrication parameters were set as follows: 50 µm layer thickness, 0.017 s minimum exposure time, 0.01/10.66 mW/cm^2 minimum/maximum light intensity. After completion of the additive manufacturing process, residual resin on the Crowntec restorations was cleaned using an applicator with alcohol, and post-curing procedures were performed according to the manufacturer's instructions. After the post-cure process, the cementation surface of the PRM restorations was roughened by using 110 µm aluminum oxide particles. During the cementation protocol, the enamel and dentin surfaces of each specimen were conditioned with 37% phosphoric acid for 30 s. The surfaces were then

rinsed with an air-water spray for 20 s and dried. A universal adhesive resin (All-Bond Universal) was applied for 20 s and gently air-thinned for 5 s. The manufactured restorations were cemented using a dual-cure resin cement following the manufacturer's instructions.

After cementation, fracture resistance testing was performed on the specimens using a universal testing machine (Instron). The maximum load at fracture was recorded in Newtons (N). The failure mode of the specimens was classified as follows: Type I, restoration fracture; Type II, restorable fracture involving both the tooth and the restoration; or Type III, non-restorable fracture of the remaining tooth structure.

Results

A statistically significant difference was observed in the mean fracture resistance values among the materials in the groups ($P < .05$). Independent of the presence of a ferrule, the Control group exhibited the highest fracture resistance, whereas the LRC group demonstrated the lowest. In the comparison of the ferrule groups, a statistically significant difference was observed ($P < .05$). The differences between the Control, PRM-F, RNC-F, and LDS-F groups and the LRC-F group were found to be statistically significant ($P < .05$), whereas no significant difference was detected among the Control, PRM-F, RNC-F, and LDS-F groups. Nonetheless, the fracture resistance values of all endocrown groups were determined to exceed the maximum masticatory forces reported in the literature.

In the comparison of the non-ferrule groups, a statistically significant difference was observed ($P < .05$). The differences between the Control, PRM-NF, and RNC-NF groups and the LRC-NF group, as well as between the Control and PRM-NF groups and the LDS-NF group, were found to be statistically significant. Among the ferrule groups, statistically significant differences were also observed between the Control, PRM-F, RNC-F, and LDS-F groups and the LRC-F group.

Comparisons of ferrule and non-ferrule groups fabricated from the same material revealed no statistically significant differences ($P > .05$ for all paired comparisons. No statistically significant difference was detected in the distribution of fracture types among either the non-ferrule groups ($P > .05$) or the ferrule groups ($P > .05$). Although no statistically significant differences were identified among the materials concerning fracture types, the results indicated that LRC restorations, which exhibited the lowest fracture resistance, were associated with the highest incidence of type I fractures. Restorations fabricated from RNC and PRM materials predominantly demonstrated restorable fractures, namely type I and type II. By contrast, the LDS group exhibited the highest incidence of catastrophic fractures.

Conclusions

Within the limitations of this in-vitro study, the materials evaluated demonstrated different fracture resistance behaviours depending on their microstructural characteristics and manufacturing techniques. The resin matrix-based RNC and PRM groups, as well as the LDS group, exhibited higher fracture resistance compared to the LRC group. LRC, which showed lower fracture resistance, generally resulted in restorable fractures, LDS restorations tended to show catastrophic failures. However, PRM and RNC groups exhibited higher fracture strength and predominantly restorable failure modes.

Implications for practice

Endocrowns used Leucite Reinforced Ceramic showed the lowest fracture resistance. In contrast, the fracture resistance values of all materials used are greater than the physiological chewing force value. The presence of a ferrule did not affect the fracture resistance values.

REFERENCE

1. Hekimoğlu KN, Düzgün S, Topçuoğlu HS. Fracture resistance of endocrowns produced by 3D printing and CAD-CAM blocks: a comparative assessment. Clinical oral investigations. 2026 Feb 18;30(2):81.

2. IS SINGLE-SHOT ANTIBIOTIC PROPHYLAXIS REALLY ENOUGH FOR STANDARD ORAL MAXILLOFACIAL (OMF) SURGERIES?

Antibiotic prophylaxis is standard in oral and maxillofacial surgery (OMS) due to the high bacterial load in the oral cavity, which elevates surgical site infection (SSI) risk in clean-contaminated procedures like fracture repair, orthognathic surgery, and third molar extractions. Evidence increasingly supports single or short-course (≤24 hours) regimens over multiple doses or prolonged courses (≥48-72 hours) to minimize resistance and adverse effects while maintaining efficacy.

Evidence on Single vs. Multiple Doses: A 2019 systematic review and meta-analysis of 21 prospective trials (1,974 patients) found no significant difference in surgical site infection (SSI) rates between short-course (≤24 hours) and extended-course (≥72 hours) prophylaxis in OMS and ear, nose and throat (ENT) procedures (RR 0.88; 95% CI 0.63-1.21). Similarly, a 2026 retrospective-prospective study of 856 OMS patients across six procedures (e.g., fractures, orthognathics) showed single-shot prophylaxis yielded comparable postoperative infection rates (9.40% vs. 7.93%) to >48-hour regimens after risk adjustment (adjusted OR 1.13; 95% CI 0.70-1.84). Contrasting evidence from orthognathic-specific meta-analyses suggests single-day prophylaxis may outperform single preoperative doses (RR 0.28; 95% CI 0.09-0.82), though long-term (2-7 days) regimens reduced SSI vs. single-day in moderate-bias RCTs.

Clinical Outcomes: Surgical site infection (SSI) rates remain low (1.5-4.5%) with prophylaxis, and short regimens show equivalent efficacy to prolonged ones in most OMS contexts, including mandibular fractures and flap reconstructions. No added benefit from extended courses was seen in preventing dehiscence, abscesses, or revisions, even in contaminated sites. Microbial aetiologies (e.g., S. aureus, Pseudomonas) did not differ by regimen duration.

Hospital Stay Impact: Single/short prophylaxis shortens stays without compromising safety. In the 2026 study, it reduced overall length of stay from 5.83 to 4.32 days ($p<0.001$), with similar drops in fractures (6.39 to 4.94 days) and plate removals. One ENT/OMS trial noted extended regimens increased stays by ~0.7 days. Fewer antibiotic days also cut consumption (63.8 to 47.0 DDD/100 patient-days).

Adverse Effects: Prolonged prophylaxis doubles adverse event risk (RR 2.40; 95% CI 1.20-3.54), mainly gastrointestinal (diarrhoea 18%), nausea (14%), and rash. Each extra 10 antibiotic days raises adverse drug event

odds by 3%, including renal/hematologic issues. Short courses mitigate resistance and costs.

Evidence Strength: High-quality synthesis from meta-analyses of RCTs supports short/single-dose equivalence for standard OMS (low heterogeneity, I^2<12%). However, evidence is moderate overall due to bias risks (e.g., incomplete blinding), retrospective elements, and subgroup limitations (e.g., high-risk orthognathics). Guidelines weakly approve perioperative single/short courses (grade IIb), urging tailoring for contamination or host factors; more placebo-controlled RCTs needed for high-risk cases

Schorn et al (2026)[1] reported on a trial that sought to evaluate postoperative complications in patients undergoing six standard oral maxillofacial surgical (OMFS) procedures at an Oral and Maxillofacial Surgery department while being treated with either only single-shot antibiotic prophylaxis or a prolonged scheme of postoperative prophylactic antibiotic use of 48 h. In addition, the duration of the inpatient stay and the total antibiotic consumption of the OMFS ward were examined. It was hypothesized that single-shot antibiotic prophylaxis would provide similar clinical outcomes compared to a prolonged regimen of postoperative prophylactic antibiotics.

Methodology

Fig 1 provides information on the study flow of 982 patients who were considered for inclusion. For inclusion, adult patients had to be undergoing of one of six standard OMF-Surgeries (open reduction and internal fixation with osteosynthesis plate of OMF-Fractures, removal of at least one osteosynthesis plate, orthognathic surgery – only bimaxillary procedures, intraoral ablative tumour surgery (exclusively intraoral tumours without further surgical steps such as plastic reconstruction or neck dissection), exclusively neck dissection and intraoral bone augmentation). Patients were excluded if they presented with concomitant infections that required antibiotic therapy.

Evaluated data included: type of operation, gender, age, BMI, allergies, general illnesses (divided into subcategories: neurological, pulmonary, cardiovascular, infections, nephrological, endocrinological, cancerous, psychological and other), medication, type of antibiotic prophylaxis (single-shot vs.48h), type of agent used, form of administration (oral or intravenous), clinical signs of infection (calor, rubor, dolor, tumour, pus), wound dehiscence (mechanical = separation of the wound edges in the absence of infection, caused by physical or technical factors that compromise wound closure, and infectious = separation of the wound edges secondary to an infectious process in the surgical site), surgery duration, surgical approach, laboratory results of parameters indicating infection (C-reactive protein, white blood cell count (WBC)), inpatient length of stay, postoperative complications (wound dehiscence, abscess, infection) and possible revision surgery.

Surgeries and standard of care

All orthognathic procedures were performed following proper orthodontic preparation. Maxillary movements were performed using a Le Fort I osteotomy in all included patients. In the mandible, bilateral sagittal split osteotomy (BSSO) was performed. Throughout the study period, the responsible surgical team remained unchanged. No relevant changes occurred with regard to surgical technique, suture material, or planning protocols. Average operating times were comparable across the study period. The interval between trauma and surgical treatment varied by fracture type: mandibular fractures were generally treated within 0–2 days, whereas midfacial fractures were managed after 4–9 days. In cases of open mandibular fractures, preoperative antibiotics were administered (e.g. Aminopenicillins with ß-lactamase inhibitors

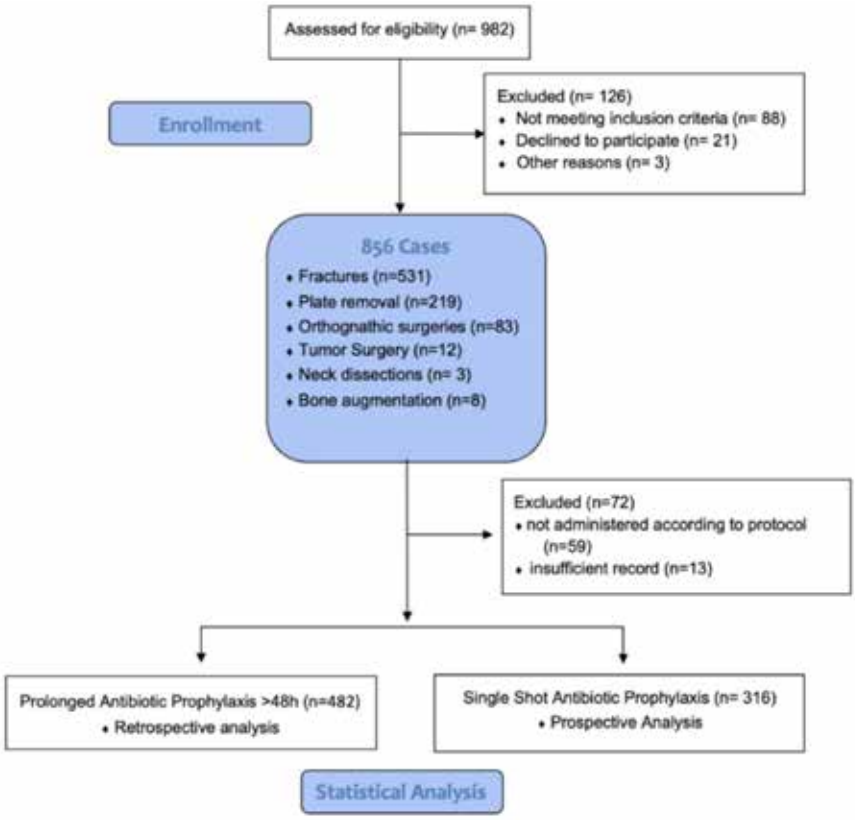

Fig 1 provides information on the study flow of 982 patients who were considered for inclusion.

1-1-1 until surgery). In all cases, trauma or orthognathic, internal fixation was achieved using titanium miniplates. In fractures the method of osteosynthesis was consistently open reduction and internal fixation (ORIF) using titanium plates. For surgeries longer than 3 h, a second dose of antibiotics was administered. Trauma patients typically remained hospitalized for 2–4 days postoperatively. Patients with mandibular fractures are admitted immediately after trauma and operated on without delay, whereas patients with midfacial fractures are admitted depending on severity. At the time of the study, patients undergoing plate removal were routinely hospitalized for 2 days. Orthognathic surgery patients routinely remained hospitalized for 5–6 days postoperatively. Postoperative radiographic controls were routinely performed and reviewed to confirm adequate reduction. There was no standardized scientific follow-up protocol; instead, patients received regular postoperative surgical follow-up based on clinical necessity.

Intravenous antibiotic consumption was calculated as defined daily doses (DDD) per 100 patient days, in accordance with the WHO ATC/DDD methodology. Data collection was limited to systemic antibiotics administered intravenously. Patient-day denominators were obtained from institutional administrative records.

RESULTS:

During the complete study period, 856 patients met the inclusion criteria. Of these 856 cases, the following surgical procedures were performed: A total of 531 fractures were included in the analysis. Midfacial fractures comprised Le Fort I ($n=10$, 1.9%), Le Fort II ($n=20$, 3.8%), Le Fort III ($n=7$, 1.3%), orbital floor fractures ($n=87$, 16.4%), zygomatic bone fractures ($n=148$, 27.9%), alveolar buttress fractures ($n=1$, 0.2%), anterior wall of the maxillary sinus ($n=2$, 0.4%), and isolated zygomatic arch fractures ($n=82$, 15.4%). Mandibular fractures accounted for 174 cases (32.8%), 219 osteosynthesis plate removals, 83 orthognathic surgeries, 12 ablative tumour surgeries, 3 neck dissections and 8 intraoral bone augmentation cases and were included in this study. 482 (56.6%) patients received prolonged antibiotic prophylaxis of 48 h. 316 (37.1%) patients received only a single dose of antibiotic prophylaxis. In 72 (8.28%) cases, antibiotic prophylaxis was either not administered according to protocol or not recorded, resulting in exclusion from the study.

Sociodemographic data revealed an average age of 41.9 years, including 29.7% ($n=259$) women and 70.2% ($n=611$) men. The mean body mass index (BMI) was 24.3. Underlying diseases included nephrological (1.7%), neurological (4.1%), cardio-vascular (17.4), pulmonary (9.2%) infectious (4.8%), endocrinological (9.8%), oncological (7.8%), psychiatric (5.8%), and other diseases (4.3%), as well as previous or current infection with Methicillin-resistant Staphylococcus aureus (MRSA) or multi-resistant gram-negative bacteria (3/4-MRGN) (1.5%).

Postoperative infection rates were 6.36% versus 8.16% for fractures ($p=0.48$), 12.96% versus 7.27% for plate removal ($p=0.18$), and 7.89% versus 20.00% for orthognathic surgery ($p=0.21$) when comparing prophylaxis > 48 h with single-shot prophylaxis. Overall infection rates were 7.93% versus 9.40%, respectively ($p=0.46$;). For Fractures in the multivariable logistic regression analysis, single-shot antibiotic prophylaxis was not independently associated with the occurrence of postoperative infection compared with prophylaxis administered for more than 48 h (adjusted OR 1.45, 95% CI 0.72–2.94; $p=0.298$). Age, sex, body mass index, comorbidity burden, and fracture type were not significantly associated with postoperative infection in the adjusted model. Stratified multivariable analyses were conducted for different fracture types with sufficient numbers of postoperative infections (Mandibular fractures, zygomatic bone fractures, Orbital fractures and Le-Fort fractures). In patients with mandibular fractures, the antibiotic prophylaxis regimen was not independently associated with postoperative infection after adjustment for age, sex, body mass index, comorbidity burden, and fracture characteristics (adjusted OR 1.90, 95% CI 0.72–4.98; $p=0.192$). In patients with zygomatic-orbital fractures, no significant association between antibiotic regimen and postoperative infection was observed (adjusted OR 0.66, 95% CI 0.07–6.40; $p=0.717$).

There was no significant difference in laboratory parameters indicative of infection (CRP and white blood cell count) for orthognathic surgeries while there was a significant difference in CRP values for removal of osteosynthesis plates (> 48 h antibiotic prophylaxis: 1.74 2.50 mg/dl versus single-shot 2.69 3.14 mg/dl, $p=0.046$). Overall surgeries, in multivariable linear regression models adjusting for age, sex, BMI, and comorbidity burden, and surgical procedure, single-shot prophylaxis was not associated with higher postoperative CRP compared with prophylaxis >48 h.

Length of stay: A significant difference depending on the length of antibiotic prophylaxis could also be demonstrated for the overall in-patient length of stay. In a multivariable linear regression model adjusted for age, sex, BMI, comorbidity burden and procedure category, single-shot prophylaxis was associated with a shorter length of hospital stay compared with prophylaxis >48 hours ((>48h antibiotic prophylaxis: 5.83 ±7.92 days versus single-shot 4.32 ±4.88 days, 95% CI −2.45 to −0.74; $p < 0.001$). Significant differences in the duration of hospital stay for the surgery subgroups of fracture osteosyntheses (>48h antibiotic prophylaxis: 6.39 ±5.74 days versus single-shot 4.94 ±2.89 days, p=0.001) and plate removal (>48h antibiotic prophylaxis: 2.48 ±2.60days versus single-shot 1.81 ±2.08 days, p=0.019).

Antibiotic consumption: Annual inpatient antibiotic consumption data from the OMFS clinic showed a decrease from 63.8 defined daily doses (DDD)/100 patient days in 2018 to 47.0 DDD/100 patient days in 2020.

Conclusion

The findings of this retrospective study suggest that single-shot antibiotic prophylaxis may be a feasible approach in selected bone-related maxillofacial procedures such as orthognathic surgery, trauma, and augmentation and may reduce patient length of stay and total antibiotic consumption. However, special surgical techniques and hospital-specific aftercare may require adaptation of strict single-shot regimens.

Implications for practice

These results support a reduction of prolonged prophylaxis but maxillofacial departments in different settings may have different pathogen spectra and local circumstances that will require a cautious approach to unilaterally changing guidelines based on studies from other parts of the world.

REFERENCE:

Schorn L, Singh DD, Mrochen F, Kempe M, Schrader F, Rana M, Sproll C, Lommen J, Joost I. Is single-shot antibiotic prophylaxis really enough for standard OMF-surgeries?. Clinical Oral Investigations. 2026 Feb 2;30(2):68

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Judicial Fury and Crisis of Credibility: Medical Certificates Under Fire

SADJ APRIL 2026, Vol. 81 No.3 P208

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ABSTRACT

Medical certificates, commonly referred to as "sick notes," occupy a critical space at the intersection of health, law, and employment. Their primary statutory purpose is to authenticate incapacity to perform work, thereby protecting patients against inequitable treatment and providing employers with evidentiary proof for managing absenteeism.

In recent years, however, courts within South Africa and elsewhere have expressed a growing concern about the misuse and substandard issuance of these documents. Judicial scrutiny has been directed not only at employees who exploit medical certificates, but also at practitioners who use them carelessly or dishonestly, as exemplified by the recent proceedings before the Madlanga Commission. This paper examines the statutory objectives of medical certificates, provides analyses of case law in which their credibility has been challenged, and highlights the ethical and professional obligations incumbent upon practitioners. It argues that in the absence of meaningful regulatory reforms, medical certificates risk losing their legitimacy as trusted instruments in regulating absenteeism.

CASE STUDY: MADLANGA' S FURY OVER "USELESS" MEDICAL CERTIFICATES

On Wednesday, the 4th of March 2026, Retired Judge Mbuyiseli Madlanga addressed the Commission regarding the submission of inadequate medical certificates by witnesses.[1] He warned that the Commission "would not accept vague or useless medical certificates as justifiable excuses for non-appearance". Judge Madlanga recorded that the Commission contemplated requesting the Health Professions Council of South Africa (HPCSA) to authenticate and assess the adequacy of the submitted medical documentation. Subsequently, the HPCSA on the 6th of March 2026 issued a public caution to doctors against deceitful or untruthful medical certificates, reinforcing the Commission's stance.[1]

Madlanga's remarks followed the absence of alleged political fixer Brown Mogotsi, who had been scheduled to testify on Monday the 2nd of March 2026, but submitted a sick note citing only "medical condition". Another witness had previously submitted a similar unsatisfactory certificate. Many vague templates, such as "unfit for work" or "as I was informed by him/her that he/she was unfit for work", remain overused by medical professionals in South Africa and internationally, compromising professional ethics.

Judge Madlanga emphasised that such absences disrupted the commission's procedural timetable. Proceedings halt entirely when witnesses fail to appear, jeopardising the commission's capacity to meet its deadlines. He criticised medical certificates for lacking detail, which did not assist the commission in understanding valid reasons for absence. In Brown Mogotsi's case, the certificate provided no specific information about the medical condition. Madlanga asserted the commission's right to call upon the issuing medical practitioner for clarification.[1]

DISCUSSION

Objectives of Medical Certificates

The primary objective of a medical certificate is to provide objective evidence of an individual's incapacity to perform prescribed duties, grounded in a qualified medical practitioner's professional examination and judgement, it is it is intended to show with facts that a person is genuinely sick or injured and therefore unable to perform their duties.[2,3]

Ethically, the medical certificate functions to protect patients against discriminatory practices, ensuring that genuine health conditions are recognised and not penalised. It is supposed to prove, with facts, that a person is genuinely sick or injured to perform their duties. Legally, it serves as proof that an employee is legitimately unable to perform duties due to illness or injury.[2-4]

Medical certificates also serve as operational and strategic instruments for employers and insurers. At the operational level, they provide clarity on the duration and nature of an employee's absence, enabling managers to plan workforce coverage, adjust schedules, and process payroll or benefits accurately. Insurers similarly rely on precise documentation to validate claims and prevent fraudulent submissions. Strategically, the credibility of medical notes underpins trust between employers, employees, and insurers. Thereby, reducing disputes and safeguarding compliance with labour laws.[5]

Patterns in medical certification also inform broader workplace health policies, wellness initiatives, and insurance underwriting, while clear documentation helps control costs and forecast liabilities. In this way, the medical certificates function as more than a clinical record; they are a critical tool for organisational continuity, financial planning, and legal protection. When poorly written or vague, however, they undermine both operational efficiency and strategic decision-making, exposing institutions to risk and eroding confidence in the medical profession.[6,7]

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A well-written certificate should balance disclosure with confidentiality. While employers require sufficient detail to manage absence, practitioners must avoid breaching patient privacy. [7] The challenge lies in providing enough information to establish credibility without revealing sensitive medical details. In essence, the medical certificate is not a shield for dishonesty but a legal and ethical instrument that must be handled with precision.[7-9]

In summary, practitioners must act as "gatekeepers of the truth" when issuing medical certificates. It is the responsibility of practitioners to ensure that the "sick note" is anchored in objectivity, ethics, and accountability, as discussed below.[8-10]

Ensure consistency – issue a medical certificate based on professional examinations and clinical findings, not only on the patient's accounts or preferences. This is in line with HPCSA Rule 16(1)(e) to 16(1)(f), which stipulates that "a medical certificate should only be issued on the basis of a proper medical examination and diagnosis of a patient, and not on the mere observation of a patient."[8]

Maintain ethical standards – uphold honesty and integrity by certifying inability only when medically justified; avoid exaggeration or falsification.

Provide accurate documents – record clear and real details of the condition and its impact on the ability of the patient to work or perform tasks

Exercise legal accountability – respect patient experience yet ensure that the inability is supported by objective medical reasons.

Protect professional credibility – resist external pressure to issue unjustified certificates.

LEGAL PRECEDENCE OF MEDICAL CERTIFICATES

1. *Woolworths (Pty) Ltd v CCMA and Others* (JA90/22) ZALAC 29

The matter before the Labour Appeal Court (LAC) on 13 June 2024 involved Woolworths' dismissal of an employee following the submission of a fraudulent medical certificate.[11-13] Woolworths had raised suspicions based on prior warnings. The CCMA found the dismissal substantively unfair, a ruling which was upheld by the Labour Court and LAC, as Woolworths failed to prove the certificate's fraudulence. The court considered the employee's knowledge of the irregularity. This was despite her inconsistent statements.about prior consultations with the same doctor. [11-12]

Outcome of the Arbitration Process

The arbitration commissioner ruled that the employee's dismissal was substantively unfair.

The commissioner concluded that the medical certificates were valid and regular, and there was no evidence to suggest that the employee had acted dishonestly or submitted fraudulent documents. Consequently, the commissioner ordered relief in favour of the LAC and dismissed Woolworth's appeal, by finding no basis to interfere with the arbitration award.[12] This case highlights the importance of employers conducting thorough investigations before taking disciplinary action based on suspicions of misconduct. In other words, employers should verify the validity of the medical certificates based on the requirements of Section 23 of the Basic Conditions of Employment Act[13] (BCEA) and Rule 16 of the HPCSA's Ethical Rules of Conduct. [7]

2. *Sibanye Rustenburg Platinum Mine vs AMCU obo D Sono and Others* [JA32/2022]

In contrast, 59 employees of Sibanye Rustenburg Platinum Mine were dismissed for submitting fraudulent sick notes, which constituted gross dishonesty and undermined the trust relationship between the employer and employees.[14] The Labour Appeal Court upheld the decision of the Labour Court, confirming the substantive fairness of the dismissals. This ruling demonstrated judicial intolerance for outright fraud, in this case, the forgery or collusion with practitioners constitutes serious misconduct. Several other cases of abuse of medical certificates have been served in South African courts, describing the "endemic abuse" of medical certificates.[14] This ongoing practice undermines workplace trust, erodes confidence in the medical profession, and costs billions annually.

3. *Mgobhozi v Naidoo NO and Others* (DA11/03) ZALAC 17; BLLR 252 (LAC)

The employee was dismissed from the Durban Metropolitan Council (Housing) on the 4th of April 2000, following an internal disciplinary inquiry that found him guilty of various acts of dishonesty. His internal appeal and application for condonation for the late filing of the review were dismissed by the Labour Court and subsequently upheld by the Labour Appeal Court.[16]

The medical certificates submitted by the employee were deemed hearsay evidence because they were not accompanied by supporting affidavits from the issuing doctors. The Labour Court adheres to the same evidentiary rules as the High Court and the Supreme Court of Appeal. The admissibility of hearsay evidence is governed by s3 of the Evidence Amendment Act 45 of 1988, which outlines specific conditions under which hearsay evidence may be admitted. The court found the medical certificates to be vague and lacking sufficient detail to substantiate the employee's claim of incapacity. The certificates did not provide specific information about the nature of his illness, the treatment prescribed, or how the illness rendered him incapable of filing the review application on time. Hence, they lacked probative value for the courts to make a ruling.

CONCLUSION

A medical certificate is hearsay, and therefore employers are not obliged to accept it at face value if they reasonably suspect its validity. Consequently, they may investigate the employee's alleged incapacity without breaching legal duties.

IMPLICATIONS OF COURT RULINGS ON MEDICAL CERTIFICATES.

Based on the above judgments, the following comprehensive ruling applies to medical certificates in practice:

1. Legal Standards for Admissibility

Although, medical certificates do not mandatorily require supporting affidavits from issuing practitioners to be valid for everyday employment purposes under section 23 of the Basic Conditions of Employment Act[13] – they serve as

prima facie proof of incapacity in such contexts. However, when tendered as evidence in formal legal proceedings, they constitute hearsay as provided for by Section 5 of the Law of Evidence Amendment Act 45 of 1988[16], unless corroborated by the practitioner's affidavit or testimony detailing the diagnosis, treatment, and functional impact, as per *Mgobhozi v Naidoo* ZALAC 17.[16]

2. Employer's Duty to Investigate

Before initiating disciplinary action, employers are entitled to investigate suspected fraudulent or irregular medical certificates to establish clear proof of misconduct. A mere suspicion or substantiated hearsay as cautioned in *Woolworths v CCMA* ZALAC 29 cannot warrant a dismissal, though procedural irregularities as per *Sibanye Rustenburg v AMCU* may justify probe escalation.[11,14]

3. Protection of Employees

Based on the *Woolworths case* outcome employees who submit medical certificates in good faith should not face disciplinary action for the alleged irregularities of the issuing doctor unless it is proven that the employee knowingly participated in fraudulent activities.

4. Professional Accountability for Doctors

Practitioners have a duty to balance disclosure with confidentiality. While patient privacy must be respected, certificates must contain sufficient detail to establish legitimacy. Professional accountability requires that doctors resist pressure from patients seeking unjustified leave. Issuing notes without examination or colluding in dishonesty breaches both ethical codes and legal obligations. Practitioners must ensure their certificates are issued based on genuine medical assessments and are defensible under scrutiny. They should avoid issuing vague or generalised certificates and must be prepared to provide affidavits or testify in court if required. The HPCSA Rule 16 outlines the requirements of a valid medical certificate.[8-10]

5. Role of Regulatory Bodies

Regulatory bodies must actively review and revise guidelines in line with current developments. Additionally, employers should report suspicious practices to these bodies rather than penalise employees who unknowingly use such services. The HPCSA has imposed cautions, reprimands, and fines not exceeding R15,000 on guilty health professionals.[7-10]

Judicial Vigilance Against Misuse

Courts must remain vigilant against the misuse of medical certificates and ensure that only admissible and credible evidence is considered in legal proceedings.

CONCLUSION

The *Woolworths, Sibanye, and Mgobhozi* judgments mark out a triangulated framework: (i) medical certificates enjoy BCEA S23 presumptive validity yet calls for evidentiary substantiation *(Mgobhozi)* and (ii) withstand employer probes where irregularity is proven (*Sibanye*), provided employee good faith is untainted (*Woolworths*).[11,14,16] This balances labour protection with fraud deterrence, placing practitioners at the *fulcrum*, ethically bound by HPCSA Booklet 2 to issue objective, verifiable certificates lest they imperil patient rights and invite judicial rebuke.[9]

In the absence of statutory reforms, mandatory serialisation, digital authentication, and practitioner certification standards, medical certificates are exposed to systemic delegitimisation, entraps bona fide (genuine) employees in evidentiary disputes while abetting abuse. Courts have issued their warning; the profession and legislature must address this health-law-employment nexus to restore trust.

Consequently, medical practitioners issuing medical certificates are obliged to acknowledge their legal and ethical responsibilities associated with their professional role. They must ensure that their certificates are meticulously detailed, explicitly specific, and supported by affidavits when used in legal proceedings. This practice upholds the integrity of medical certificates, safeguards the rights of all parties, and perfectly aligns with professional ethical standards requiring transparency, accountability and the avoidance of insufficient or misleading evidence.

REFERENCES

1. Qwesha N. Truth or Tactics? How Legal Delays Are Stalling the Work of the Madlanga Commission. Daily Maverick. 2026. Available at:https://www.dailymaverick.co.za/opinionista/2026-03-11-truth-or-tactics-how-legal-delays-are-stalling-the-work-of-the-madlanga (Accessed 19 March 2026).
2. Delshad P, Ball L, Arab R. Medical certificates: More than just paperwork. Australian Journal of General Practice. 2024; 53(5):123 -7. https://doi.org/10.31128/AJGP-02-24-7154
3. Mbatha N, Street RA, Ngcobo M, Gqaleni, N. Sick certificates issued by South African traditional health practitioners. South African Medical Journal.2012;102(3): 129–131. https://doi.org/10.7196/SAMJ.5290
4. Collie A, Ruseckaite R, Brijnath B, Kosny AA, Mazza D. Sickness certification of workers compensation claimants by general practitioners in Victoria, 2003-2010. Med J Aust. 2013;199(7):480–83. doi: 10.5694/mja13.10508
5. Abbasi, M. (2024). Analyzing False Medical Certificate in Iranian Legal System. Iranian Journal of Surgery. 2024:108-120.
6. Hartika Y, Saputra R, Pakpahan NH, Darmawan D, Putra AR. A Study on the Falsification of Health Certificates: Perspective of Criminal Law and Professional Ethics. Journal of Social Science Studies. 2023;3(2):175-180.
7. Bae H. (2013). Physician liability and social responsibility related with medical certificates. The Ewha Medical Journal.2013' 36(2):102-11.
8. Health Professions Council of South Africa Ethical and Professional Rules of the Health Professions Council of South Africa (Booklet 2, September 2016) rule 16. Available at https://www.hpcsa-blogs.co.za/wp-content/uploads/2020/12/Ethics_Booklet-2.pdf (Accessed 10 March 2026).
9. Health Professions Council of South Africa General Ethical Guidelines for the Health Care Professions (Booklet 1, revised December 2021). Available at https://aestheticdoctors.co.za/wp-content/uploads/2023/02/Booklet-1-General-ethical-guidelines-for-health-care-professions.pdf (Accessed 19 March 2026).
10. Health Professions Council of South Africa 'Public Advisory on Fraudulent Certificates' (HPCSA Blogs, 6 March 2026) https://www.hpcsa-blogs.co.za/hpcsa-guidance-on-medical-certificates (Accessed 10 March 2026).
11. Woolworths (Pty) Ltd v Commission for Conciliation, Mediation and Arbitration and Others (JA90/22) ZALAC 29; 8 BLLR 881 (LAC) (13 June 2024). Available at https://www.saflii.org/za/cases/ZALAC/2024/29.html accessed 19 March 2026.
12. Schindlers Attorneys. van der Merwe P and Masutha K 'Woolworths (Pty) Ltd v CCMA and Others (JA90/22) ZALAC 29: Sick Notes. 2025. Available at: https://hbgschindlers.com/woolworths-pty-ltd-v-ccma-and-others-ja90-22-2024-zalac-29-sick-notes (Accessed 19 March 2026).
13. Republic of South Africa. Basic Conditions of Employment Act, No. 75 of 1997— s 23. Government Gazette. Available at:https://www.gov.za/sites/default/files/gcis_document/201409/a75-97.pdf (Accessed 10 March 2026).
14. Sibanye Rustenburg Platinum Mines (Pty) Ltd v Association of Mineworkers and Construction Union obo Sono and Others (JA32/2022) ZALAC 23; (2024) 45 ILJ 1623 (LAC) (2 May 2024). Available at https://www.saflii.org/za/cases/ZALAC/2024/23.html accessed 19 March 2026.
15. Mgobhozi v Naidoo NO and Others (DA11/03) ZALAC 17; 27 ILJ 786 (LAC); 3 BLLR 242 (LAC) (18 November 2005). Available at https://www.saflii.org/za/cases/ZALAC/2005/17.html (Accessed 19 March 2026).
16. Republic of South Africa.Law of Evidence Amendment Act 45 of 1988 — s 3.Available at https://www.justice.gov.za/legislation/acts/1988-045.pdf(Accessed 19 March 2026).


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CPD questionnaire

Oral health professionals' knowledge, perceptions, and practices regarding community engagement in rural South Africa

1. **Select the CORRECT answer. What percentage of participants expressed uncertainty regarding the monitoring and evaluation of oral health service delivery, including Oral Health Community Engagement Activities (OHCEAs)?**
   A. 53.1%
   B. 90.1%
   C. 46.9%
   D. 71.9%

2. **Select the CORRECT answer. Which of the following was identified by 90.1% of participants as a major challenge in implementing Oral Health Community Engagement Activities (OHCEAs) in rural communities?**
   A. Language barriers
   B. Lack of community participation
   C. Inadequate infrastructure and financing
   D. Limited oral health awareness campaigns

Is there a Need for Analogue Imaging in the Modern Dental Radiology Curriculum? Use of Analogue and Digital Imaging in Gauteng, South Africa.

3. **Which answer is CORRECT. Provide the key reason phosphor plate systems (PSP) are commonly used in dental schools in the United States and Brazil?**
   A. They are more accurate than direct digital systems (DD)
   B. They are easier to connect to smartphones
   C. They are similar to conventional film, cost-effective, and cause minimal patient discomfort
   D. They are the fastest image acquisition method available

4. **Choose the CORRECT statement. Identify the reason for the ongoing debate about including analogue imaging in the revised dental radiology curriculum?**
   A. Analogue imaging is more technologically advanced than digital imaging
   B. Most countries have banned analogue imaging equipment
   C. Analogue imaging requires significant teaching time and resources despite its declining use
   D. Students prefer analogue imaging due to image quality and comfort

Breast Cancer Patients' Knowledge, Attitudes and Practices of Oral Health and Treatment Related Complications

5. **Which statement is CORRECT. Why are patients on HER2 inhibitors considered at heightened risk for oral health complications?**
   A. The inhibitors require concurrent radiation treatment
   B. Drug and hormonal changes may compromise oral health
   C. HER2 inhibitors suppress dental immune responses directly
   D. They lead to immediate dental caries formation
   E. They interact with fluoride-based products

6. **Select the CORRECT answer. Which of the following best aligns with the study's proposed solution to address oral health gaps?**
   A. Developing mobile dental clinics for rural outreach
   B. Integrating dental professionals into oncology care teams
   C. Replacing questionnaires with clinical oral exams
   D. Encouraging patients to seek private dental insurance
   E. Delaying chemotherapy until after dental care is completed

7. **Choose the CORRECT answer. Which response best summarizes the systemic issue identified in the study?**
   A. Lack of oncologist awareness of breast cancer risks
   B. Inadequate surgical follow-up for oral hygiene management
   C. Patient noncompliance with dental recommendations
   D. Weak referral systems and poor interdisciplinary collaboration
   E. Overreliance on self-reported oral hygiene practices

8. **Which option is CORRECT. What inference can be drawn from the fact that only 3.7% of patients had a pre-treatment dental examination?**
   A. Most patients had already completed dental exams prior to diagnosis
   B. Dental professionals are integrated into oncology teams at BCCE
   C. Oral health is insufficiently prioritized in cancer care pathways
   D. Patients preferred to avoid dental care during cancer treatment
   E. Most patients had no dental complications requiring attention

Oral health workers' perspectives on systemic challenges and service disparities in denture services provision in selected districts of KwaZulu-Natal, South Africa.

9. **Choose the CORRECT answer. What is the correct number of themes that emerged in this study?**
   A. 6
   B. 4
   C. 5
   D. 3

10. **Which answer is CORRECT. According to the participants who are based in rural areas, where do they refer patients who need dentures?**
    A. Durban.
    B. Port Shepstone.
    C. Pietermaritzburg.
    D. Richards Bay.

11. **Select the CORRECT answer. Which of the statements regarding the participants' views regarding high volumes of dental extractions is correct?**
    A. Patients demand for their teeth to be extracted.
    B. Extracting teeth is the only treatment that they are permitted to perform by their scope of practice.
    C. They end up performing a lot of dental extractions largely to meet the performance indicators.
    D. None of the above statements.

12. **Choose the CORRECT option. Which of the following findings regarding NHI is correct?**
    A. Majority of interviewees stated that they are very knowledgeable about the NHI programme.
    B. Majority of interviewees stated that they lack knowledge and understanding of the NHI programme
    C. Majority of interviewees stated that they are involved in the NHI programme implementation
    D. None of the above statements.

Anthropometry of the Sphenoid sinus and its association with vertical skeletal facial growth patterns.

13. Select the CORRECT statement. Concerning the sphenoid sinus.

A. It is the most anterior of the paranasal sinuses.
B. It is located in the midline within the greater wing of the sphenoid bone.
C. It reaches it full size around 10 years of age.
D. It is located with the body of the sphenoid bone.

14. Which statement is CORRECT. Still on the development of the sphenoid sinus.

A. Primary pneumatization occurs.
B. Pneumatization occurs by constriction of the presphenoid recess followed by secondary pneumatization.
C. Pneumatization occurs by outpouching of the lateral nasal wall.
D. The air sinus is aerated at birth.

15. Select the CORRECT statement. In pneumatization of the sphenoid sinus in the sagittal plane.

A. A thick cancellous bone of 20mm separate the sinus from the sella turcica in the fetal type.
B. The posterior wall of the sinus lies posterior to the anterior wall of the sella turcica in the juvenile type.
C. The posterior wall lies below the sella turcica in the sella type
D. In the complete sella type, the posterior wall of the sinus lies anterior to the sella turcica.

16. Which statement is CORRECT. Concerning the Frankfurt mandibular plane angle (FMPA).

A. An increase in FMPA will lead to hyperdivergent facial pattern.
B. An increase in FMPA will lead to hypodivergent facial pattern.
C. A decrease in FMPA will lead to hyperdivergent facial pattern.
D. A decrease in FMPA will lead to normodivergent facial pattern.

Teaching of Digital Workflow in the Removable Partial Denture Undergraduate Curriculum: A Scoping Review.

17. Choose the CORRECT answer. Which of the following is identified as the most common barrier to implementing digital workflow in undergraduate RPD education?

A. Student disinterest
B. Limited patient availability
C. Financial constraints and lack of resources
D. Curriculum irrelevance
E. Poor clinical outcomes

18. Select the CORRECT statement. What percentage of predoctoral programmes in the USA reported providing instruction on CAD/CAM RPDs, according to Ishida et al.?

A. 5%
B. 12.5%
C. 25%
D. 50%
E. 75%

19. Which of the following is CORRECT. Why is the integration of digital workflow into RPD curricula particularly relevant in countries like South Africa?

A. Because CAD/CAM is not taught in other countries
B. Due to the high cost and inaccessibility of fixed prostheses
C. Because all universities in South Africa already use digital workflows
D. To eliminate the need for traditional impression materials
E. Because South Africa manufactures most digital dentistry tools

20. Choose the CORRECT answer. What educational benefit is most commonly associated with integrating digital workflows into the RPD curriculum?

A. Increased tuition revenue
B. Decreased enrolment in clinical courses
C. Enhanced learning experiences through interactive and intuitive tools
D. Replacement of manual dexterity skills
E. Reduced need for faculty involvement

Ethics: Judicial fury and crisis of credibility: medical certificates under fire

21. Select the CORRECT statement. Judge Madlanga criticised vague medical certificates during commission proceedings. Which evaluation best captures the systemic risk posed by such certificates?

A. They protect patient confidentiality but reduce employer trust.
B. They undermine judicial processes by failing to provide probative value.
C. They balance disclosure and privacy, ensuring fairness in hearings.
D. They strengthen employee rights by limiting employer investigations.

22. Which answer is CORRECT. In Woolworths v CCMA, the dismissal was ruled substantively unfair. What is the most defensible evaluation of the employer's failure?

A. Woolworths failed to prove employee dishonesty beyond reasonable doubt.
B. Woolworths relied on suspicion without verifying certificate validity under BCEA s23.
C. Woolworths ignored the HPCSA's ethical rules on proper medical examination.
D. Woolworths failed to provide sufficient detail in its disciplinary procedures.

23. Choose the CORRECT option. If tasked with designing a reform to restore credibility in medical certificates, which innovation would most effectively address both fraud and confidentiality?

A. Mandatory affidavits for all medical certificates submitted in employment disputes.
B. Employer-led investigations into all medical absences exceeding three days.
C. Digital authentication with practitioner serialisation and limited disclosure fields.
D. Public reporting of practitioners who issue vague or incomplete certificates.

24. Which answer is CORRECT. The *Mgobhozi v Naidoo* case treated medical certificates as hearsay. Which evaluation best explains why this precedent is significant for labour law?

A. It confirms that medical certificates are inadmissible unless supported by testimony.
B. It establishes that employers must always accept certificates at face value.
C. It demonstrates that vague certificates can still protect employee rights.
D. It shows that courts prioritise patient confidentiality over evidentiary standards.

25. Which option is CORRECT. Imagine you are advising the HPCSA on strengthening ethical compliance. Which policy proposal would most effectively align with Rule 16 and judicial expectations?

A. Require doctors to disclose full medical diagnoses in every certificate.
B. Introduce fines for employers who reject certificates without investigation.
C. Develop a standardised certificate template with mandatory clinical findings.
D. Allow patients to self-certify short-term incapacity to reduce doctor workload.

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

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

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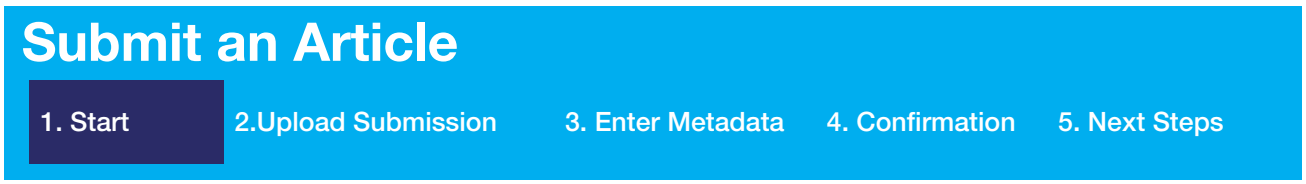

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