

THE SOUTH AFRICAN DENTAL JOURNAL

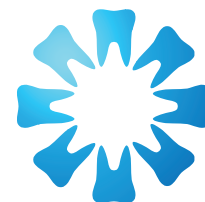
SADJ

JUNE 2026

Volume 81 Number 5

ISSN No. 2519-0105 – Online Edition

ISSN No. 1029-4864 – Print Edition



SADA

THE SOUTH AFRICAN
DENTAL ASSOCIATION



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The Roggeveld Mountains lie between the Northern Cape and Western Cape, forming part of the Great Escarpment. They rise above the semi-desert Karoo and create a cooler, wetter highland region. The area is known for wide open landscapes, winter snowfall near Sutherland, and rich fossil deposits. Sheep farming dominates the region, while visitors value its isolation, star-filled skies, and stark natural beauty.



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PRODUCTION OFFICE**Publisher:**

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The curious life of dental myths: why stories outlive science

SADJ JUNE 2026, Vol. 81 No.5 P297-P300

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

INTRODUCTION

Somewhere in every family, there is an expert.

Not necessarily a doctor or a dentist, but someone who possesses remarkable confidence in matters of health. They know that aspirin belongs directly on an aching tooth. They are certain that pregnancy steals calcium from teeth. They have no doubt that "soft teeth" run in the family. And should you question these truths, they will often lean forward and utter the most powerful words in all of medicine:

"It worked for me."

Dentists encounter these stories almost daily. Some are charming, others perplexing, and a few have demonstrated extraordinary resilience despite decades of scientific progress. Yet perhaps we should resist the temptation to dismiss them too quickly. For myths are not simply errors waiting to be corrected. They are stories, and stories have accompanied human beings long before textbooks, clinical guidelines, and systematic reviews entered the scene.

Indeed, every profession has its folklore, and dentistry is no exception. The characters may change, the remedies may evolve, and the village elder dispensing wisdom may now appear through a smartphone rather than over a garden fence, but the underlying impulse remains remarkably constant. Human beings have always sought explanations that are memorable, comforting, and easy to share.

Perhaps that is because people do not experience life through p-values and confidence intervals. They experience it through conversations, anecdotes, and stories. And while science is extraordinarily good at explaining the world, stories have always been rather better at travelling through it. Which may explain why, despite all our technological advances and scientific sophistication, generations of dentists continue to hear one timeless diagnosis, delivered with complete conviction:

"Doctor, I think I just have soft teeth."

Every profession has its folklore

Long before Google, YouTube, and TikTok, patients arrived carrying stories.

Every dentist has heard them. Some are passed down through generations with remarkable confidence. Others emerge from neighbours, grandparents, colleagues, or that mysterious relative who seems to possess unwavering certainty on every medical subject imaginable. Somewhere in nearly every family, there is someone who knows that aspirin should be placed directly on an aching tooth, that pregnancy "steals calcium" from teeth, or that unfortunate dental problems are simply the result of having inherited "soft teeth."

Dentists sometimes regard these ideas with quiet amusement. Yet perhaps we should resist the temptation to dismiss them too quickly. Every profession, after all, has its folklore.

Long before scientific journals and evidence-based guidelines, human beings understood illness through stories. They attributed toothache to worms, disease to imbalances of mysterious forces, and remedies to the wisdom of family traditions. These explanations may not always have been correct, but they served an important purpose: they transformed uncertainty into something understandable. Stories, unlike pathology, are easier to carry.

And perhaps this explains why myths are so remarkably durable. Patients rarely inherit misinformation. More often, they inherit narratives. A grandmother's remedy, a parent's experience, or an uncle's certainty becomes woven into family memory and repeated with affection and conviction. Science evolves. Stories are handed down.

The truth is that dentistry itself has always existed alongside folklore. The materials have changed, the technologies have advanced, and the storytellers have evolved, but human nature has remained surprisingly constant. People do not merely seek explanations. They seek meaning. And meaning, more often than not, arrives in the form of stories. Which may explain why, after all these years, so many consultations still begin with a sentence every dentist recognises immediately:

"Doctor, I think I just have soft teeth."

Soft teeth, charcoal, and coconut oil

Among the many mysteries patients bring into the surgery, few are as enduring or as confidently delivered as the declaration, "Doctor, I have soft teeth."

It is a fascinating diagnosis because it is rarely based on biology and almost always based on experience. A mother had dentures early. An uncle lost several teeth. A sibling needed numerous fillings. Somewhere along the line, a family narrative emerged, and over time it acquired the status of inherited truth. To the patient, it often feels less like a theory and more like destiny.

Then there are the remedies. Aspirin placed directly on an aching tooth. Clove oil, which at least has a respectable history and some pharmacological merit. Warm salt water, whiskey, bicarbonate of soda, and the occasional advice to simply "leave it alone and let it settle." More recently, activated charcoal has promised dazzling smiles, while coconut oil has enjoyed a remarkable renaissance through the ancient practice of oil pulling. Lemons, strawberries, hydrogen peroxide, and various internet-inspired concoctions have all enjoyed moments of popularity.

Perhaps the remarkable thing is not that these remedies exist, but that every generation seems to rediscover them. The ingredients change, but the underlying hope remains remarkably constant. Human beings have always sought relief from pain, uncertainty, and vulnerability. Faced with a toothache, few people are inclined to wait patiently for a journal article. Most would rather trust something recommended by a grandmother, a friend, or increasingly, someone speaking confidently into a smartphone.

And confidence, it turns out, is a powerful medicine. A remedy does not need to be correct to be convincing. It merely needs to be memorable, familiar, and accompanied by a story beginning with the timeless words:

"It worked for me."

Perhaps that is why myths survive so effortlessly. They are rarely malicious. More often, they are expressions of hope, handed down from one generation to the next with affection, conviction, and occasionally a teaspoon of coconut oil.

TikTok: The new village elder

For centuries, health advice travelled through families, neighbours, and communities. Every village had its wise aunt, trusted neighbour, or retired gentleman who possessed remarkable confidence and a cure for almost everything. Their qualifications were seldom scrutinised. Their certainty was qualification enough.

In many ways, not much has changed.

Only now, the village elder has acquired millions of followers.

Social media platforms, particularly TikTok, have become extraordinary vehicles for health information. They have democratised knowledge, created communities, and given voice to clinicians and educators who might otherwise never have reached such vast audiences. Some of the finest oral health education available today can be found online, delivered with creativity, humour, and admirable clarity.

But social media has also inherited another ancient human tradition: the confident storyteller.

DIY aligners, miraculous whitening hacks, "veneer checks," tongue-scraping revelations, activated charcoal, and homemade orthodontics all compete for attention in an environment where entertainment and information often occupy the same space. Algorithms, unlike peer reviewers, are not particularly concerned with biological plausibility. Their task is simpler. They reward what is interesting.

And interesting usually travels faster than accurate.

Yet perhaps it is unfair to blame technology alone. Human beings have always gravitated towards compelling stories delivered by people who appear trustworthy. A hundred years ago, it was a neighbour leaning over the garden fence. Today, it may be someone speaking confidently through a ring light.



The storyteller has changed. Human nature has not.

Perhaps the greatest irony is that dentists themselves have joined the conversation. Some have become exceptional communicators, educators, and advocates for oral health. Others have discovered that the internet occasionally rewards confidence more generously than caution.

Which brings us to a rather uncomfortable truth.

The problem with misinformation has never really been that people prefer falsehoods.

It is that stories are simply more memorable than facts.

And no storyteller in history has ever introduced a tale by saying:

"According to a recent systematic review..."

Why stories outlive science

If myths are so frequently wrong, why are they so difficult to eradicate?

The answer may lie not in ignorance, but in human nature itself.

Science is extraordinarily good at explaining the world. It offers evidence, probabilities, confidence intervals, and systematic reviews. But people rarely experience life through confidence intervals. They experience it through stories. We remember anecdotes more readily than statistics, personal experiences more vividly than prevalence data, and emotional narratives more deeply than abstract facts.

This presents dentists with an interesting dilemma. We are trained to communicate scientifically. Patients, however, often listen narratively.

A clinician may explain the aetiology of caries with impeccable accuracy, only to discover that the patient remains more influenced by the neighbour who insists that "our family simply has bad teeth." Not because the neighbour is more knowledgeable, but because stories have something science often lacks: familiarity, emotion, and meaning.

Indeed, facts and stories do not really compete on equal terms. Facts appeal to reason. Stories appeal to identity. And identity is remarkably resistant to correction. Telling someone that a belief is inaccurate is seldom enough to replace it. Human beings do not easily abandon stories that help them make sense of themselves and the world around them.

Perhaps the most enduring myth in healthcare is the belief that facts alone change minds.

Patients rarely remember the details of an explanation involving demineralisation or periodontal attachment loss. They remember conversations. They remember being frightened. They remember being reassured. And above all, they remember what someone they trusted told them.

Which may explain why misinformation can spread so effectively. Falsehoods are not always persuasive because they are convincing. Often, they are persuasive because they are memorable.

Science explains.

Stories persuade.

And perhaps the challenge facing modern healthcare is not merely to provide better evidence, but to tell better stories.

After all, no one has ever sat around a dinner table and captivated their audience with a particularly elegant forest plot.

Perhaps Dentists Need Stories Too

By now, it may be tempting to imagine that myths belong exclusively to patients. But dentists, if we are honest, are not entirely immune to storytelling ourselves.

Every profession develops its own folklore. Certain ideas become accepted truths through repetition, experience, and tradition. Some age remarkably well. Others, viewed through the lens of hindsight, acquire a certain charm. Future generations may well smile affectionately at some of our current certainties, just as we smile at charcoal toothpaste and aspirin placed on aching teeth.

And perhaps that should make us humble.

Because not all stories are myths. Indeed, much of dentistry itself is built upon stories. The frightened child who discovers that the dental chair is not so terrifying after all. The patient whose pain finally disappears after a sleepless week. The embarrassed smile restored after years of self-consciousness. The elderly gentleman who can once again enjoy a meal with his family. Long after probing depths, radiographs, and treatment plans have faded from memory, these are the stories patients carry with them.

Patients rarely quote systematic reviews to one another.

Instead, they say:

"My dentist told me..."

And in those four words lies something profoundly important. Dentists are not merely custodians of evidence. We are interpreters of science and, whether we recognise it or not, storytellers ourselves. Every explanation we offer, every analogy we use, every reassurance we provide is an attempt to transform complexity into understanding.

Perhaps that is why myths have survived for so long. Human beings have always relied upon stories to navigate uncertainty. The task of the modern dentist is therefore not simply to correct myths, but to replace them with narratives that are kinder, clearer, and closer to the truth.

Because science, for all its extraordinary power, does not usually defeat stories.

It simply tells better ones.

CONCLUSION

Perhaps the enduring lesson of dental myths is not that people are irrational, but that they are human.

Human beings have always relied upon stories to navigate uncertainty. Long before evidence-based dentistry, there were family remedies, trusted neighbours, and the reassuring wisdom of those who had "seen it all before." Today, the storytellers may have acquired smartphones and ring lights, but the underlying need remains remarkably unchanged. People still seek explanations that are simple, memorable, and above all, meaningful.

And perhaps dentists should find this less frustrating and more familiar.

After all, we too are beneficiaries of stories. We remember mentors whose advice shaped our careers. We carry lessons handed down through generations of clinicians. We recount remarkable cases, difficult diagnoses, and unforgettable patients. No profession is built entirely upon data. Even science advances through narratives—through observations, questions, and the stories we tell ourselves about how the world works.

The challenge, then, is not merely to replace myths with facts. Facts, by themselves, are surprisingly poor travellers. The challenge is to become better storytellers. To explain science

with clarity, humility, and compassion. To offer narratives that are not only accurate, but memorable. To understand that patients do not arrive carrying misinformation so much as they arrive carrying inherited wisdom, family history, and the accumulated stories of lives well lived.

And perhaps that is why, after centuries of scientific progress, the consultation remains such a profoundly human encounter. A conversation. A relationship. A story shared between two people, one seeking understanding and the other attempting to provide it.

Because in the end, science rarely triumphs over stories. It simply tells better ones.

And somewhere, many years from now, a patient may be reassuring a worried friend with words that every dentist secretly hopes to hear:

"Don't worry. My dentist told me..."

RECOMMENDED READING

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The rise of DSO – California’s stand against corporate interference in dental practice relevance to South Africa

SADI JUNE 2026, Vol. 81 No.5 P302-P303

Mr KC Makhubele – CEO, South African Dental Association

The rise of Dental Service Organisations (DSOs) in South Africa is fundamentally altering the landscape of oral healthcare delivery. What began as a trickle of corporate interest in private practices is growing into a significant wave, with DSOs now controlling an increasing share of the dental market. This transformation raises profound questions about professional autonomy, clinical decision-making, and the future of dentist-patient relationships in our country.

Against this backdrop, a recent legislative development in California deserves our close attention. Senate Bill 351, which took effect on January 1, 2026, represents one of the most comprehensive attempts by the American government to limit corporate interference in medical and dental practice. For South African dentists watching the steady consolidation of corporate dentistry, this law offers both a warning and a potential roadmap.

What California’s SB 351 actually does

The California law targets Hedge Fund and Private Equity Group (HFPEG) owners of dental practices with remarkable specificity. It prohibits these corporate entities from interfering with the professional judgment of dentists in making healthcare decisions. More concretely, it bars them from:

- Determining what diagnostic tests are appropriate for a particular condition
- Interfering with referrals or consultations with other practitioners
- Dictating treatment options available to patients
- Setting quotas for how many patients a dentist must see or how many hours they must work

The law also strips corporate owners of control over patient medical records, it prevents them from hiring or firing clinical staff based on competency, and removes their authority over coding, billing, and the selection of medical equipment and supplies.

Perhaps most significantly for employed dentists, SB 351 voids any contract clauses that would prevent a departing practitioner from competing with the practice or from speaking out about quality of care, ethical challenges, or revenue-increasing strategies employed by the corporate owner.

The South African context: DSOs on the rise

The relevance of California’s move to South African dentists

lies in the parallel trajectory of our own dental market. DSOs are expanding rapidly across South Africa, acquiring established practices and employing growing numbers of recent graduates. The model is familiar: corporate entities handle administration, marketing, and supply chain management while dentists focus on clinical care – at least in theory.

In practice, some South African dentists employed by DSOs are reporting concerns remarkably similar to those that prompted California’s legislation. Productivity pressures, restrictions on referral patterns, limitations on treatment options based on cost considerations, and corporate oversight of coding and billing decisions have become recurring themes in professional conversations.

The fundamental tension is structural. DSOs, by their nature, answer to investors seeking returns. Dentists, by training and ethical obligation, answer to patients seeking care. When these interests align, the model works beautifully. When they diverge, the dentist’s professional judgment should prevail – but the corporate structure does not always make that outcome automatic.

Could South Africa follow suit on the Californian example – A pre-emptive necessity.

The question for our profession is whether South Africa might someday adopt similar protective legislation. The answer depends on several factors.

First, there is the matter of existing law. South Africa’s Health Professions Act of 1974 establishes the Health Professions Council of South Africa (HPCSA) and provides for control over the training, registration, and practices of health practitioners. However, the Act predates the modern DSO phenomenon and does not specifically address corporate ownership structures or the division of authority between clinical and business decision-makers.

Second, there is the question of regulatory appetite. California’s SB 351 emerged from years of growing concern about private equity influence in healthcare, culminating in bipartisan legislative action. South Africa has not yet reached that tipping point, but the continued expansion of DSOs suggests we may be moving in that direction.

Third, there is the matter of enforcement mechanisms. California’s law empowers the Attorney General to seek injunctive relief and recover attorneys’ fees for violations. Any South African equivalent would require clear enforcement pathways and meaningful penalties to be effective.

What South African dentists should watch for

For SADA members, several developments bear watching:

Contract provisions: The specific clauses that SB 351 targets – non-compete agreements, non-disparagement clauses, and provisions that cede clinical authority to corporate entities – are already present in many South African DSO employment contracts, in one form or the other. Members should review their own agreements with these concerns in mind.

Regulatory signals: The HPCSA's stance on corporate practice of dentistry will be crucial. In recent years, some confusion arose within the healthcare sector regarding the Health Professions Council of South Africa (HPCSA) position on corporate ownership of healthcare practices. This followed amendments to the Ethical Rules of Conduct published in 2023, which introduced broader provisions for collaboration and multidisciplinary practice models. These changes led some stakeholders to interpret that corporate entities might now be able to own or employ practitioners within healthcare practices.

The HPCSA subsequently clarified that this was **not the case**. Through its Business Practices Policy and related communications, the Council reaffirmed its long-standing position that **professional healthcare practices must be owned and controlled by registered practitioners**. Corporate entities may therefore **not directly or indirectly own a healthcare practice or share in professional fees or profits derived from patient care**.

What remains permissible is the provision of **non-clinical support services by corporate entities**, such as administration, billing, IT systems, financing, or premises rental. These arrangements must be conducted on an arm's-length basis and may not function as a mechanism for sharing in professional income.

In essence, the HPCSA has clarified that **while corporate service arrangements are allowed, corporate ownership or profit participation in professional healthcare practices remains prohibited**, and clinical control must remain with registered practitioners.

International precedent: California is unlikely to be the last jurisdiction to act. Other American states are watching SB 351 closely, and similar legislation may emerge elsewhere. These developments will provide both models and cautionary tales for any future South African efforts.

CONCLUSION

As Dr. Laurance Jerrold observed in his commentary on SB 351, "This is the kind of legislation that our governing body will have to follow closely as it not only winds its way through the California courts, but also as other states adopt similar legislation."

For South African dentistry, the rise of DSOs presents both opportunities and challenges. Corporate investment can bring modern equipment, efficient systems, and expanded access to care. But it must not come at the cost of clinical autonomy or ethical practice. California's experiment in drawing clear lines around corporate authority deserves our attention – not because we should copy it blindly, but because it forces us to ask what lines we would draw in our own context.

The relationship between organised dentistry and corporate dentistry is complex and evolving. Watching how it unfolds elsewhere may help us shape a future that serves both our profession and our patients.

The SADA will continue to monitor developments in corporate dentistry regulation both locally and internationally. Members with concerns about employment contracts or corporate practice structures are encouraged to contact SADA for guidance.

Online CPD in 6 Easy Steps



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Evaluation of Canine retraction rate in adult orthodontic patients using miniscrew-facilitated micro-osteoperforation: A split-mouth randomized clinical study

SADJ JUNE 2026, Vol. 81 No.5 P304-P313

HS Ojebor,¹ AA Umweni,² CC Azodo,³ GO Bassey,⁴ NE Onyia⁵

ABSTRACT

Introduction

Canine Retraction Rate (CRR) using NiTi closed coil springs may be enhanced by miniscrew-facilitated osteoperforation (MOP).

Aims and Objectives

To determine whether MOP significantly accelerates CRR in adults undergoing bilateral first premolar extraction and to evaluate short-term pain levels post-procedure.

Study Design

A split-mouth randomised controlled trial with 17 participants (Mean age: 24.9 ± 4.6 years; 64.7% females). Randomisation was performed per arch with concealed allocation.

Methods

On the experimental side, three vertical perforations were created on the buccal cortical plate using a 6 mm × 1.5 mm miniscrew. A 9 mm NiTi closed coil spring delivering 150 g of force facilitated canine retraction. CRR was measured at weeks 1, 8, and 12, and pain levels were assessed at 24 hours, 3-, and 7-days post-MOP using the Wong-Baker FACES Pain Scale.

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2. AA Umweni, Professor, – Principal Supervisor (15%).
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4. GO Bassey – Data Entry, Result Representation, and Article Writing/Editing (20%).
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Results

The MOP group showed higher mean CRRs (3.6 ± 1.8 mm at week 8, 6.2 ± 1.8 mm at week 12) compared to the control group (2.5 ± 1.5 mm at week 8, 4.7 ± 1.6 mm at week 12). Pain levels at days 3 and 7 post-MOP were significantly higher in the MOP group ($p = 0.027$ and $p = 0.042$).

Conclusion

MOP significantly accelerates canine retraction but increases short-term pain levels.

Keywords

Canine Retraction Rate, Miniscrew-facilitated Micro-osteoperforation, Split-mouth Study, Orthodontic Tooth Movement, Accelerated Orthodontics.

INTRODUCTION

With the growing demand for orthodontic treatment among adult patients,¹ long treatment duration remains a fundamental issue that has become the most important adverse factor affecting the treatment process.^{1,2} Orthodontic tooth movement (OTM) has been estimated to be 1 mm in 4 weeks, putting the average time needed for maxillary canine retraction under maximum anchorage at 7 months and putting total treatment time at about 2 years.³ The long process that is associated with orthodontic treatment has prompted many adult patients to accept a less esthetic treatment option, like the use of prostheses, than orthodontic treatment, which is an average of 2 years in duration.⁴

Reducing this long duration associated with orthodontic treatment remains a concern for both orthodontists and patients, as prolonged treatment time has been associated with not just loss of time but also oral diseases like dental caries, root resorption,⁵ gingival inflammation and recession, and enamel decalcification.⁶ Most important too is the patients' psychosocial affectation, and loss of patients' cooperation as a result of burnout, which can further prolong treatment time.⁴

There is still no consensus on the ability of MOP as a procedure to accelerate orthodontic tooth movement, thereby shortening treatment time; hence, several researchers have called for the need for more work to be done on MOP to be able to ascertain its effectiveness or non-effectiveness in accelerating tooth movement⁷⁻⁹ the extended duration of this treatment often leads to its replacement with alternative methods that offer shorter treatment times. Micro-osteoperforation (MOP). Thus, a need for this study.

AIMS AND OBJECTIVES

To compare the canine retraction rate using NiTi close coil spring alone in canine retraction with that from the use of NiTi close coil spring with adjunctive miniscrew-facilitated MOP in adult patients aged 18 years and above undergoing fixed orthodontic treatment.

To compare the rate of canine retraction using NiTi closed coil springs with a one-time application of adjunctive miniscrew-facilitated micro-osteoperforation (MOP) at the start of retraction versus repeated applications at the start and 8 weeks after initiation of retraction in adult patients (≥ 18 years) undergoing fixed orthodontic treatment.

To compare levels of pain and discomfort among adult patients aged 18 years and above undergoing fixed orthodontic treatment in the canine retraction stage using a NiTi close coil spring with the pain and discomfort levels using a NiTi closed coil spring with miniscrew-facilitated MOPs.

METHODOLOGY

This is a multistage randomised clinical trial. The first stage of randomisation was to allocate intervention, i.e., experiment group (EG), either to the right or left with the control, i.e., control group (CG), being the opposite side with a 1:1 allocation. The EG was further randomised into one-off MOP (EG₁) or twice MOP (EG₂) with a 1:1 allocation ratio. The randomisation was accomplished by using the permuted random block size of 2 with the random generation function in Excel (Microsoft, Redmond, Wash).

Subsequently, the random sequences to either the right or left were concealed in opaque envelopes and shuffled before the intervention to increase the unpredictability of the random allocation sequence. Each patient was asked to pick a sealed envelope to assign the surgical intervention to either the right or left side and pick another to assign the intervention side to group EG₁ or EG₂. Allocation concealment was done to prevent selection bias and protect the assignment sequence until allocation.

Participants' Eligibility Criteria

Ethical approval was obtained from the University of Benin Teaching Hospital, Benin City, Edo State, Nigeria, with approval number 148260. This trial was also registered at PACTR.org with identifier number PACTR202201662414178. Participants were recruited from new adult patients attending the orthodontic clinic of the University of Benin Teaching Hospital.

Inclusion Criteria

Patients aged 18 years; patients who underwent bilateral extraction of the first premolars in either one or both arches; no previous history of fixed orthodontic treatment; no history of systemic disease, bone pathology, or active periodontal disease. Patients who do not use tobacco.

Exclusion Criteria

Patients on prolonged use of antibiotics, anti-inflammatory drugs, systemic corticosteroids, and calcium channel blockers, poor oral hygiene even after attempts at motivation, patients who had transalveolar extraction of their first premolars, and patients with evidence of active dental caries.

Sample Size

The formula for comparing means between two groups was used to estimate the sample size for the split-mouth design.¹⁰

Blinding

This was ensured only during data collection, as blinding of participants and clinicians was not feasible.

Intervention

Before the commencement of this procedure, informed consent was obtained from all study participants.

Accessibility of the area of interest for MOPs was performed as prescribed by Sangsuwon *et al.*¹¹

Patients who met inclusion criteria with the following diagnosis:

- Class I malocclusion cases with moderate to severe crowding
- Class II malocclusion
- Class III malocclusion
- Bimaxillary prognathism

And required 2-unit extractions in one or both arches as part of their treatment were recruited.

Extractions were carried out 2 weeks before the commencement of fixed orthodontic treatment

0.022x0.030 Roth prescription; Dentaurem® brackets were used for all study participants. All teeth were leveled and aligned using various sizes of NiTi wires. The canine retraction was done on a wire sequence of 0.019x0.025 stainless steel wire placed 4 weeks before commencing canine retraction.

A digital periapical radiograph was used to evaluate the bone between the canine and second premolar and to evaluate the root of the canine.

Anchorage for canine retraction was done using a 1.8x8mm miniscrew by GDT® inserted buccally between the roots of the first permanent molar and the second premolar bilaterally one week prior to the commencement of canine retraction.

Impression of the arch(s) to be used for MOP and control was made using Elvydent® colour changing, normal set, peppermint flavoured, and dust-free alginate material. Casts were produced using type IV Dental stone and then converted to digital models using a three-dimensional (3D) scanner. This was performed using the White Light Scanner (COMET5, 100-200-400, Steinbichler Optotechnik Germany) with 3D reverse modeling software.

The distance between the centre of the canine and second premolar brackets was measured as used in a previous study.¹² These landmarks were chosen due to ease of identification. Values obtained are marked as T0. This is the baseline distance before the commencement of canine retraction. All measurements in this study were done on digital models obtained from casts using the 3D reverse scanner with modeling software to remove errors due to parallax. The accuracy of the scanner software was verified and confirmed by scanning and measuring 20 randomly

selected casts which were rescanned and remeasured one week later.

Following the method described by Sangsuwon *et al.* using orthodontic miniscrews as follows.

- Patient was asked to rinse with 15 ml of chlorhexidine for 30 seconds
- The area intended for MOPs following balloting was identified and anaesthetised first with a topical anaesthetic agent and then two minutes later infiltrated using a local anesthetic agent (0.5 ml Zey[®] lidocaine) placed 3 mm distally away from the intended MOP site. The tip of a dental explorer was used to prick the attached gingiva around the area anaesthetised to establish that the anesthesia was sufficient.
- A sterile GDT[®] orthodontic miniscrew (6 mm × 1.5 mm), attached to a driver, was used to create three equally spaced vertical perforations approximately 2 mm apart. The first perforation was placed apical to the attached gingiva on the buccal cortical plate. The perforations were made along a straight line drawn 3 mm parallel to the distal surface of the canine to be retracted. Each perforation was created using gentle rotational movements of the miniscrew driver until a depth of 6 mm was reached. N/B: One miniscrew per patient per visit was used to reduce the chances of infection from the procedure.
- Where bleeding was observed after MOP, gentle pressure using a gauze pack was used to arrest the bleeding.
- No analgesics were routinely prescribed after the procedure or during the study period. However, participants who experienced severe pain were permitted to take rescue analgesia (1 g paracetamol). Three participants required this within the first 24 hours following MOP. These participants were instructed to record analgesic intake, and while this was considered during data interpretation, it was not adjusted for in the analysis and was therefore regarded as a potential source of bias, particularly in the 24-hour pain and discomfort scores.

A 9mm NiTi closed coil spring (Sentalloy, 3M Unitek, USA) was used in canine retraction on both the experiment and control sides, anchored to the head of the miniscrew posteriorly and to the canine hooks on the canine bracket anteriorly.

A force of 150g,¹⁴ which was produced by 6mm stretching of the springs and was calibrated using a Correx gauge[®], where the canine–miniscrew distance was more than the activated coil spring length, ligature wire was used to account for the length disparity by attaching it to the coil spring and securing it to the miniscrew to ensure uniform force delivery on coil springs on the right and left quadrants on the same arch.

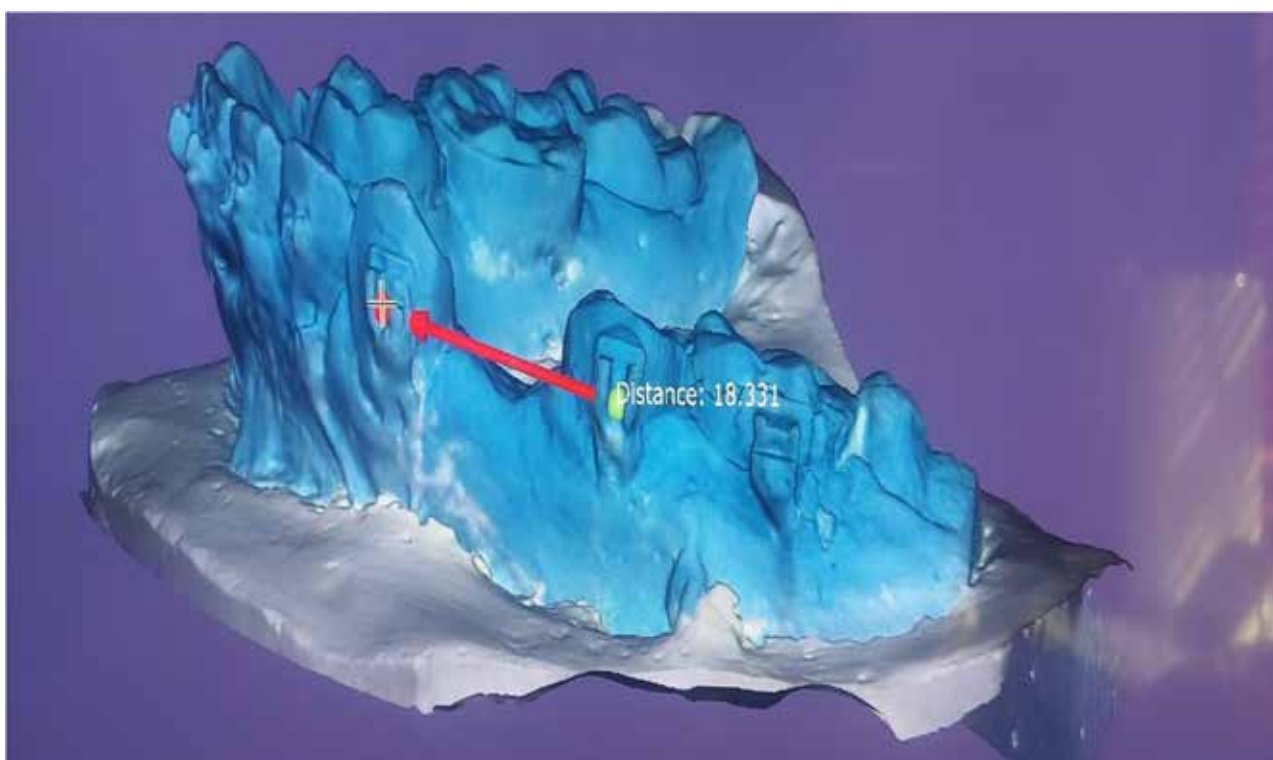
A repeat impression of the arch(es) with MOP was made at weeks 8 and 12 for all patients, and casts were converted to digital models.

The new distance between the centre of canine and second premolar brackets was measured in T_{week8} and T_{week12}. The difference in this new distance, T_{week8} from the baseline (T₀) and T_{week12} from T₀ is the canine retraction rate in 8 weeks and 12 weeks and is marked as T₁ and T₂ respectively. Repeat MOPs were done only for EG₂ patients at 8 weeks from the commencement of retraction to evaluate the effect of repeat MOP application. This is to attempt to sustain the maximum Regional Acceleratory Phenomenon (RAP), which is believed to start to wane after 2 months.¹⁵

The secondary outcome of this study, which was pain and discomfort, was measured using the Wong-Baker FACES Pain Rating Scale at 24-hour, 3- and 7-day post-MOP procedures at T₀ for all participants. Study participants were advised not to take any form of pain medication during the study and to notify the investigator when they had severe pain. Reminders were sent electronically, and values were sent electronically on the day. All values obtained were entered into the data collection form for analysis. Canine retraction in this study was the total distance moved by the canine in 12 weeks.



Figure 1: Clinical picture showing 3 bleeding spots following MOP application



Ethical Considerations

Before the commencement of this study, approval was obtained from the Health Research Ethics Committee of the University of Benin Teaching Hospital, Benin City, with approval number ADM/E22/AVOL.VII/148260.

Also, an informed consent form was administered to every patient who met the inclusion criteria after a thorough explanation of the procedure and its possible advantages and complications for signature in the presence of a witness.

Data analysis

Data collected was analysed using SPSS version 23.0 (SPSS Inc., Chicago, Ill). The variables and outcome of the study were described by descriptive statistics using mean, standard deviation (SD), range (minimum-maximum), charts, and tables. The Shapiro-Wilk test of normality was used to determine the appropriate parametric and non-parametric tests. Paired samples were used to compare the change in canine retraction over time within CG and EG, while independent samples were used to compare the canine

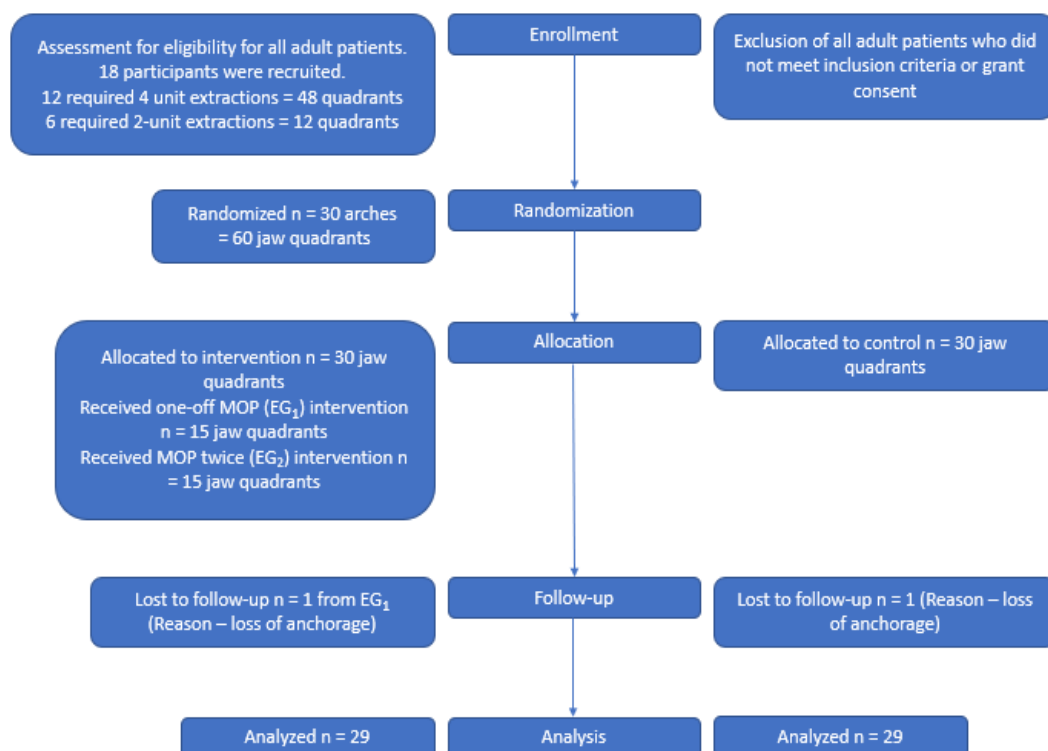


Figure III: Flowchart showing selection, randomization, allocation, follow-up and analysis procedures

retraction rate between CG and EG. A comparison of the canine retraction rate between genders was done using an independent sample. This was also done to compare the maxilla and mandible. The relationship between age and the canine retraction rate was determined using Pearson's correlation.

The pain levels were described using the median and interquartile range; a comparison between the MOP and control group was done using the Mann-Whitney U statistic. All analysis was evaluated with a $P \leq 0.05$, considered significant in all cases, at 95% confidence intervals (CI).

RESULTS

Participant flow

The subjects' ages ranged from 18 to 33 years (Fig. 1) with a mean age of 24.9 ± 4.6 years and consisted of 11 (64.7%) females and 6 males (35.3%). 29 jaws (14 upper and 15 lower) consisting of 58 quadrants were used in this study. In this study, 18 subjects were recruited into the study. 1 was lost due to loss of anchorage. Out of the 17 subjects who

completed the study, 12 had 4-unit extractions constituting 48 quadrants and 5 had 2-unit extractions constituting 10 quadrants. 14 quadrants received one-off MOP with 14 contralateral quadrants as control, and 15 quadrants received MOP twice with 15 contralateral quadrants as control.

Table I: Sociodemographic Characteristics of the Participants

Parameter	N (%)	Mean Age (in years) $\pm$ SD
Gender		
Male	6 (35.3%)	21.9 ± 3.1
Female	11 (64.7%)	26.3 ± 4.6
Total	17 (100.0%)	24.9 ± 4.6
SD = Standard deviation		

Average Distance Between Mid-Canine Bracket and Mid-2nd Premolar Bracket

At T_0 , the average distance between the mid-canine bracket and mid-second premolar bracket was 15.6 ± 2.5 mm in

Table II: Average distance between mid-canine bracket and mid-2nd premolar bracket

	MOP (T_0 mm)	Control (T_0 mm)	MOP ($T_{\text{week}8}$ mm)	Control ($T_{\text{week}8}$ mm)	MOP ($T_{\text{week}12}$ mm)	Control ($T_{\text{week}12}$ mm)
N	29	29	29	29	29	29
Mean	15.6	15.8	12.0	13.4	9.4	11.1
Std. Deviation	2.5	1.9	2.7	2.2	2.2	2.3

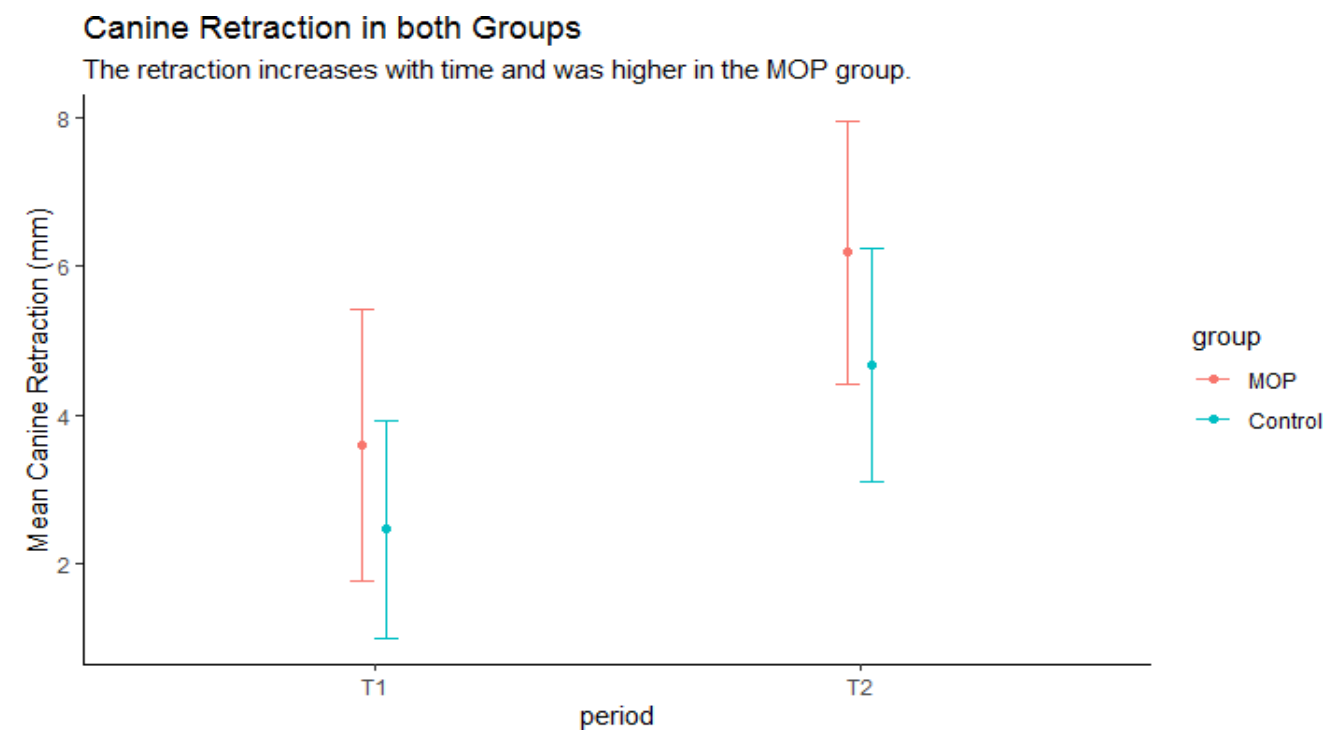


Figure IV: The mean $\pm$ 1 standard deviation (error bar) of canine retraction rate across the periods, T1 (week 8) and T2 (week 12) in the MOP and Control.

the MOP group and 15.8 ± 1.9 mm in the control group. At Tweek8, the average distance was 12.0 ± 2.7 mm and 13.4 ± 2.2 mm in the MOP and control group, respectively. While at Tweek12, the average distance was 9.4 ± 2.2 mm in the MOP group and 11.1 ± 2.3 mm in the control group.

The average canine retraction rate increased over time. At both points in time, the average canine retraction was higher in the MOP group (Figure IV).

Canine Retraction Rate (Mean Difference) within Experiment and Control Groups at 8 Weeks and 12 Weeks

In the MOP group (Table III), the mean canine retraction rate (CRR) was 3.6 ± 1.8 mm at week 8 and 6.2 ± 1.8 mm at week 12, while in the control group, the mean CRR was 2.5 ± 1.5 mm at week 8 and 4.7 ± 1.6 mm at week 12. The retraction rate (Table III) at week 8 and week 12 differed significantly from baseline (week 0) in both the MOP group ($p = 0.000$) and the control group ($p = 0.000$).

Comparison between the Canine Retraction Rate (CRR) of MOP and the Control Group

As shown in Table IV, at week 8 the mean CRR of the

MOP group was significantly higher ($p = 0.011$) than that of the control group by a difference of ≈ 1.1 mm ($0.3 - 2.0$, 95% CI, $p = 0.011$). This trend was also observed at week 12; the mean CRR of the MOP group was statistically significantly higher ($p = 0.001$) than that of the control group by a difference of ≈ 1.5 mm ($0.6 - 2.4$, 95% CI, $p = 0.001$).

Canine Retraction Rate Based on the Number of MOP Appointments

At weeks 8 and 12, as shown in Table V, the mean canine retraction rate was higher in participants who received two MOP applications compared to those who received a single application. The differences were statistically significant at both time points ($p = 0.011$ and $p = 0.001$, respectively).

Gender and Canine Retraction Rate (CRR) in Experiment and Control Groups

In the MOP group, the mean CRR was higher in males across the time periods, although the difference was only statistically significant at week 12 ($p = 0.020$). In the control group, the mean CRRs of males were slightly higher than that of females but not significant at week 8 ($p = 0.353$) as well as at week 12 ($p = 0.357$).

Table III: Canine retraction rate (mean difference) within experiment and control groups at 8 weeks and 12 weeks

Group	Mean Difference (mm) $\pm$ SD			
	$T_1 (T_0 - T_{\text{week8}})$	p-value	$T_2 (T_0 - T_{\text{week12}})$	p-value
N	29		29	
MOP	3.6 ± 1.8	0.000**	6.2 ± 1.8	0.000**
Control	2.5 ± 1.5	0.000**	4.7 ± 1.6	0.000**

T1 = week 8, T2 = week 12, SD = standard deviation
 ** Significance at the 0.01 level

Table IV: Comparison between the Canine Retraction Rate of MOP and Control Group

Period	MOP	Control		Mean Difference (mm)	95% CI	p-value
	Mean (mm) $\pm$ SD	Mean (mm) $\pm$ SD				
N	29	29				
T1	3.6 ± 1.8	2.5 ± 1.5	1.1	$0.3 - 2.0$		0.011*
T2	6.2 ± 1.8	4.7 ± 1.6	1.5	$0.6 - 2.4$		0.001*

T1 = CRR at week 8, T2 = CRR at week 12, SD = Standard Deviation, CI = Confidence Interval
 * Significance at the 0.05 level
 ** Significance at the 0.01 level

Table V: Canine retraction rate of the MOP group based on the number of MOP appointments

Period	NA = 1	NA = 2	Mean Difference (mm)	95% CI	p-value
	Mean (mm) $\pm$ SD	Mean (mm) $\pm$ SD			
N	14	15			
T_1	3.2 ± 1.3	4.0 ± 2.2	-0.8	$-2.1 - 2.0$	0.011*
T_2	6.1 ± 1.9	6.3 ± 1.6	-0.2	$-1.6 - 2.4$	0.001*

T_1 = week 8, T_2 = week 12, SD = standard deviation, CI = confidence interval

Table VI: Canine retraction rate based on gender

	Time	Male Mean $\pm$ SD	Female Mean $\pm$ SD	MD (mm)	95% CI	p-value
MOP	T ₁	4.0 $\pm$ 1.5	3.4 $\pm$ 2.0	0.6	-0.9 - 2.1	0.390
	T ₂	7.3 $\pm$ 1.6	5.7 $\pm$ 1.7	1.6	0.3 - 2.9	0.020*
Control	T ₁	2.8 $\pm$ 1.7	2.3 $\pm$ 1.4	0.5	-0.6 - 1.8	0.353
	T ₂	5.1 $\pm$ 1.7	4.5 $\pm$ 1.5	0.6	-0.7 - 1.9	0.357

T₁ = week 8, T₂ = week 12, SD = standard deviation, MD = mean difference
 * Significance at the 0.05 level

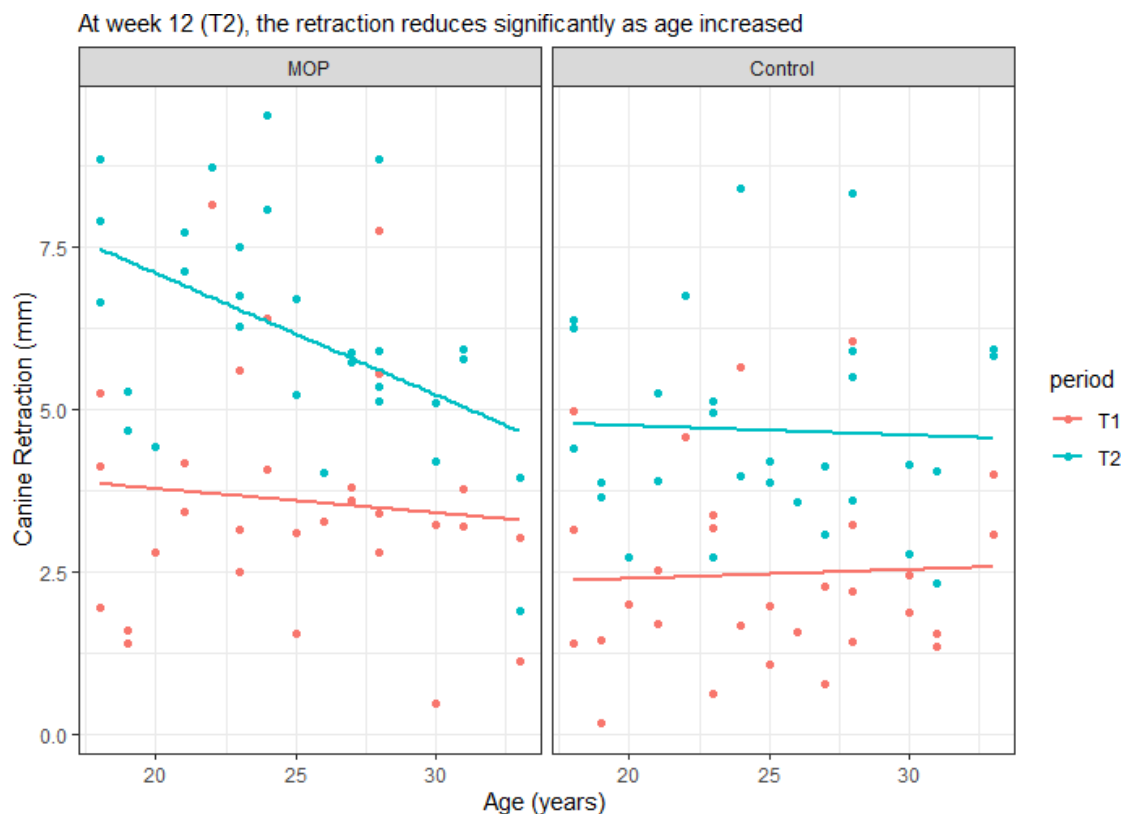


Figure V: Age and Canine Retraction Rate

Age and Canine Retraction Rate

Figure V above shows the correlation between the age of the subjects and the canine retraction rate in both the MOP and control groups. At week 8 (T₁), there was no relationship between age and canine retraction rate in both groups. However, at week 12 (T₂), in the MOP group there was a significant negative relationship ($r = -0.49$, $p = 0.007$) between age and canine retraction (retraction decreased as age increased).

Assessment and Comparison of the Level of Pain between the Experiment and Control Groups

The level of pain recorded in the groups is shown in the plot below (Fig. VI). In the MOP group, the median pain level was 6.0 (4.0 – 8.0) on day 1, 4.0 (2.0 – 5.0) on day 3, and 1.0 (0.0 – 2.0) on day 7. In the control group, the median pain level was 5.0 (4.0–6.0) on day 1, 3.0 (1.0–4.0) on day 3, and 0.0 (0.0–1.0) on day 7. In both groups, there was a significant reduction in the level of pain as the days increased ($p = 0.000$ in both groups).

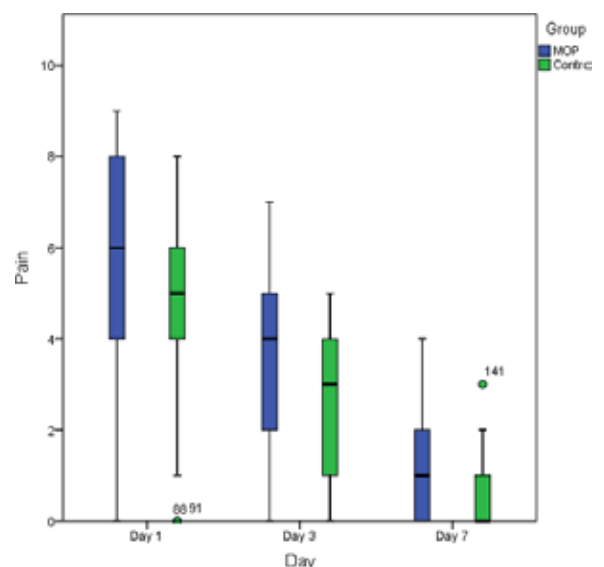


Table VII: Comparison between the pain level of MOP and control group

	MOP (N = 29)	Control (N = 29)	
	Median (IQR)	Median (IQR)	p-value
Day 1	6.0 (4.0 – 8.0)	5.0 (4.0 – 6.0)	0.094
Day 3	4.0 (2.0 – 5.0)	3.0 (1.0 – 4.0)	0.027*
Day 7	1.0 (0.0 – 2.0)	0.0 (0.0 – 1.0)	0.042*

IQR = Inter-quartile range
 * Significance at the 0.05 level

Comparison between the Pain Level of MOP and the Control Group

Between the experiment (MOP) and control groups, as shown in Table VII, the distribution of pain levels was not the same, but the difference was not statistically significant at 24 hours post-procedure ($p = 0.094$), while at day 3 and day 7, the pain level differences of the MOP group were statistically significant from those of the control ($p = 0.027$ and $p = 0.042$, respectively). In the MOP group, there was no significant difference in the distribution of pain from the control group at day 1 (24 hours) ($p > 0.05$), but there was a significant difference in the distribution of pain at day 3 ($p = 0.030$) and day 7 ($p = 0.040$).

DISCUSSION

The daunting task of reducing the treatment duration¹⁶ as well as its accompanying undesirable side effects associated with prolonged treatment time in fixed orthodontic treatment in general and among adult patients in particular has led to the introduction of new treatment modalities such as MOP.¹⁷

This split-mouth study design helped reduce the biological variability as each subject served as its control. Homogeneous subjects (young adult patients) were, as much as possible, used in this study. This allowed for similar inflammatory responses to MOP based on their close age range. Confounders were eliminated using the inclusion criteria.¹⁸ This study, conducted to determine CRR using a NiTi close coil spring with MOP on the experiment side and a NiTi close coil spring only on the control side, produced a mean retraction rate of 6.2 ± 1.8 mm from the experiment sides and 4.7 ± 1.6 mm from the control sides at the end of 12 weeks of retraction. This finding was significantly higher on the experiment side, which had a NiTi close coil spring with MOPs applied, when compared with that on the control side, which had a NiTi close coil spring only. This result has been attributed to the RAP elicited by the micro-traumatic nature of MOP, which translates into an increase in inflammatory markers and osteoclastic activity, which is the hallmark of OTM.¹⁹ The finding from this study, which showed about 1.34 times faster CRR, is in keeping with reports from other studies like that by Zoya Ahsan *et al.*²⁰ which had 30 participants and reported a 1.6 times faster retraction rate. Other studies have reported even higher values of a 2.3 times faster retraction rate.¹² Studies that have shown no difference in CRR following MOP application also exist in the literature, with Alkebsi *et al.* reporting no difference whatsoever in retraction rate.^{21,22}

One of the popularised distinctive advantages of MOP placement is the repeatability of the procedure as opposed

to the other highly invasive surgical-assisted techniques. This repeat application is believed to cause a constant circulation of inflammatory chemokines and cytokines within the localised region where MOP is applied, thus leading to a sustained increase in localised alveolar bone turnover^{23,24} and the other side received micro-osteoperforations (MOPs). Wilcko *et al.*¹⁵ reported that RAP takes effect in 1 or 2 days following the surgical intervention and reaches its peak levels in about 1 or 2 months and then starts to wane; repeats of MOP in a subset of the experimental sites in this study were planned for 8 weeks from the time of commencing this study. A statistically significant increase in CRR was observed when MOP was repeated 8 weeks after study commencement in the subset of the experimental group ($p = 0.011$ at week 8; $p = 0.001$ at week 12). However the magnitude of the difference between the groups was small, and the confidence intervals included zero, suggesting that the clinical significance of this finding may be limited. This finding contrasts with previous studies that reported no significant increase in OTM following repeated MOP applications over a 3 month-period.^{25,26} The discrepancy may be related to methodological differences, including variations in force delivery. In contrast, Attri *et al.*²⁴ reported a significant increase in retraction rate and faster space closure when MOPs were repeatedly applied every 28 days over 3 months. In that study, six MOPs were applied to both the mesial and distal aspects of the alveolar bone adjacent to the canines, which may have enhanced the RAP, thereby increasing OTM.

Therefore, further studies are needed to evaluate the influence of factors such force reactivation, number and location of perforations, and depth of MOP in determining the effectiveness of repeated applications. Although some studies have reported no increase in OTM following MOP, the variability in findings suggests that the biological response induced by RAP may be modest and influenced by procedural differences.²⁶

The average rate of tooth movement by conventional orthodontics is estimated to be around 0.8 to 1.2 mm/month when continuous forces are being applied.²⁷ It was observed to be less than that derived from this study on both the control and experiment sides with values of 1-2.⁶ mm/month. This observation may have been a result of the differences in the form of anchorage used. This study used absolute anchorage in the form of TADs. This is also true when compared to other studies on canine retraction rates published by Dixon *et al.*²⁸ who observed that the rate of canine retraction with NiTi closed coil springs was 0.81 mm/month, and Cacciafesta *et al.*²⁹ who reported a 1.1 mm/month canine movement but did not use absolute anchorage.

Therefore, absolute anchorage should be considered where possible if a faster OTM is desired. This eliminates anchorage loss and invariably reduces OTM associated with other forms of anchorage design.

On the secondary outcome of our study, which was pain and discomfort, the highest values of pain scores were recorded on day one on both the control and experimental sides. This can easily be attributed to the force effect on the periodontium of the canines by the NiTi close coil spring. The pain perception of the study participants from the experiment quadrants when compared to that from the control quadrants was statistically not significant 24 hours post MOP application but was statistically significant at day 3 and day 7 post MOP application. Even though there was a decrease in pain reported from both the experiment and control sides as the number of days post-MOP increased, the pain levels on the experiment sides were higher at day 3 and day 7. This can be a result of the microtrauma associated with MOP, both to the mucosa and the underlying alveolar bone, and/or lack of blinding in the application of MOP to the experiment quadrants in this study. Our study had 11 females and 6 males, with three of the female study participants reporting severe pain before 24 hours post-MOP application, with all three requiring a single dose of 1 g of paracetamol for their pain. Some other studies have not only shown more pain experience on the experiment quadrants but have also reported adverse effects on patients' quality of life.²⁶

Other complications associated with MOP administration, which, even though not reported in the results, were observed, were rotation/tipping of the canines. This was observed in both the experiment and control mouth sides despite the use of 0.19 x 0.025 stainless steel wire placed 4 weeks before commencement of retraction and throughout retraction. The direction of force application could have accounted for this finding. Canine root resorption, which is also an associated MOP complication, was equally assessed by comparing digital periapical radiographs taken at the zero week and 12th week of this study, with no form of resorption observed after 12 weeks.

A reduction in time of about 2.9 weeks was observed from this study in the canine retraction phase of fixed orthodontic treatment. This may not still be as significant as the overall reduction in orthodontic treatment time. Therefore, MOP applicability in other stages of orthodontic treatment must be equally evaluated if an appreciable reduction in total treatment time is desired, which will improve its acceptance by both patients and clinicians.

STUDY LIMITATIONS

The use of rescue analgesia by a small number of participants within the first 24 hours may have influenced reported pain and discomfort scores. As this was not adjusted for in the analysis, it represents a potential source of bias, particularly at the 24-hour time point.

CONCLUSION

From this study, the canine retraction rate using a NiTi close coil spring with adjunctive miniscrew facilitated MOP was significantly higher than that from the use of a NiTi close coil spring alone.

Also, the canine retraction rate using a NiTi close coil spring with two applications of an adjunctive miniscrew facilitated

MOP at the commencement of retraction and 8 weeks afterward but did not produce a significantly faster retraction rate when compared to once the application of MOP at the commencement of canine retraction.

Pain from the administration of adjunctive MOP to NiTi close coil spring activation in canine retraction, even though it was not statistically significant 24 hours post-administration from pain from NiTi close coil activation alone, was significantly higher than pain from the latter by day 3 and day 7 post-MOP administration.

CONFLICTS OF INTEREST

All authors declare no conflicts of interest related to this study. The research was conducted independently, without financial or personal relationships that could inappropriately influence or bias our findings. All materials and equipment used in this study were obtained through standard procurement channels, and no external funding or sponsorship was received.

FUNDING

No external funding was provided for this study. All funding was provided by the authors.

TRIAL REGISTRATION DETAILS

Registry 1: University of Benin Teaching Hospital, Benin City Edo State, Nigeria

Registration number: 148260

Registration date: 9 Jan 2020

Registry 2: PACTR.org

Registration number: PACTR202201662414178

Registration date: 24 Jan 2022

CONSENT TO PUBLISH DECLARATION

Not applicable as study does not contain any identifying information of study participants.

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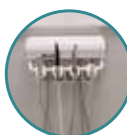
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Preventive oral health knowledge, attitudes and practices of patients attending selected private dental practices in Pretoria, South Africa

SADJ JUNE 2026, Vol. 81 No.5 P314-P322

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ABSTRACT

Introduction

Despite the well-established role of preventive oral health behaviours in reducing oral disease, limited evidence exists on the knowledge, attitudes, and practices (KAP) of adults attending private dental practices in South Africa. This study was undertaken to assess preventive oral health behaviours among patients in selected private practices in Pretoria.

Aim and Objectives

The study aimed to determine the preventive oral health KAP of patients attending selected private dental practices in Pretoria.

Design

A descriptive cross-sectional study design was employed.

Methods

A descriptive cross-sectional study was conducted among adult patients attending four selected private dental practices in Pretoria. Participants were recruited using convenience sampling and completed a validated, self-administered questionnaire. Data were analysed using SPSS version 28, with descriptive statistics (frequencies, proportions, and

means) and inferential analysis using the Chi-square test to assess associations between variables at a 5% significance level ($p \leq 0.05$).

Results

More than 100% of the sample, or 325 out of the estimated 304 members of the representative sample, agreed and completed the survey. Out of 325 participants (59.1% female, mostly aged 30–39), 55% were aware of dental caries and 65% of its causes, while 77% associated gingivitis with poor oral hygiene. Most (89%) had received oral hygiene instruction, mainly from dentists (64%), and 74.5% brushed twice daily. About 60% attended regular dental check-ups.

Conclusion

Although adult dental patients attending private practices in Pretoria demonstrate generally positive oral hygiene behaviours, significant gaps remain in preventive oral health knowledge and practices, particularly regarding fluoride use, diet, flossing, and routine dental attendance. These findings highlight the need for targeted, evidence-based preventive education strategies in private dental practice settings.

Key words

Preventive oral health, oral hygiene behaviour, KAP study, dental patient education, South Africa, private dental practice

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MMB, NHD and TKM designed and conceptualized the article. NHD conducted the literature search. NHD, MMB, and TKM assisted with the literature review. All authors edited the final version of the manuscript. All authors read and approved the final version of the manuscript.

INTRODUCTION

Oral health is a fundamental component of overall health and well-being, with substantial evidence demonstrating a strong association between oral diseases and comorbidities such as cardiovascular disease, diabetes mellitus, respiratory infections, adverse pregnancy outcomes, just to name a few.¹⁻⁴ Oral diseases, particularly dental caries and periodontal disease, are among the most prevalent chronic conditions globally and are primarily caused by bacterial biofilm accumulation.⁵ If left untreated, these diseases can lead to pain, tooth loss, impaired mastication, nutritional imbalances, and reduced quality of life.^{1, 6, 7} Furthermore, pathogenic microorganisms and their by-products may enter the bloodstream, triggering systemic inflammation and contributing to the progression of systemic diseases.^{2, 3} As life expectancy increases and individuals retain their natural dentition for longer, maintaining oral health through effective preventive strategies has become increasingly important to preserve oral function and overall health.¹

The Health Belief Model (HBM) provides a useful framework for understanding preventive oral health behaviours.^{8, 9} This

model suggests that individuals are more likely to engage in preventive health behaviours if they perceive themselves to be susceptible to disease, recognise the severity of the condition, understand the benefits of preventive action, and perceive minimal barriers to implementing such behaviours.⁸⁻¹⁰ In the context of oral health, improving oral health knowledge is essential for early diagnosis, prevention, and prompt treatment of dental diseases.^{5, 7} Understanding oral health enables individuals to adopt appropriate preventive measures such as toothbrushing, interdental cleaning, and regular dental visits, which are essential for controlling dental plaque and preventing disease progression.^{5, 11, 12} Additionally, patient education and motivation are key factors influencing adherence to oral hygiene practices, as knowledge transfer promotes behavioural change and the establishment of lifelong preventive habits.^{2, 12, 13}

Preventive dentistry focuses on addressing the underlying causes of oral disease through education, early intervention, and behavioural modification.¹² Preventive strategies include oral hygiene instruction, fluoride use, dietary counselling, and regular dental examinations, all of which contribute to improved oral and systemic health outcomes.^{14, 15} Clinical evidence indicates that prevention and treatment of oral diseases, particularly periodontal disease, can reduce systemic inflammatory burden and improve general health.³ In addition, effective preventive care reduces the need for invasive and costly dental treatments such as root canal therapy and tooth extraction, benefiting both individuals and healthcare systems.^{1, 6, 7} Within private dental practice settings, oral health professionals play a crucial role in delivering preventive education and reinforcing positive oral health behaviours during patient interactions.¹⁶

Despite the availability of preventive dental services and education, many patients continue to seek dental care only when symptoms become severe, frequently postponing treatment until limited options remain.¹² This behaviour reflects gaps in preventive oral health KAP, which may be influenced by sociodemographic factors such as education level, socio-economic status, and access to healthcare services.¹² Furthermore, although private dental practice patients may have improved access to dental care, access alone does not guarantee adequate preventive knowledge or appropriate oral health behaviours. There is limited published data on preventive oral health KAP among adult dental patients in South Africa, particularly those attending private dental practices. This lack of evidence limits the ability of oral health professionals to develop targeted preventive education strategies and oral health promotion interventions tailored to this population.

Therefore, the aim of this study was to assess the preventive oral health KAP of patients attending selected private dental practices in Pretoria, South Africa, in order to identify knowledge gaps and inform future oral health promotion and preventive care strategies.

The aim of the study was therefore to assess the KAP of dental patients regarding oral preventative measures in selected private dental practices in Pretoria.

MATERIALS AND METHOD

Study design

A descriptive cross-sectional study was conducted to assess oral health KAP among patients attending selected private dental practices in Pretoria, South Africa. Cross-

sectional designs are appropriate for assessing population characteristics and associations between variables at a single point in time.¹² Data were collected over a six-month period during 2023.

Study setting

The study was conducted in four private dental practices located in different geographic regions of Pretoria (North, South, East, and West). These practices were purposively selected to obtain a broader representation of patients attending private dental care facilities across the city. Prior to the commencement of the study, the principal investigator contacted the practice owners to explain the objectives of the research and request permission to recruit patients from their practices. Gatekeeper permission was obtained from the practice owners before data collection commenced.

Study population

The study population consisted of adult patients attending routine dental appointments at the selected practices during the study period. Patients were approached while waiting for their dental consultation and were invited to participate in the study.

Inclusion criteria

- Patients aged 18 years or older
- Patients attending the participating dental practices during the data collection period
- Patients able to read and understand English
- Patients who voluntarily provided informed consent

Exclusion criteria

- Patients younger than 18 years
- Patients unable to read English
- Patients who declined to participate or did not provide informed consent

Sampling framework

A non-probability convenience sampling approach was used to recruit participants. Patients present in the waiting areas of the participating dental practices during the data collection period were invited to participate if they met the inclusion criteria. Based on the patient flow of the participating practices, two practices consulted an average of seven patients per day (approximately 140 patients per month), while the other two practices consulted approximately five patients per day (approximately 100 patients per month). Over a six-month data collection period, the estimated accessible population was therefore approximately 1,440 patients. The minimum required sample size was calculated using the Raosoft sample size calculator, assuming a population size of 1,440, a 95% confidence level, and a 5% margin of error (Calculator, Raosoft (2004) Sample size. Raosoft. <http://www.raosoft.com/samplesize.html>). The calculated minimum sample size was 304 participants.

Data collection

Data were collected using a modified, validated self-administered questionnaire adapted from previously published research.¹² The questionnaire was administered electronically using Google Forms (Google LLC, Mountain View, CA, USA). Electronic administration was selected to facilitate secure data storage, minimise manual data entry errors, and enable efficient data management. At the time of the study, the electronic format was the only method available for participants to complete the questionnaire.

Recruitment procedure

The principal investigator coordinated the data collection process and communicated with the four participating practices prior to the commencement of the study. Practice staff were informed about the study procedures and assisted in identifying potential participants in the waiting area. Patients were approached before their dental consultation and provided with a brief explanation of the study. Individuals who expressed interest received an information sheet and were given the opportunity to read the informed consent document and ask questions. Patients who agreed to participate provided written informed consent before completing the questionnaire.

The principal investigator remained available at the practice during data collection periods to assist participants with questions and ensure that the consent process was properly followed.

Questionnaire structure

The questionnaire consisted of 31 closed-ended questions and was divided into three sections. The first section collected demographic information, including age, gender, highest level of education, and medical aid membership. The second section comprised of 22 questions assessing participants' oral health knowledge and practices, including dental hygiene behaviours and preventive oral health measures. The final section included five questions evaluating participants' attitudes toward oral health and dental care. Closed-ended questions were used to ensure standardised responses and to facilitate quantitative statistical analysis.

Pilot testing

Prior to the main study, the questionnaire was pilot tested among a small group of individuals who met the inclusion criteria but were not part of the final study population. The pilot study assessed the clarity of the questions, time required to complete the questionnaire, and the functionality of the electronic data collection platform. Minor adjustments were made to improve wording and usability before the questionnaire was implemented in the main study.

Data collected through Google Forms (Google LLC, Mountain View, CA, USA) were exported to Microsoft Excel and subsequently imported into SPSS version 28 (IBM Corp., Armonk, NY, USA) for statistical analysis.

Data cleaning

Prior to analysis, the dataset was reviewed for completeness,

duplicate responses, and inconsistencies. Incomplete responses and invalid entries were removed where necessary. Variables were coded appropriately to ensure compatibility with the statistical software before analysis.

Descriptive statistics

Quantitative variables were summarised using frequencies, proportions, percentages, means, standard deviations, and ranges where appropriate.

Inferential statistics

Associations between categorical variables were evaluated using the Chi-square test of independence. This test was selected because the study variables consisted primarily of categorical data and the analysis aimed to determine whether statistically significant associations existed between demographic variables and oral health KAP. The assumptions for the Chi-square test were assessed prior to analysis, including:

- independence of observations
- categorical nature of the variables
- adequate expected cell frequencies

A significance level of $p \leq 0.05$ was used to determine statistical significance. A statistician was consulted during the data analysis process to ensure the appropriateness of the statistical methods used.

Ethical considerations

Ethical approval for the study was obtained from the University of Pretoria Faculty of Health Sciences Research Ethics Committee (Reference number: 500/2022). Participation in the study was voluntary, and informed consent was obtained from all participants prior to completing the questionnaire. Participants were informed that they could withdraw from the study at any time without any consequences to their dental care. No personal identifying information was collected, and all responses were anonymised. Data were stored securely in password-protected electronic files accessible only to the research team. All study procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Results

Of the estimated representative sample of 304, 325 consented and completed the questionnaire, resulting in a response rate of more than 100% of the representative

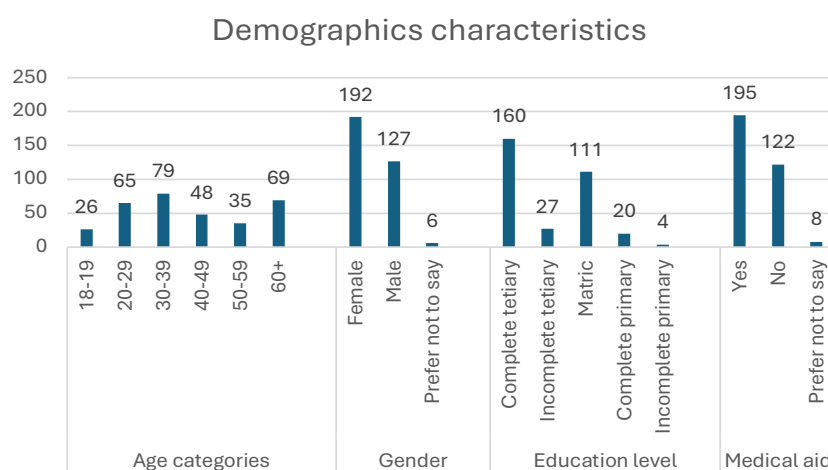


Figure 1: Demographic Characteristics (n=325 except for age and education level n=322)

sample. More than half of them being female (59.1%), and most of them were aged between 30 and 39. Nearly half of the respondents had completed tertiary education, and the majority (60%) had medical aid. The rest of the demographic features can be seen in Figure 1 below.

Knowledge component

More than half of the participants were knowledgeable about dental caries, 177 (55%), and 65% of them knew the causative factors for dental caries. Almost two-thirds cited a lack of hygiene practices as the cause of gingivitis (77%). 57% of the participants lacked knowledge regarding the role that diet plays in oral and dental health. Fluoride and dietary advice findings represent critical targets for patient education in private dental practice. The preventive oral and dental health knowledge of the respondents can be seen in Table 1 below.

Horizontal bars represent the proportion of participants correctly identifying each item. Disease awareness items reflect single response yes/no questions. Green shading denotes areas of strength ($\geq 50\%$); amber denotes knowledge gaps ($<50\%$).

*Note: Causative factor items allow multiple responses – percentages do not sum to 100%. Response counts vary slightly per question due to non-responses. Dietary advice refers to food and drink choices that promote or are harmful to oral and dental health.

Attitudes – component

As can be seen in Table 2 below most (59,9%) of the participants go to the dentist mainly for a check-up and dental cleaning. A positive attitude pattern can be seen where most respondents agree that regular visits to the dentist are necessary (84.3%) and that oral health should be promoted on visual media (83.7%). Most of the participants are willing to teach younger individuals about oral health and prevention techniques (79%), while 61 % don't believe it is proper to talk to people about your mouth and how to take care of it.

Attitude patterns are presented across six domains: barriers to flossing, motivations for dental visits, positive attitudes toward preventive care, oral health communication behaviour, and perceived reasons for social silence about oral health.

Colour key: **Positive** = supportive attitude toward preventive care; **Barrier** = reported obstacle to optimal behaviour; **Concern** = clinically unfavourable pattern; **Informational** = contextual data point.

*Notes: Flossing barrier items and reasons-for-visit items allow multiple responses – percentages do not sum to 100% and are expressed relative to all respondents (n = 325).

Practices – component

Most participants (89%) received oral hygiene instruction, and more than half of the participants indicated that the instructions were mainly given by a dentist (64%). Most respondents brush

Table 1: Preventive Oral and Dental Health Knowledge of Respondents:

Knowledge Indicator	Result	Visual Scale (each block $\approx 5\%$)	Rating
DISEASE AWARENESS			
Knowledge of gingivitis	83%		Strength
Knowledge of dental caries	55%		Strength
CAUSES OF DENTAL CARIES (MULTI-RESPONSE)			
Lack of hygiene	65%		Strength
Improper diet	30%		Gap
Weak teeth	28%		Gap
Familial heritage	13%		Gap
Mouth breathing	10%		Gap
CAUSES OF GINGIVITIS (MULTI-RESPONSE)			
Lack of hygiene	77%		Strength
Improper diet	30%		Gap
Weak teeth	21%		Gap
Mouth breathing	15%		Gap
Familial heritage	14%		Gap
PREVENTIVE KNOWLEDGE			
Aware of fluoride benefits	49%		Gap
Received dietary advice	43%		Gap

Table 2: Attitude patterns of Respondents

Attitude indicator	Result	Visual scale (each block ≈ 5%)	Rating
BARRIERS TO FLOSSING (MULTI-RESPONSE — % OF ALL RESPONDENTS)			
Don't know how to use it	16.3%		Barrier
Gums bleed when flossing	12.8%		Barrier
Takes too long	11.6%		Barrier
Feel pain when flossing	7.3%		Barrier
Too expensive	7%		Barrier
REASONS FOR DENTAL VISITS (MULTI-RESPONSE)			
Dental cleaning and check-up	59.9%		Positive
Pain relief only	43.6%		Concern
Orthodontic reasons	4.2%		Informational
Aesthetic reasons	4.2%		Informational
False teeth / dentures	6.7%		Informational
POSITIVE ATTITUDES TOWARD ORAL HEALTH PROMOTION			
Regular dental visits are necessary	84.3%		Positive
More oral health ads on social media / TV	83.7%		Positive
Willing to teach younger people about oral health	79.1%		Positive
ORAL HEALTH COMMUNICATION BEHAVIOUR			
Talks to others about own oral health	39.1%		Concern
REASONS PEOPLE DON'T DISCUSS ORAL HEALTH (MULTI-RESPONSE)			
Lack of interest	35.1%		Barrier
Feeling of embarrassment	30.5%		Barrier
Inadequate knowledge	27.7%		Barrier
Don't feel it is important	26.2%		Barrier

twice a day (74.5%) with a medium-bristled toothbrush (57%). Half of the respondents flossed their teeth, and 83% of the participants cleaned their tongues. Most of the participants went for dental visits only when they had a problem (39.7%), with the rest of the respondents visiting the dentist at various intervals. The oral health practice patterns of the patients can be seen in Table 3.

Summary of oral health practice patterns across eight domains.

Colour key: **Strength** = guideline-aligned or high positive uptake; **Gap** = moderate / suboptimal practice; **Concern** = clinically concerning behaviour.

*Notes: OHI source items allow multiple responses – percentages do not sum to 100%. Recommended dental check-up interval: every 6 months; optimal for high-risk patients: every 3 months. Soft bristle toothbrushes are the clinically recommended type.

Sociodemographic associations with oral health behaviours: The cells in the matrix below (Table 4) show the direction

and group pattern of each significant association. Education is the dominant predictor – it shows significant associations across 8 of the 11 behaviours tracked, more than any other demographic variable. The one inverse finding – tertiary-educated patients talking less to others about oral health – was an interesting finding. Gender and age are selective – females outperform males consistently on physical hygiene habits (brushing frequency, toothbrush type, tongue cleaning), while age effects are concentrated in the 30-39 peak and the 60+ group for dietary habits. Medical aid membership acts as a proxy for access – its associations cluster specifically around fluoride knowledge and flossing, both of which depend on professional instruction, reinforcing the access-driven inequality argument.

Significance matrix summarising statistically significant associations between four sociodemographic variables (age, gender, education level, medical aid membership) and eleven oral health behaviours.

*Notes: All Chi-square tests conducted in SPSS version 28. Significance level set at $p \leq 0.05$; all reported associations met the more stringent threshold of $p = 0.001$. “—” indicates

Table 3: Oral health practice patterns of Respondents

Practice indicator	Result	Visual scale (each block ≈ 5%)	Rating
ORAL HYGIENE INSTRUCTION (OHI)			
Received OHI	89%		Strength
Received flossing instructions	69%		Strength
Actually flosses daily	51%		Gap
SOURCE OF OHI (MULTI-RESPONSE)			
Dentist	64%		Strength
Parents	49%		Strength
Visual media	11.6%		Gap
Teacher	8.3%		Gap
Friends	0.9%		Concern
BRUSHING FREQUENCY			
Twice a day	74.5%		Strength
Once a day	21.5%		Gap
More than 3x/day	1.8%		Strength
1–2 times a week	1.5%		Concern
Don't know	0.6%		Concern
TOOTHBRUSH TYPE			
Medium bristle	57%		Gap
Soft bristle	33%		Strength
Hard bristle	9%		Concern
Not sure	1%		Concern
TOOTHBRUSH REPLACEMENT FREQUENCY			
Every 3 months	41.8%		Strength
When needed	20.6%		Gap
Every 6 months	20.9%		Gap
Once a month	8.9%		Strength
Once a year	5.8%		Concern
Not sure	1.8%		Concern
ADDITIONAL HYGIENE HABITS			
Cleans tongue regularly	83%		Strength
SNACKING FREQUENCY			
Once a day	50.8%		Strength
No snacking	20.6%		Strength
2–3 times a day	23.1%		Gap
4–5 times a day	2.8%		Concern
6+ times a day	2.2%		Concern
DENTAL VISIT FREQUENCY			
Only when in pain	39.7%		Concern
Once a year	27.1%		Gap
Every 6 months	21.5%		Strength
Less than once a year	10.5%		Gap
Every 3 months	1.2%		Strength

Table 4: Sociodemographic associations with oral health behaviours

Oral health behaviour	Age (significant age groups noted)	Gender (female > male)	Education (tertiary > other)	Medical aid (member > non- member)
BRUSHING & TOOTHBRUSH HABITS				
Brushing twice daily	+ significant 30-39 & 60+ yrs	+ significant females higher	+ significant tertiary highest	—
Toothbrush change every 3 months	+ significant 30-39 & 20-29 yrs	+ significant females more frequent	+ significant tertiary highest	—
Toothbrush type (soft / medium bristle)	—	+ significant females: more soft & medium	—	—
INTERDENTAL CLEANING & TONGUE HYGIENE				
Tongue cleaning	+ significant younger groups higher	+ significant females more likely	—	—
Flossing (actual practice)	—	—	+ significant tertiary more likely	—
Received flossing instructions	—	—	+ significant tertiary more often	+ significant members more often
PREVENTIVE KNOWLEDGE				
Knowledge of gingivitis	—	—	+ significant tertiary higher	—
Fluoride benefits awareness	+ significant 60+ yrs highest	—	+ significant tertiary higher	+ significant members higher
DIETARY BEHAVIOUR				
No / low sugar in coffee or tea	+ significant 60+ yrs most likely	—	+ significant tertiary strongest	—
Snacking once daily or less	—	—	+ significant tertiary: majority single serving	+ significant members snack less
Talks to others about oral health	—	—	- inverse tertiary talks less	—
Total significant associations	5	4	8	3

Key

+ significant	Higher education / medical aid membership / female gender / certain age group associated with more positive behaviour ($p \leq 0.001$)	- inverse	Association in an unexpected or less favourable direction
—	No statistically significant association detected for this variable–demographic combination		

no statistically significant association was identified in the study data for that variable-demographic combination.

DISCUSSION

This study aimed to assess the preventive oral health KAP of patients attending selected private dental practices in Pretoria. The findings provide insight into several behavioural patterns and knowledge gaps related to preventive oral health. Participants' overall level of fundamental oral health knowledge was moderate to high, especially when it came to the causes of dental caries and gingivitis. However, there were notable disparities in preventive practices such as consistent flossing, nutritional knowledge, and proactive dental attendance, which was consistent with findings from earlier local and international studies.^{6,7,12} A comparable KAP study conducted among hospital patients in Guangzhou, China (2023) similarly reported that while knowledge and

attitude scores were good, practice scores remained only moderate, and that education level was significantly associated with practice outcomes – a pattern that closely mirrors the sociodemographic associations identified in the present study.¹⁷

With 74.5% of respondents brushing twice a day, the brushing frequency of this study group was noticeably high and aligned with broader epidemiological data.⁵ This is a positive finding that supports the guidelines of preventive dentistry, which emphasise mechanical plaque control as the foundation for maintaining oral health.⁵ However, only 51% of respondents reported flossing every day – a habit that is essential for removing interdental plaque and is frequently overlooked in routine oral hygiene practice.¹ The gap between receiving flossing instruction (69%) and actually flossing (51%) is particularly noteworthy and suggests that informational

interventions alone are insufficient to produce sustained behavioural change. This is consistent with research by DeFulio and Rzeszutek (2022), who demonstrated that interdental cleaning behaviour is influenced not only by knowledge but by sensitivity to delayed health outcomes, social norms, and the degree of trust a patient has in their healthcare provider – factors that a single oral hygiene instruction session may not adequately address.¹⁸

Only 49% of participants reported being aware of the advantages of fluoride, indicating a serious gap in preventive education. According to Tschoppe *et al.* (2011), fluoride remains one of the most scientifically supported caries prevention strategies, as it promotes remineralisation and inhibits demineralisation.¹⁹ This disparity highlights the continued need for effective oral health education initiatives, particularly those that highlight fluoride's function beyond conventional brushing messages. By contrast, in the Guangzhou KAP study, 80.5% of patients recognised fluoride as essential for preventing tooth decay – a substantially higher proportion than found in the present study, suggesting that fluoride communication in South African private practice settings may lag behind comparable clinical environments internationally.¹⁷ Notably, fluoride awareness in the present study was significantly associated with both higher education level and medical aid membership, reinforcing that access to professional preventive education mediates this knowledge gap.

Participants generally expressed positive attitudes toward oral health promotion, with 83.7% indicating that oral health messages should receive greater visibility through media platforms, and 84.3% agreeing that routine dental check-ups are essential. These results are consistent with earlier research that highlights the vital role of public health campaigns in promoting preventive behaviours.^{11,13} Crucially, the willingness of 79% of participants to impart oral health knowledge to younger people suggests that intergenerational transmission of healthy habits may be a productive approach in community-based interventions.¹⁶ Despite participants' reported willingness to educate others about oral health, only 39.1% indicated that they actually discussed their own oral health with others. This suggests that barriers to communication may be driven more by social norms than by a lack of knowledge. Lack of interest (35.1%) and embarrassment (30.5%) were identified as the main reasons for not engaging in such discussions, supporting evidence that stigma and perceived irrelevance can hinder oral health communication.¹³ Interestingly, participants with tertiary education were less likely to discuss oral health with others, an unexpected finding that warrants further investigation to better understand the influence of social and cultural norms on oral health communication.

Sociodemographic factors – including age, gender, education level, and medical aid membership – were found to be significantly associated with oral health behaviours ($p < 0.001$). Better hygiene habits, lower sugar intake, and more preventive knowledge were substantially correlated with higher education levels, consistent with previous research demonstrating that health literacy and the adoption of preventive behaviours are positively associated with educational achievement.^{12, 15} A 2023 cross-sectional study by Veladas *et al.*, published in BMC Public Health, confirmed that oral health literacy levels differ significantly by sex, age, and educational achievement, with younger participants

and those with higher education demonstrating significantly higher levels of adequate oral health literacy – a finding that directly supports the sociodemographic patterns observed in the present study.²⁰ A similar positive correlation was observed between medical aid membership and better oral health behaviours, likely reflecting both improved access to preventive care and greater exposure to professional oral health instruction. This access-mediated inequality is particularly relevant in the South African context, where structural barriers to dental care disproportionately affect lower-income and uninsured populations.

Particular attention should be paid to dietary practices. Although snacking once a day was most common, a significant proportion of participants regularly consumed highly cariogenic items such as chips, chocolates, and sugary drinks. The need for comprehensive dietary counselling during dental consultations is further supported by the fact that dietary sugar remains a major risk factor for the development of dental caries.^{2, 4} Preventive measures must extend beyond oral hygiene to incorporate broader lifestyle factors, including diet, given the bidirectional relationship between oral and systemic health.^{3, 21, 22} Interestingly, individuals aged 60 and older demonstrated a significantly greater tendency to consume no sugar in their coffee or tea, while the 30-39 age group showed the highest rates of twice-daily brushing and regular toothbrush replacement – a pattern that suggests middle-aged adults may represent the most receptive target group for preventive reinforcement in private practice settings.

The pattern of dental attendance in this study was predominantly reactive, with 39.7% of participants visiting the dentist only when in pain – the single largest attendance group. Only 21.5% attended every six months in line with the recommended standard, and a mere 1.2% attended at the optimal three-monthly interval. This finding is consistent with earlier research¹² and reflects a well-documented global challenge in shifting patients from symptom-driven to preventive dental attendance. A 2023 systematic review by Tu *et al.* in Gerodontology identified education, gender, and dental anxiety as key predisposing factors influencing the frequency of dental attendance, which aligns with the sociodemographic associations found in the present study.²³ According to Ashley (1989), the results generally support the preventive dentistry approach, which emphasises early intervention, education, and the maintenance of health-promoting practices throughout life.⁵ Nonetheless, the persistent knowledge-behaviour gap – particularly regarding flossing, dietary habits, and dental attendance – indicates that preventive messaging must inspire long-term behavioural change and not merely inform, especially among socioeconomically disadvantaged groups.¹³ Future interventions should consider multifactorial approaches combining education, motivational support, structural access improvements, and regular reinforcement through professional dental care. Leveraging media platforms, educational institutions, and family networks as channels for preventive knowledge could strengthen dissemination and encourage personal and social accountability for oral health.¹³

CONCLUSION

This study highlights that although adult dental patients attending private practices in Pretoria demonstrate generally positive oral hygiene behaviours, important gaps remain in

preventive oral health knowledge and practices, particularly regarding fluoride use, dietary risk factors, flossing, and routine dental attendance. The observed associations between preventive behaviours and sociodemographic factors underscore ongoing inequities in oral health literacy and access to preventive care. These findings have important implications for clinical practice and public health policy, underscoring the need for targeted, evidence-based patient education strategies that extend beyond basic oral hygiene instruction to include dietary counselling, fluoride education, and behavioural reinforcement. Dental practitioners in private practice are uniquely positioned to address these gaps through consistent, tailored preventive messaging and the integration of health promotion into routine care. At a societal level, the strong participant support for media-based oral health promotion and intergenerational knowledge transfer presents an opportunity to leverage community and digital platforms to strengthen preventive behaviours beyond the clinical setting. Future research should explore longitudinal and intervention-based designs to evaluate the effectiveness of targeted educational strategies and to compare preventive oral health behaviours across public and private healthcare contexts in South Africa. Collectively, this study contributes to the limited body of South African data on adult preventive oral health behaviours and provides an evidence base to inform more equitable, context-responsive oral health promotion initiatives.

LIMITATIONS AND STRENGTHS

This study has several limitations that should be considered when interpreting the findings. The research was conducted in four private dental practices in Pretoria using convenience sampling, which may limit the generalisability of the results to the wider South African population. If the study were to be conducted again, a larger and more representative sample including additional private and public dental practices could be considered to improve external validity. In addition, the questionnaire was administered only in English, which may have excluded individuals who were not proficient in the language. The use of self-reported responses and closed-ended questions may also have introduced response bias and limited deeper exploration of participants' perceptions and behaviours. Future research could incorporate translated questionnaires and qualitative methods to provide a more comprehensive understanding of oral health behaviours. Finally, the cross-sectional design allows for the identification of associations between variables

but does not allow causal relationships to be established. Despite the limitations, the current study provided useful information that may inform future oral health education approaches of patients in private practice.

Acknowledgements, funding sources

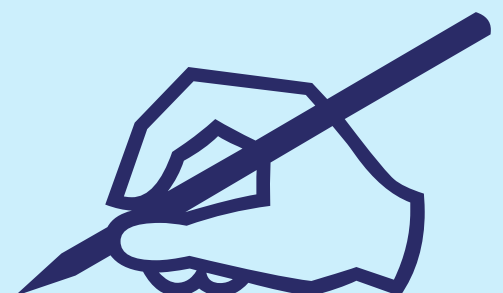
None

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CPD questionnaire on page 354

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.



Determinants and barriers to oral health services utilisation at Katutura Hospital, Namibia

SADJ JUNE 2026, Vol. 81 No.5 P323-P330

JJ Rutabanzibwa,¹ A Ross²

ABSTRACT

Introduction

Oral diseases remain a significant public health concern globally, particularly in low- and middle-income countries where access to dental services is often limited. In Namibia, utilisation of oral health services is influenced by multiple individual and systemic factors, resulting in delayed care-seeking and poor oral health outcomes.

Aim and Objective

This study aimed to explore the factors influencing the utilisation of oral health services and the perceived barriers to accessing these services among patients attending Katutura Hospital in Windhoek, Namibia.

Methods

A qualitative cross-sectional exploratory study was conducted among adult patients attending the outpatient department and dental clinic at Katutura Hospital between March and August 2024. Purposive sampling was used to recruit 24 participants. Data were collected through in-depth interviews using open-ended questions and analysed using an inductive thematic content analysis approach.

Results

Three major themes emerged: (1) knowledge and awareness of oral health, (2) perceived barriers to utilisation of oral health services, and (3) patterns of oral health service utilisation. Participants demonstrated basic awareness of oral health but had limited understanding of preventive care and

available services. Utilisation was predominantly problem-driven, with most participants seeking care only when experiencing severe pain. Key barriers included financial constraints, long waiting times, limited service availability, dental anxiety, and negative perceptions of healthcare providers. Misconceptions about oral diseases and the use of harmful self-care practices were also reported.

Conclusion

Oral health service utilisation in this setting is shaped by limited awareness, structural barriers, and a strong reliance on symptomatic care. Strengthening oral health education, improving accessibility and service delivery, and promoting preventive care are essential to enhance utilisation and improve oral health outcomes.

Keywords

Oral health, service utilisation, barriers, dental care, Namibia

INTRODUCTION

Oral health is an integral component of general health and well-being, yet it remains one of the most neglected areas within public health, particularly in low- and middle-income countries (LMIC). Worldwide, oral diseases, such as dental caries, periodontal disease and oral infections, continue to affect billions of people and contribute significantly to pain, impaired function, reduced quality of life and avoidable healthcare costs.¹ The World Health Organisation (WHO) emphasises that access to timely and affordable oral-health services is essential for preventing disease progression and minimising the burden of untreated oral conditions. However, disparities in the utilisation of oral-health services persist due to a complex interplay of demographic, socio-economic, systemic and individual factors.²⁻⁹

Studies on financial barriers to a wide range of health care services found that irrespective of age, income level and type of insurance, more people reported financial barriers to receiving dental care compared to any other type of health care. Lack of awareness of the importance of dental care may have contributed to these results.^{10,11} In many sub-Saharan African (SSA) settings, including Namibia, access to oral-health services is often limited by shortages of dental personnel, inadequate infrastructure, long waiting times and financial constraints. These systemic issues are further compounded by individual-level barriers, such as limited awareness of oral-health practices, fear or anxiety associated with dental treatment, cultural perceptions and low prioritisation of preventive care. As a result, many patients seek dental treatment only when symptoms become severe, leading to late presentations, higher treatment costs and poorer outcomes.¹¹⁻¹⁹ WHO Oral Health Country profile

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We declare that This manuscript is our original work and we are the owners of this manuscript and own the copyright.

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Authors contribution

1. Juvenary John Rutabanzibwa: conceptualization, Draft preparation. 60%
2. Andrew Ross: Draft review and editing. 40%

report 2022 for Namibia indicated that the total expenditure on dental care is estimated at US\$ 2.8 million, and the total productivity loss due to dental diseases is US\$ 45 million.²⁰

Katutura Hospital is a public sector intermediate level facility that is located in Windhoek that serves as a major referral facility, providing both outpatient and dental services to a large and diverse population. Despite the availability of dental services, anecdotal evidence and clinical observations suggest that utilisation patterns remain sub-optimal, many patients presenting with advanced stages of oral disease.²¹ Understanding the factors that influence patients' decisions to seek care, and the barriers that hinder accessibility, is essential for improving service delivery, strengthening public-health interventions and promoting equitable access to oral healthcare.

This study therefore seeks to understand the factors influencing the utilisation of oral-health services, and to explore the perceived barriers to accessing these services among patients attending the Katutura Hospital Outpatient Department (OPD) and Dental Clinic. This entailed exploring the types of oral health services available, assessing their oral health knowledge and awareness, understanding the pattern of oral health service utilisation and the perceived barriers of oral health services utilisation. The findings will inform targeted strategies to enhance access, reduce delays in seeking care, and ultimately improve oral-health outcomes within the community.

MATERIAL AND METHODS

Study design and approach

This cross-sectional, explorative study was facility based and entailed the collection of qualitative data using in-depth interview with open-ended questions of patients attending the Katutura Hospital outpatient department (OPD) and dental clinic from March to August 2024.

Study setting

The study was conducted at Katutura hospital, the second biggest referral hospital in Namibia and serves the Khomas Region, which has a population of approximately 486,186 people²², as well as referred cases from other regions. Most of the patients who attend the OPD are walk-in or self-referred patients from around Windhoek, with an average of patients 112 per day. Katutura Hospital dental clinic is the biggest public sector dental clinic in Namibia, offering both general and specialised dental services, including oral and maxillo-facial surgery, such as tooth extraction, minor and major surgery, restorative dentistry (e.g. filling) and prosthodontics (e.g. dentures and orthodontics appliances).

Study population, sample size determination and sampling procedure

Purposive sampling was used to select participants, the selection criteria being adult patients 18 years old and above attending the Katutura Hospital OPD and dental clinic during the time of study who resided in Windhoek and could speak English. The sample size of 24 participants was determined by data saturation, 23 with 10 patients from the OPD and 10 from the dental clinic first being interviewed. The data was then transcribed and thematically analysed, after which another two patients were interviewed from both the general OPD and the dental clinic. As no new data emerged after the 24 interviews, it was concluded that data saturation had been reached. The in-depth interview consisted of demographic

details, and seven open-ended questions focusing on knowledge and awareness of oral health, perceived barriers to the utilisation of oral health services and patterns of oral health services utilisation.

Data collection and quality control

A voice recorder was used to record the interviews and transcribed, to enable the data to be transcribed verbatim, then coded, categorised and developed themes during thematic analysis.²³

Data analysis

The data was analysed using inductive, conventional content analytical approach based on grounded theory, with all the text or responses that exemplifies the same theoretical or descriptive idea being coded the same name. This was followed by grouping the initial codes into a smaller group to develop the conceptual categories to capture important information in relation to the research questions. Finally, similar conceptual categories were grouped into themes, and the influence, relevance and meaning of each discussed.

Reliability and Trustworthiness

Reliability and trustworthiness are essential aspects of any study to enable the findings to be regarded as credible and potentially relevant for other settings.²⁴

This was addressed as follows:

Dependability: detailed description of the methods and how the study was conducted were provided. A thorough description of the entire research process enabled an unrestricted shared understanding, which enhanced a clearer and better analysis of the data.

Credibility: Prolonged engagement until the scope of data was adequately covered and data saturation obtained, with referential adequacy achieved through use of a tape recorder and field notes, purposive sampling and dense descriptions. To reduce information bias, the researcher established a good relationship and a friendly environment with the research participants to win their trust and confidence and thereby obtain reliable data. Using the method of open-ended, unstructured interviews with strategically chosen participants also reduced bias.

Reflexivity: The researcher kept memos and voice recorder as a trace trail and reflexivity of his opinion. Efforts were made to minimise researcher bias by regularly reflecting on the data and the analysis process. The researcher used the interpretivist paradigm, which follows an inductive approach that is flexible and emergent in design, enabled some uncertainty and fluidity within the context of the phenomenon of interest and was not based on a set of determinate rules. The researcher identified his possible underlying beliefs or opinions that could have potentially impacted the study outcome.

Ethical Consideration

Ethical approval was obtained from University of KwaZulu-Natal Human Science Research Ethics Committee (HSSREC/00006068/2023), the research ethics committee of the Ministry of Health in Namibia (Ref: 22/4/2/3), and permission to conduct the study granted by the management committee of Katutura Hospital. Study participants were required to provide signed consent to participate and were

informed that the anonymous research findings may be used to improve health service delivery in Namibia. Unique identifiers were used instead of participant's names to ensure that confidentiality and anonymity were maintained throughout the study.

RESULTS

The results are presented as follows: summary table of participants demographic characteristics, and in three themes according to participants' knowledge and awareness of oral health, perceived barriers to utilisation of oral health services and pattern of oral health services utilisation.

Demographic characteristics

Participants were drawn from Katutura hospital OPD and dental clinic. A total of 24 participants including 11 males and 13 females adults consented and participated in the study. Only 7 participants were employed. (Table I and II)

Table I: Participants characteristics (OPD)

Participant ID	Gender	Age (Years)	Employment Status
Participant 1	M	45	YES
Participant 2	M	27	NO
Participant 3	F	33	NO
Participant 4	F	50	NO
Participant 5	F	41	YES
Participant 6	F	36	NO
Participant 7	M	53	YES
Participant 8	M	18	NO
Participant 9	M	57	NO
Participant 10	F	23	NO
Participant 11	F	48	YES
Participant 12	M	33	YES

Table 2: Participants characteristics (Dental clinic)

Participant ID	Gender	Age (Years)	Employment Status
Participant 1	F	21	NO
Participant 2	F	28	NO
Participant 3	F	40	YES
Participant 4	F	48	NO
Participant 5	M	39	YES
Participant 6	M	35	NO
Participant 7	M	55	YES
Participant 8	F	24	NO
Participant 9	M	31	NO
Participant 10	F	27	NO
Participant 11	M	44	NO
Participant 12	F	20	NO

Theme 1: Knowledge and Awareness of oral health

Knowledge and awareness of oral health is an important component of overall well-being, as it influences individuals' attitudes, behaviours and utilisation of dental services. Having adequate knowledge and awareness enables people to understand the importance of maintaining good oral hygiene, seeking preventive care and recognising early signs of oral diseases. (table III)

Table III: Theme 1 subthemes and categories for knowledge and awareness of oral health

Subtheme	Category
1. Knowledge of oral disease	1. Importance of oral health
	2. Causes of oral diseases
	3. Prevention of oral diseases
2. Awareness of available dental treatment	1. Emergency
	2. Restorative
	3. Preventive

Subtheme 1: knowledge of oral diseases

Knowledge of oral diseases plays an important role in shaping oral health behaviours and outcomes. When individuals are well informed about common oral health conditions, their causes and prevention, they are more likely to practice proper oral hygiene and seek timely professional care.

Category 1. Importance of oral health

Participants demonstrated a basic and functional understanding of the importance of oral health, with most associating healthy teeth with eating and chewing. Participants emphasised the role of *teeth in food consumption* as "*teeth are important for eating*" (participant 2) and "*for chewing*" (participant 3). These responses indicate that oral health was primarily valued for its immediate practical function rather than its broader health implications.

Category 2. Causes of oral disease

Participants' responses revealed diverse and sometimes conflicting perceptions regarding the causes of oral diseases, ranging from accurate biomedical explanations to misconceptions rooted in personal beliefs and cultural interpretations. Three key patterns emerged within this subtheme, namely: the role of diet and of oral hygiene, lifestyle related causes and misconceptions, and hereditary beliefs regarding oral health.

Most participants demonstrated a reasonable level of awareness by correctly associating tooth decay with excessive sugar consumption and the contribution of poor oral hygiene practices. For example, one participant stated:

"it is the sweet things that we eat and then we go to work from 7 to 7 eating a lot of snacks, but I do not go with my toothbrush" (participant 2).
"sugar causes tooth decay" (participant 5)

Some participants expanded their explanations to include lifestyle behaviours, such as alcohol and smoking, as causes of oral diseases. A participant noted that, "*Too much alcohol and smoking can damage your teeth*" (Participant 1).

A few participants attributed tooth decay to factors such as inadequate breastfeeding, too much eating of meat or hereditary factors. One participant said that "*when there was not enough breast milk from the mother, the teeth get weak*"

(Participant 8), while another claimed *"meat causes tooth decay because it goes between the teeth"* (Participant 4). Some perceived tooth decay as a genetic condition rather than a preventable disease, as reflected in statement such as:

"I think I can inherit tooth decay from my family because my daddy has also terrible teeth problems" (Participant 7)
"most of my aunts have teeth diseases, this cannot be because of sweet, it is heritage" (Participant 10)

Category 3. Prevention of oral diseases

Participants indicated that toothbrushing is important for preventing tooth decay and that *"You have to brush your teeth 3 times a day"* (Participant 3). However, participants felt that

"men cannot take care of their mouth like ladies, ne..." (Participant 8)
"Men can use one toothbrush for one-year, haaaa!" (Participant 10).
"If one use toothbrush for more than two months it can damage the teeth" (Participant 9)

Sub-theme 2: Awareness of available treatment

Awareness of available dental treatment is essential to promote effective utilisation of oral health services. When individuals are informed about the range of dental services offered, including emergency, curative, restorative and preventive, it may influence their choice of treatment.

Category 1. Emergency

Most participants indicated that they only seek emergency treatment (mainly) for tooth extraction due to severe pain:

"It started paining last year, then I crushed Panadol and put on the tooth to stop the pain. This time the pain was too much, even Panadol could not stop it especially at night. I decided to come to the hospital" (Participant 6)

However, some participants recognised the need for dental services and recommended that *"the dental clinic should be opened even in the weekends and after hours"* (Participant 4)

For some participants, the first port of call was family, friends or the internet when they had toothache as *"I do not come here when I have pain, but people advise me to use Colgate toothpaste, it relieves pain"* (Participant 7), only presenting when the pain was unbearable.

Despite engaging with advice from family, a number of participants still ended up at the dental clinic for treatment, as stated by one participant:

"last year I had a toothache but did not come to the hospital because people advised me to put the clove oil in my tooth and the pain got better. But this time the pain is unstoppable" (Participant 6)

Category 2. Restorative

Some participants indicated that they did not know if government health facilities could offer other types of dental treatment besides tooth extraction. They were unaware that teeth with holes could be filled *"The thing is, we do not get informed, like me I had a hole in my tooth, but I was not informed that I can fix my tooth"* (Participant 8), and that

it was possible to get artificial teeth *"Oho! Imagine! Didn't know that you can get artificial teeth here"* (Participant 10). The participants were surprised that government facilities were able to offer services similar to those offered in the private sector

"Ohoo! Do you also do other dental treatments like in private?! What we do know is that you only do teeth extraction" (Participant 4)

Although some participants were aware of the dental services provided and had previously presented to the dental clinic, their experiences of filling teeth had not been very satisfactory:

"I had a decayed tooth, I filled it and after 6 month it was again painful, I decided to remove it. Filling is not good option" (Participant 2)

Patients were keen for dentists to inform them of their options when they present with holes in their teeth:

"They must inform us on different types of treatment available" (Participant 7). *"tell us if they can put something on your tooth instead of removing it before they inject us"* (Participant 10)

Category 3. Preventive

Most participants acknowledged that they were not aware about preventive services available at the hospital. However, one participant came for preventive service after he was informed by a relative about the importance of routine dental check-up.

"Like me, I have removed more than four teeth, the last time I came to the hospital, I was informed to come for a routine check-up twice a year" (Participant 4)

Theme 2: Perceived barriers of utilisation of oral health services

Perceived barriers to the utilisation of oral health services may influence individuals' decisions to seek dental care. These barriers included predisposing factors, personal barriers and health system factors (table IV)

Table IV: Theme 2 sub-theme and categories for perceived barriers of utilisation of oral health services

Sub-theme	Category
1. Predisposing factors	1. Lack of awareness of the need for dental treatment
	2. Anxiety or fear of dental treatment
2. Personal barriers	1. Lack of funds to pay for treatment cost
	2. Unavailability of services
	3. Cultural/belief/practice
3. Health system factors	1. Attitude of oral health professions
	2. Lack of availability of oral health services
	3. Poor infrastructure and organisation
	4. Affordability of oral health services

Subtheme 1: Predisposing factors

Predisposing factors for oral health services utilisation refers to individual characteristics and perceptions that influence the likelihood of seeking oral health care. These factors include lack of awareness of the need for dental treatment and anxiety about treatment.

Category 1. Lack of awareness

Most of the participants perceived that they need to go to the hospital only if you have unbearable pain.

"You must go to the hospital only if the tooth is very painful, otherwise you can use the pain killers" (Participant 5)

Others indicated that when they have a toothache they do not need to go to the hospital, but can use painkillers or other home remedy to relieve the pain, such as smoking and car brake fluid.

"For us guys, we smoke so that the pain can come down, it sterilises the pain for an hour, hahahaaaaaa!" (Participant 9);

"I was using brake fluid of the car to stop pain; it kills pain but also it breaks the tooth into small pieces." (Participant 10)

Some were unaware that Katutura Hospital, or any other government facility, could do fillings or provide artificial teeth:

"Katutura hospital also does fillings? Me, I only come here for extractio" (Participant 3)

"Me, I thought only private hospitals can fill the tooth. So, I come here to remove my tooth" (Participant 5)

A few believed that as tooth decay is a hereditary disease, there was nothing they could do:

"Most of my aunties have tooth diseases, this cannot be because of sweet, it is in heritage" (Participant 10)

Some revealed that dental problems were not a priority:

"Just to wakeup and come to the hospital to me it is a problem. I just do not have time;" (Participant 3)

Category 2. Anxiety or fear of dental treatment

Participants highlighted that anxiety and fear of dental treatment were a significant deterrent to the use of dental services. This fear was largely shaped by previous painful dental treatment experience and injections, resulting in many individuals delaying or avoiding seeking professional dental care. Several participants described past dental treatment as extremely painful and traumatic. One participant recalled,

"Last year I had a toothache but did not go to the hospital because a year before I went to the hospital, they took out two teeth, I had a terrible pain, that was the most terrible day of my life" (Participant 3)

Fear of injection was repeatedly mentioned as a specific source of anxiety. Participant expressed apprehension about needles and their associated pain, which discouraged timely dental visits. One participant stated,

"like for me, I have a problem of fear of injection, so before I must come to the hospital, I use Panadol or clove oil or anything possible to avoid injection" (Participant 10)

Subtheme 2: Barriers

Barriers to utilisation of oral health services continue to limit access to timely and appropriate dental care for many individuals.

Category 1. Lack of funds to pay for treatment cost

Participants indicated that lack of funds, long travelling distances, waiting times and queues at the hospital were reasons for not going to the dental clinic.

"We really suffer because we do not have medical aid, so we have to look for cash" (Participant 6)

Category 2. Availability of services

Participants indicated that Katutura Hospital is congested with too many patients due to the limited availability of dental services among the population it serves:

"Some of us, we stay in the location, it is very dangerous, there is no taxis, can't they build a dental clinic in the location" (Participant 5)

"You have to wake up very early so that you can get in front of the queue, for example, like me, I arrived here at 4 in the morning but I am still here unattended" (Participant 4)

Subtheme 3: Health system factors

Health system factors, such as the attitude of oral health professionals, availability of dental service, poor infrastructure and well as quality of care received influenced the use of dental services.

Category 1. Attitude of oral health professions

Participants indicated that the negative attitude of health care workers, long queues and poor infrastructure were some of the reasons that could prevent patients going to the hospital. Several participants reported the uncaring or unprofessional behaviour of some dentists, which discouraged future visits. One participant stated,

"Some staff members are busy on their cell phones instead of assisting patients" (Participant 2),

Others highlighted inadequate communication as a major concern, particularly the failure of professionals to explain the procedures and treatment options, which they found frustrating, and that the dentists were stressed due to high patient loads:

"When we say our problems, the doctor must listen to us, try to make patient understand too, doctors must take time not to rush us" (Participant 9)

"Dentists at Katutura Hospital are always stressed due to the long queue of patients" (Participant 10)

Category 2. Lack of availability of oral health services

Participants highlighted that dental services are limited to only being available in town, making it difficult for those staying in locations out of town to reach the services. Many participants had tiring experiences:

"You have to work-up very early morning and walk a long

distance to Katutura hospital to be able to get a number in the queue but sometimes you find that the numbers for that day are finished! So you go back home without any treatment" (Participant 5)

Another participant wanted to know "why dental clinics do not open after hours and during the weekends?" (Participant 1)

Category 3. Poor infrastructure and organisation

Old, dilapidated and dirty hospital buildings were a key deterrent for not seeking professional dental services for most participants. One participant complained about its condition:

"I was admitted here for two days, the hospital is very dirty and smelling. I signed a consent form to go home before I was discharged. I do not want to go there again" (Participant 10)

Another participant complained about the long queues and poor organisation,

"Like me, I arrived here early in the morning but I am still here because of the long queue and poor organisation, I have seen some patients who arrived after me are passing me" (Participant 5)

Category 4. Affordability of oral health services

The study found that most of participants come to Katutura Hospital as it is cheap compared to the private dental clinic. The participants stated,

"I had severe pain but did not want to come to Katutura Hospital, I wanted to go to private dentist, but did not have money hence I ended up coming here!" (Participant 6)
Only Katutura Hospital takes many patients, other dental clinic takes few patients and they are expensive" (Participant 7)

Theme 3: Pattern of oral health services utilisation

The pattern of oral health services utilisation generally reflects how, when and why individuals seek dental care, and is often characterised by irregular and problem-oriented visits rather than routine preventive care. (table V)

Table V: Theme 3 Subthemes and categories for pattern of oral health services utilisation

Sub-theme	Category
1. Problem-driven (symptomatic) utilisation	Seeking care only when pain is unbearable
2. Irregular utilisation of services	Missed follow-up appointment
3. Self-care/home remedy	Use of self medication for pain relief

Subtheme 1: Problem-driven (symptomatic) utilisation

Problem driven oral health services utilisation refers to a pattern in which individuals seek dental care primarily in response to pain, discomfort or visible oral health problems rather than for preventive or routine check-up.

Category 1. Seeking care only when pain is unbearable

Most of the participants indicated that they only go to the hospital when they have unbearable pain. Others believed that dental care is only for an emergency, that they must wait until they are in pain to visit the hospital:

"Just to woke-up to go to the hospital, for me it is difficulty! Unless I have a severe pain" (participant 4)

Subtheme 2: Irregular utilisation

Irregular utilisation of oral health services is characterised by inconsistent and infrequent dental visits that often occur only when the symptoms become severe or unavoidable.

Category 1. Missed follow-up appointment

The study revealed that participants did not make routine hospital visits and sought care only when experiencing pain. Some participants expressed a desire for dentists to provide guidance and information on treatment options and the need for regular visits. They also indicated that they would like the dentists to follow up with them and send reminders about their appointments:

"I came here for treatment, I was given an appointment for a follow-up, but they did not contact me up to date" (Participant 1)

"Does Katutura Hospital have a 'dial a dentist' telephone line? Because we would want to get some advises or appointment even when we are at home" (Participant 10)

Subtheme 3: Self-care/home remedy

Home remedy dental care utilisation refers to the practice of managing oral health problems using traditional methods or self-care approach instead of seeking professional dental services.

Category 1. Use of self medication for pain relief

Some participants indicated that they preferred using painkillers, such as Panadol and clove oil, to avoid going to the hospital. A few participants noted that they use traditional medicine herbs that they put in the tooth until the tooth comes out. One participant indicated that he uses the herbs to relieve pain as revealed in the following participants' responses.

"Every time I have a tooth ache, I use a certain herb that I got from my mother, it relieves pain" (Participant 7)

DISCUSSION

The findings from this study provide insight into the oral health knowledge and awareness, perceived barriers to accessing dental care, and patterns of oral health services utilisation among participants attending Katutura Hospital. Overall, the results highlight significant gaps in preventive dental behaviour, limited understanding of available services and a reliance on problem-driven care.

Theme 1. Knowledge and awareness of oral health,

Participants demonstrated basic awareness of tooth decay and identified sugar consumption and poor oral hygiene as contributing factors. However, misconceptions were also evident, including beliefs that tooth decay is hereditary or unrelated to dietary sugars. Similar inconsistencies in oral health knowledge have been reported in other low- and middle-income contexts, where biomedical explanations coexist with cultural beliefs. 25 Such misconceptions may undermine preventive practices and delay appropriate care-seeking.

Although toothbrushing was widely acknowledged as important, participants showed limited understanding of effective oral hygiene practices, including correct brushing frequency and toothbrush replacement. This finding aligns

with existing literature indicating that knowledge does not necessarily translate into sustained health behaviour.^{26, 33,34} For example, research conducted in Germany among children and adolescents found that while many participants know the recommended toothbrush frequency and duration, their brushing habits were weaker or inconsistent, indicating that appropriate knowledge does not automatically translate into correct behaviour.³⁵ The gap between awareness and practice suggests the need for behaviour-focused oral health promotion rather than information-only approaches.

Participants largely framed the importance of oral health in functional terms, primarily eating and chewing without linking it to broader health or quality-of-life outcomes, his narrow conceptualisation possibly limiting motivation for preventive engagement.

Notably, many participants believed that government facilities only provide extractions for when the tooth ache is so severe that patients can no longer tolerate the pain, with most not being unaware of the restorative and preventive services offered. This aligns with findings from studies in other low-resource settings, where communities perceive public oral health services as limited to emergency extractions.²⁷ Limited knowledge of restorative services influenced treatment expectations, with some participants expressing dissatisfaction with previous fillings and therefore preferring extraction. Comparable findings have been documented in settings where negative restorative experiences reinforce extraction as the definitive solution.³⁰

Preventive services were minimally recognised, with only a small proportion of participants reporting that they attended routine check-ups, often following advice from relatives or healthcare workers. This limited awareness of preventive care contributes to delayed presentation and reinforces symptom-based utilisation.

Theme 2: Perceived barriers to utilisation of oral health services

Predisposing factors, including limited awareness and dental anxiety, shaped utilisation patterns. Many participants perceived dental care as necessary only in the presence of severe pain, reflecting a curative orientation. This perception is widely reported in oral health research and is associated with delayed service utilisation.²⁶ Dental fear, particularly related to injections and previous negative experiences, further discouraged routine attendance. Consistent with existing evidence, dental anxiety emerged as a significant deterrent to preventive care,²⁸ reinforcing avoidance and reliance on self-management.

Structural barriers were prominent. Financial constraints, long waiting times, transportation challenges, and service congestion limited timely access. Although Katutura Hospital was perceived as more affordable than private facilities, indirect costs and logistical burdens remained substantial obstacles. Financial and accessibility barriers have consistently been identified as determinants of underutilisation in low- and middle-income countries.²⁶ Participants also highlighted organisational inefficiencies and overcrowding, occasionally resulting in missed treatment opportunities. These findings align with broader evidence demonstrating how resource limitations within public health systems affect service delivery and patient satisfaction.¹⁸

Perceived need strongly influenced care-seeking behaviour. Participants commonly reported seeking care only when pain became unbearable. Some considered asymptomatic dental decay unworthy of treatment, while others attributed oral disease to hereditary causes. According to Andersen's behavioural model, perceived need is a central determinant of healthcare utilisation.⁶ In this context, low perceived susceptibility and symptom-based thresholds for action contribute to delayed engagement.

Health system factors further shaped utilisation, with reports of negative provider attitudes and limited communication undermining trust and continuity of care. Effective provider-patient communication is essential for fostering satisfaction and ongoing attendance.²⁶ The absence of structured follow-up systems or appointment reminders contributed to irregular attendance and missed follow-ups. Strengthening patient communication, continuity systems and service organisation may therefore improve retention and preventive utilisation.

Theme 3. Patterns of oral health services utilisation

The main utilisation pattern was reactive, with most participants only seeking care when they experienced severe pain. This problem-driven approach mirrors findings from similar settings, where dental services are accessed primarily for emergency relief rather than prevention.⁷ Such delayed presentation increases the likelihood of extractions and advanced disease management.

Preventive and routine utilisation of dental services was limited, with few participants attending regular check-ups, with awareness of preventive services being low. Evidence consistently demonstrates that regular dental attendance is associated with improved oral health outcomes and reduced disease progression.³¹ The limited preventive engagement observed in this study likely contributes to the high burden of symptomatic presentations. Negative perceptions of restorative outcomes further discouraged preventive-oriented care, reinforcing extraction as the preferred treatment option.³⁰ Irregular attendance and missed follow-up appointments were common, the participants indicating limited communication regarding recall visits and follow-up scheduling. Irregular utilisation undermines continuity of care and increases the risk of disease progression, while regular attendance has been associated with improved oral health outcomes and reduced emergency visits.³³

Self-medication and home remedies were widely practiced, with some participants reporting that they used analgesics, clove oil, herbs, and, in extreme cases, harmful substances such as brake fluid. This behaviour reflects fear, financial barriers, limited awareness and accessibility constraints. Similar practices have been documented in low-resource settings where access to formal care is restricted.³⁴ While some self-care measures may provide temporary symptom relief, they do not address the underlying pathology and may exacerbate complications. The use of hazardous substances represents a significant public health concern and underscores the urgency of targeted oral health education and improved service accessibility.

Similar global studies report high prevalence of self-medication for toothache. For example, a study in Cameroon found that people use analgesics or other substances without professional guidance, which has been linked to delayed professional care and poor health outcomes.³⁶ In

some settings, individuals have applied harmful substances, such as petrol or aspirin powder, directly to painful tooth, with case reports documenting chemical injury to oral tissues from such practices.³⁶ These findings highlight the need for improved oral health education and greater access to professional dental services to reduce reliance on potentially dangerous home remedies.

LIMITATIONS OF THE STUDY

This study provides valuable insights into the determinants and barriers influencing oral health service utilisation at Katutura Hospital; however, several limitations should be acknowledged.

First, the study employed a qualitative cross-sectional design with a relatively small sample size of 24 participants. Although data saturation was achieved, the findings may not be generalisable to the wider population of Namibia or other settings, particularly rural areas with different healthcare access challenges.

Second, the study was facility-based, involving only patients attending Katutura Hospital OPD and dental clinic. This may have introduced selection bias, as individuals who do not seek care at health facilities – potentially those facing the greatest barriers – were not included. Their perspectives might differ significantly from those captured in this study.

RECOMMENDATIONS

To improve oral health service utilisation and outcomes, targeted interventions are required at both community and health system levels. Oral health education programs should be strengthened to promote preventive practices, correct misconceptions, and discourage harmful self-care behaviours. Increased awareness of available public dental services, particularly restorative and preventive care, is essential to improve informed utilisation.

Efforts should also focus on enhancing accessibility through extended clinic hours, decentralisation of services, and improved staffing to reduce long waiting times. Addressing financial and logistical barriers, including transportation challenges, may further support access. In addition, improving health system efficiency, infrastructure, and patient flow management is necessary to enhance patient experience.

Strengthening patient-provider communication and introducing structured follow-up systems, such as appointment reminders, may improve continuity of care. Interventions to reduce dental anxiety should also be considered. Finally, promoting a shift from problem-driven to preventive care, alongside further research in diverse settings, is critical for achieving sustainable improvements in oral health outcomes.

CONCLUSION

The study revealed that limited knowledge and awareness, multiple barriers and problem-driven utilisation patterns shape how individuals engage with dental services. To improve oral health outcomes, interventions need to strengthen oral health education focused on prevention and available services and address structural barriers by improving service accessibility and organisation. In addition, enhancing patient-provider communication and follow-up systems may encourage more regular, preventive orientation towards oral health care and reduce reliance on emergency-only utilisation. Optimising dental health not only has

implications for oral health, but for the longer term ability to chew, enjoy food and take in sufficient nutrition to enjoy a good quality of life.

CONFLICT OF INTEREST

The authors declares that the study was conducted without any commercial or financial associations that may give rise to a conflict of interest

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End of an era or a premature goodbye? Dental amalgam's place in the curriculum

SADJ JUNE 2026, Vol. 81 No.5 P331-P335

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ABSTRACT

Dental amalgam has been a restorative material in dentistry for over a century due to its durability, cost-effectiveness, and ease of placement. However, growing environmental concerns over mercury content, combined with advances in alternative restorative materials, have prompted a global shift in its clinical use. International regulations, such as the Minamata Convention on Mercury, have influenced dental schools to re-evaluate amalgam teaching within their curricula. This article explores the current role of dental amalgam in dental education, examining trends in teaching practices, student competency requirements, and the balance between clinical training and environmental concerns. A literature review of restorative dental training highlights significant variation in amalgam teaching across institutions, including South Africa. The review highlights the importance of integrating environmental sustainability, evidence-based material selection, and patient-centred care into restorative dentistry education. Recommendations include curriculum adjustments to ensure that dental graduates possess foundational knowledge of amalgam's properties, clinical indications, and safe handling protocols while prioritising minimally invasive techniques and mercury-free alternatives in alignment with global teaching trends. Are South African dental institutions adequately prepared for a complete phase-out of dental amalgam? This is a narrative review that summarises the existing research, including the author's research.

Keywords

Dental amalgam, dental education, dental schools, resin composite, mercury

INTRODUCTION

Dental amalgam is a widely used material for restoring teeth due to its durability, strength, and low cost. However, dental amalgam contains mercury, a toxic heavy metal that poses a risk to human health and the environment. Improper handling and disposal of dental amalgam waste can lead to the release of mercury into the air, water, and soil, potentially harming ecosystems and human health. Mercury exposure can cause various adverse health effects, including neurological and developmental disorders, respiratory

problems, and kidney damage. Additionally, mercury can accumulate in the environment and bioaccumulate in aquatic organisms, potentially harming ecosystems.¹ Managing dental amalgam use and waste properly is crucial for minimising the potential risks linked to mercury exposure. Chronic mercury exposure was associated with neurological symptoms (memory loss, anxiety, depression, tremors), renal dysfunction, and oxidative stress. Mercury's neurotoxic and cytotoxic effects were linked to damage in proteins, DNA, and cell membranes. Dental professionals consistently showed higher mercury levels in urine, blood, hair, and nails.²

The Minamata Convention on Mercury is an international environmental treaty established to protect human health and the environment from the adverse effects of mercury. It is named after the city of Minamata, Japan, where severe mercury poisoning occurred in the mid-20th century due to industrial pollution. This convention was adopted in October 2013.³ Following the Minamata Convention, it is worth noting that ongoing discussions and initiatives have been taking place globally, including in South Africa, regarding the potential phase-down or phase-out of dental amalgam due to environmental and health concerns associated with mercury. The South African Dental Association (SADA) has recognised the need to properly manage dental amalgam use and waste, to minimise mercury exposure and its environmental impact. SADA encourages dentists to follow best practices for amalgam handling. These include using amalgam separators to capture and dispose of amalgam waste in a safe and environmentally responsible manner. The International Association for Dental Research (IADR) further affirmed the use of dental amalgam for the general population without allergies and renal diseases. It states that it should be available as the best restorative option when alternatives are less than optimal for clinical, economic, or practical reasons. In addition, IADR supports the phase-down approach and increased prevention to reduce the need for restorative care.⁴ The World Health Organisation (WHO) supports the phase-down as well as the phase-out approach. At the country level, policymakers need to implement measures recommended by the Minamata Convention, with clear timelines and a stepwise approach, to protect both our environment and health.³

Several studies have investigated the use and management of dental amalgam in different countries. In South Africa, dental amalgam is widely used; however, its use in both the public and private sectors is declining as tooth-coloured restorations gain popularity.⁵ This trend is observed in Australia, New Zealand, Brazil, and the United States. Some countries that have banned or imposed restrictions on the

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use of dental amalgam include the European Union, Norway, Sweden, Finland, Denmark, the Netherlands, and Japan.

According to the British Dental Academy (BDA), alongside the Council of European Dentists (CED) and the FDI World Dental Federation (FDI), the BDA has maintained that dental amalgam, alongside other restorative materials, must remain available as one of the tools in the armoury of the dental profession for the repair and maintenance of damaged teeth. The BDA advocates that the treating clinician is best placed to discuss the available options with the patient and to obtain valid consent for the treatment offered. Whilst alternative materials do exist, none currently fully replicate the clinical and economic effectiveness of amalgam. BDA further agrees with the Minamata Convention and the World Health Organisation (WHO) that additional research is needed on the health and environmental impacts of new restorative materials.⁶

The teaching and training trends of dental amalgam globally

United Kingdom

The British Dental Association policy statement on amalgam use is 'No use of amalgam in the treatment of deciduous teeth; in children under 15 years; or pregnant or breastfeeding women, except when strictly deemed necessary by the practitioner, or on the grounds of specific medical needs required by the patient'.⁶

It was found that students in the UK and Ireland gain more experience in placing posterior composites than in placing dental amalgam. This shift in the teaching trend is due to the growing emphasis on minimally invasive dentistry.⁷ A study found that the first pre-clinical skills experience in the restoration of posterior teeth is now with resin composite material, rather than amalgam, for the majority of students.⁸ It is further anticipated that the future generation of dentists and dental therapists who join the dental professional workforce will be more skilled in placing composite restorations rather than amalgam. This would mean that this generation of practitioners will be more conservative in their approach to cavity design. The old approach of GV Black's, "extension for prevention," should now be transformed into a more prevention-oriented, patient-centred approach. In most UK dental schools, amalgam placement is no longer taught on child patients.⁷ However, in the latest research emerging from the United Kingdom, the consensus is that there is a disparity between what is being taught at universities and the real-world demands. A study conducted by Jebur *et al.* in 2023 highlighted the fact that 'dental schools need to be aware that amalgams are used more frequently by graduates than anticipated and that they perceive themselves to be under-prepared in the use and placement of amalgam restorations. The clinical and educational impact of this understanding is that undergraduate dental curricula should take steps to improve the knowledge and practical skills of dental students in placing amalgams to better prepare them for real-world practice and ensure safe practice'.⁹

America

The American Dental Association policy statement confirms that dental amalgam is a safe, durable and affordable material that has been used to restore the teeth of over 100 million Americans.

According to a study by Ben-Gal *et al.* (2011), posterior composite resin restorations now outnumber amalgam

restorations in the United States.¹⁰ It further stipulates that dental faculties should define criteria, based on up-to-date clinical studies, for using new materials.

A study conducted in North America among 33 dental schools assessed whether dental schools are adapting their curricula to align with current trends in dentistry and what rationale supports this adaptation. This study determined whether amalgam or resin composite is being used more frequently to restore posterior teeth. The study revealed that there were no clear guidelines for cavity preparation of composite restorations, compared to the explicit guidelines for preparing amalgam restoration cavities. Dental schools will benefit when a clear consensus is reached.¹¹

A further study, published in June 2019, examined the transition of pre-clinical paediatric dental clinics from amalgam to other restorative dental materials. This study, conducted among 44 dental schools, revealed that US dental schools were not ready to phase out dental amalgam training. It highlighted that amalgam is still widely used in paediatric predoctoral training as a restorative material for both primary and permanent teeth.¹²

Asia

This third edition of the Position Statement on the Use of Dental Amalgam was adopted by the Malaysian Dental Council (MDC) on 13 January 2020. The Position clarifies the policy of the MDC on the use of alternative restorative materials, compared to dental amalgam, and recommends best practice in the management of restorative materials.¹³

In a 2020 study conducted in Malaysia, among final-year dental students, it was revealed that more students chose tooth-coloured restorations over amalgam, with the primary reason being the conservation of tooth structure.¹⁴

A study conducted in Lahore, Pakistan, aimed to evaluate dentists' attitudes towards posterior composite restorations, specifically regarding case selection and concerns. It was found that the conservation of tooth structure and aesthetics were the primary reasons for selecting posterior composites.¹⁵ Dental amalgam seems to be less frequently used among Saudi dentists. Recent dental graduates used amalgam less frequently compared to experienced dentists. Aesthetics and patients' desires were found to be the major reasons for restricting the use of amalgam amongst participants.¹⁶

A study conducted in India in 2023 found a clear shift away from amalgam towards composite resins. This shift was driven by concerns regarding mercury toxicity, as well as a general trend towards aesthetic tooth-coloured restorations.¹⁷ Countries can play a key role in the Phase-down of dental amalgam use by requesting cooperation from dental schools. Dental schools can be encouraged to develop curricula that train students to use mercury-free alternatives, provide continuing education for those already in practice, and educate current and future dentists about the environmental impact of amalgam.¹⁸ In some countries, dental schools have adopted these criteria into their curricula.¹⁸

In Japan, the teaching of dental amalgam restorations is no longer emphasised in the educational system.¹⁷ This was probably due to the fear that gripped the Japanese nation after the Minamata poisoning incident in the mid-1950s.

Europe

The European Union policy statement on the use of dental amalgam is as follows: 'to reduce the use of mercury-added products in line with the intention of the Minamata Convention, and that the first material used in the treatment of deciduous teeth and pregnant women, alternate materials to amalgam should be the first choice'.¹⁹

In Sweden, amalgam teaching was not carried out for many years before its ban. To reduce spills and exposure, mercury hygiene was emphasised. Pre-encapsulated amalgam was used. Dental schools have since demonstrated the efficacy of mercury-free alternatives and can also provide information on best management practices.²⁰ In Denmark, dental schools are actively collaborating in efforts to phase out amalgam. The use of mercury-free alternatives is part of the dental school's obligatory training.²⁰ In the Netherlands, dental schools stopped teaching the placement of amalgam between 1995 and 2005.

In the EU, the majority of professionals (70%) and students (60%) believe dental amalgam poses some health risks to patients. Dentists (32.9%) and students (36.4%) reported moderate health risks to staff, with regional differences noted in these perceptions. Both groups suggested that professional organisations share more information on the safety and environmental impact of amalgam and mercury.²¹

Africa

Nigeria initiated a campaign called the Abuja Declaration in 2001, a civil society campaign aimed at eliminating the use of amalgam in Africa. This declaration's impact was felt throughout Africa, resulting in 'Africa Day' for Mercury-free dentistry, which is held annually on 13 October.²²

One implementation of the declaration is to change the dental school curriculum to emphasise the use of resin composites, glass ionomers and other minimally invasive and amalgam-free restorative materials. It aims to de-emphasise the teaching of amalgam and thereafter phase out instruction in amalgam. The declaration aims to provide training in mercury-free restorations to older dental practitioners.²³ Some of the other policy measures that Africa has promoted are to stop the placement of amalgam restorations in children and females of child-bearing age, not just pregnant or lactating women, by 2020. This was stipulated in the Tanzanian guidelines.²³

According to a study conducted in Ibadan, Nigeria, it was found that amalgam, as a choice of restorative material, is gradually being replaced by composite.

In African countries, such as Uganda, Kenya, and Tanzania, it has been found that the phase-down of amalgam is feasible if dental schools adhere to specific guidelines. These include creating awareness of the environmental risks associated with dental amalgam, promoting alternatives to dental amalgam, emphasising oral health promotion to reduce caries (thereby avoiding the need for restoration), supporting best management practices, and environmentally sound waste management.²³ In a baseline study conducted at a Nigerian dental school in 2016, prior to the implementation of the Minamata phase-down policies, it was found that almost 60% of all restorations placed are mainly dental amalgam. Two of the recommendations further made in the study were that more emphasis should be placed on MID (Minimal Invasive Dentistry) and mercury-free dental materials.²⁴

South Africa

The South African Dental Association (SADA) supports the call for a gradual phase-down in the use of dental amalgam as a restorative material. SADA supports the call for more research to be conducted on suitable alternative materials that are comparable to amalgam.²⁵

It was stated that developing countries will face challenges in phasing down amalgam due to the lack of comparable alternative restorative materials. However, following ratification of the Minamata Convention, a phase-down of dental amalgam is necessary to reduce mercury exposure. It was recommended that oral health care practitioners promote the use of alternative materials such as composites, glass ionomers, and ceramics, especially in occlusal cavities and deciduous teeth; employ best management practices for the safe disposal of amalgam, offer more oral health education on preventing caries, and support more research on the discovery of suitable alternative restorative materials.²⁶ In a study carried out at a dental school in 2017, it was found that 'dental amalgam is no longer the preferred material for the restoration of posterior teeth in the South'.²⁷ Resin composite was the most widely used material to repair or replace defective amalgam restorations.²⁷ In a study at a dental school that was conducted in 2023 by Essa *et al*, it was concluded that 'while the pre-clinical and clinical teaching requirements of amalgam restorations have been decreased at all universities, the economic climate in South Africa is not conducive to a complete phase-out of amalgam restorations'.²⁸ Thus, the complete phase-out of amalgam restorations is unanimously discouraged due to affordability concerns for the masses.' This coincides with the findings of a study conducted in 2021 by Bissoon and Moodley, which found that 'the dental curriculum should be reviewed to ensure that the university keeps up with international trends while still considering the economic climate of South Africa'.¹²⁹

DISCUSSION

The teaching of dental amalgam is continuing. However, the emphasis now placed on amalgam is either equal to or less than that on dental composite. Recent systematic reviews continue to show that dental amalgam remains a safe and durable restorative material, with no consistent evidence of clinically significant adverse health effects and strong long-term performance in posterior restorations.³⁰⁻³¹ This is further affirmed by both the American Dental Association (ADA) and the South African Dental Association.²⁵ The use of amalgam material is suitable for areas that are not aesthetically demanding and for surfaces that require extensive tooth restoration, which may include one or more cuspal surfaces. In the mid-1990s, amalgam was the material of choice for posterior restorations. However, by the late 1990s, resin composite was becoming the predominant choice of material in the teaching of posterior restorations. This trend continues to the present at dental schools, according to a study by Essa *et al* (2023).²⁸ The reason for this shift is that newer composite materials are found to be longer-lasting and more durable compared to earlier composite materials.³² The teaching of dental amalgam is declining in most dental schools in the United States and Europe, with a greater emphasis being placed on composite materials in their pre-clinical laboratories and clinics.³³ Additionally, it was found that dental practitioners with more than thirty years of experience in dentistry often lack extensive experience in the placement of adhesive materials.³⁴ In 2019, a study conducted in Turkey revealed that composite has replaced

amalgam in the dental curriculum.³⁵ A review conducted by Burke (2004) showed that in North American dental schools, the trend is toward the greater use of resin composites.³⁶ However, there is a greater emphasis on dental amalgam for Class II cavities. A recent study conducted in Canada by Khodayari *et al* in 2023 found that 'later dental graduates and private practitioners reported decreased amalgam use.'³⁷ As amalgam remains a safe and effective dental material, its removal may not be prudent. Dental educators play a crucial role in the future of amalgam opinion and use.

European dental schools have shown a shift towards resin composites. A 2006 study highlighted that 60% of dental schools used resin composite for Class II restorations in their teaching. A study in Australia revealed that the use of dental amalgam in dental training had decreased from 58% to approximately 23% (Burke, 2004).³⁸ A more recent study in Australia found that the use of dental composites increased by 1.4% per year from 2010 to 2019, compared to a 30.2% decrease in the use of dental amalgam.³⁹

A South African government gazette published in March 2025 highlighted the regulations regarding a phase-down approach to dental amalgam.³⁹ This was promulgated by the Department of Environmental Affairs, Forestry and Fisheries (DEFF). The purpose of these regulations was to ensure the environmentally safe management of mercury, to establish measures for the phase-down and phase-out of mercury-added products, to regulate the manufacturing process of mercury products, and to regulate the manufacture of mercury stocks. These regulations stipulate that, concerning dental amalgam, the following regulations must be adhered to: dental amalgam must only be used in a pre-encapsulated form not exceeding 0.58 ml. Any facility using dental amalgam must be equipped with amalgam separators for the retention and collection of amalgam particles, as specified by the manufacturer's instructions. These separators must be installed in all facilities by 01 April 2026, and ensure a minimum retention level of at least 95% of amalgam particles. Another specification is that no practitioner should release dental amalgam into the environment under any circumstances (FDI World Dental Federation).⁴⁰

These regulations will have a direct impact on the teaching and practice of dental amalgam in training institutions, as many institutions lack amalgam separators.

A dental amalgam symposium was held in March 2025, featuring dental schools from South Africa. Representatives from five schools participated. The concerns raised were the environmental impact of dental amalgam and the lack of dental amalgam separators at dental schools. The participants agreed on the Phase-down approach to dental amalgam, as most institutions have decreased their use of dental amalgam and are now using more resin-based restorations. This finding aligns with a 2021 study conducted at a dental school in KwaZulu-Natal, South Africa, which revealed that training with resin composites accounts for more than 50% of dental restorations placed by students.⁵

CONCLUSION

Dental amalgam use remains prevalent globally, including in South Africa, but there is an increasing shift towards resin-based materials as an alternative. Resin materials offer numerous benefits, including aesthetically pleasing tooth-coloured restorations, adhesive bonding, and a

reduced environmental impact, which contributes to their growing popularity in dental practice. The implementation of Minamata Convention policies reveals a distinct difference in amalgam use, which is based on countries and income status. The higher-income countries exhibit more vigorous implementation policies compared to lower-income countries.³ Regarding the teaching and training of dental amalgam, three-quarters (74%) of high-income countries reported having regulations for dental amalgam waste disposal in dental facilities and dental schools. In contrast, a mere 10% of low-income countries reported this practice.³

Within the South African context, the integration of dental amalgam in undergraduate curricula varies across institutions. While some dental schools have begun to reduce the emphasis on amalgam, placing greater focus on composite resins and minimally invasive techniques, others maintain amalgam training, due to contextual needs, such as public sector demand, cost-effectiveness, and clinical applicability. This shift in curricular focus seeks to align local dental education with global trends and regulatory momentum toward the phase-down – and potential future phase-out – of mercury-containing dental materials.

This raises a pertinent question: Are South African dental institutions adequately prepared for a complete phase-out of dental amalgam, and how will they balance educational reform with the clinical realities of practice, particularly in resource-constrained settings?

ACKNOWLEDGEMENTS

The researcher would like to thank all participants for their contribution to the focus group discussions.

Conflict of Interest

The authors declare that they have no competing interests.

The authors received no financial support for this article's research, authorship, and publication.

CONTRIBUTION

The principal author (SB) contributed substantially to the conception and design, as well as the acquisition, analysis, and interpretation of the data. The co-author (RM) assisted with the discussion and literature review. All authors critically revised the article for its valuable intellectual content and approved the final version for publication.

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Policy Analysis of South Africa's National Oral Health Policy and Strategy (2024-2034)

SADJ JUNE 2026, Vol. 81 No.5 P336-P342

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ABSTRACT

South Africa (SA) faces a mounting OH crisis shaped by apartheid-era inequities, a quadruple disease burden, workforce shortages, and chronic under-investment. This article presents an analysis of SA's National Oral Health Policy and Strategy (NOHP&S) 2024–2034 using the Walt and Gilson Policy Triangle Framework. The policy content, context, actors, and processes to assess alignment with global best practice and feasibility of implementation were examined. The NOHP&S demonstrates strong conceptual alignment with the WHO Global Strategy and Action Plan on Oral Health (2023–2030) and the Minamata Convention, with emphasis on prevention, integration into primary health care, universal health coverage, and environmental stewardship. However, significant gaps threaten translation into practice, including funding constraints, workforce maldistribution, weak service integration, the omission of a targeted early childhood caries prevention strategy, and surveillance shortcomings driven by limited indicators. Actor mapping highlights diffuse leadership and uneven coordination across government levels, with fragile NGO capacity and under-leveraged public–private partnerships. Process analysis indicates broadly framed strategies without operational detail, risking fragmented implementation and

weak accountability. A pragmatic implementation roadmap anchored in policy-capacity assessment, strengthened monitoring and evaluation with quality, standardised outcome indicators, and investment in prevention-oriented services is proposed to catalyse sustainable improvements in population OH.

Keywords

oral health policy, oral health equity, oral health strategy, workforce, governance

1. INTRODUCTION

Oral health (OH) is an essential, yet often neglected aspect of overall health, with profound negative implications for individual well-being, health system efficiency, and population-level health equity. Globally, oral diseases affect approximately 3.5 billion people and are among the most prevalent noncommunicable (NCD) conditions, disproportionately impacting vulnerable and marginalised populations.¹ However, despite this substantial burden, oral diseases remain siloed from broader health policy frameworks, and inadequately prioritised in universal health coverage (UHC) agendas.²

South Africa (SA) is characterised by profound health inequalities, a quadruple burden of disease, and is facing an escalating OH crisis.³ Its challenges are exacerbated by socioeconomic inequalities, workforce shortages, urban–rural divides, and the long-standing under-prioritisation of OH in health planning and resource allocation.⁴ While the 2002 National OH Strategy established a roadmap for service delivery, it lacked the depth, traction, and integration mechanisms to drive systemic change.⁵ In light of these challenges, the introduction of the National Oral Health Policy and Strategy (NOHP&S) 2024–2034 marked a pivotal moment in SA's health policy landscape. The policy articulates an expanded vision for OH; however, its potential for success hinges on implementation within a context of resource constraints, fragmented governance, and the historical lack of political will.

This paper presents a comprehensive policy analysis of SA's NOHP&S, examining its alignment with global best practices, feasibility within the public health system, and barriers to implementation. Using the Walt and Gilson Policy Triangle Framework,⁶ it deconstructs the policy's content, context, actors, and processes to assess its strengths, limitations, and prospects. As OH gains renewed global attention through World Health Organisation's (WHO) Global Strategy and Action Plan on Oral Health (2023–2030),⁷ this analysis offers timely insights into how SA's evolving policy framework could translate global commitments into sustainable, contextually grounded outcomes.

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Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest.

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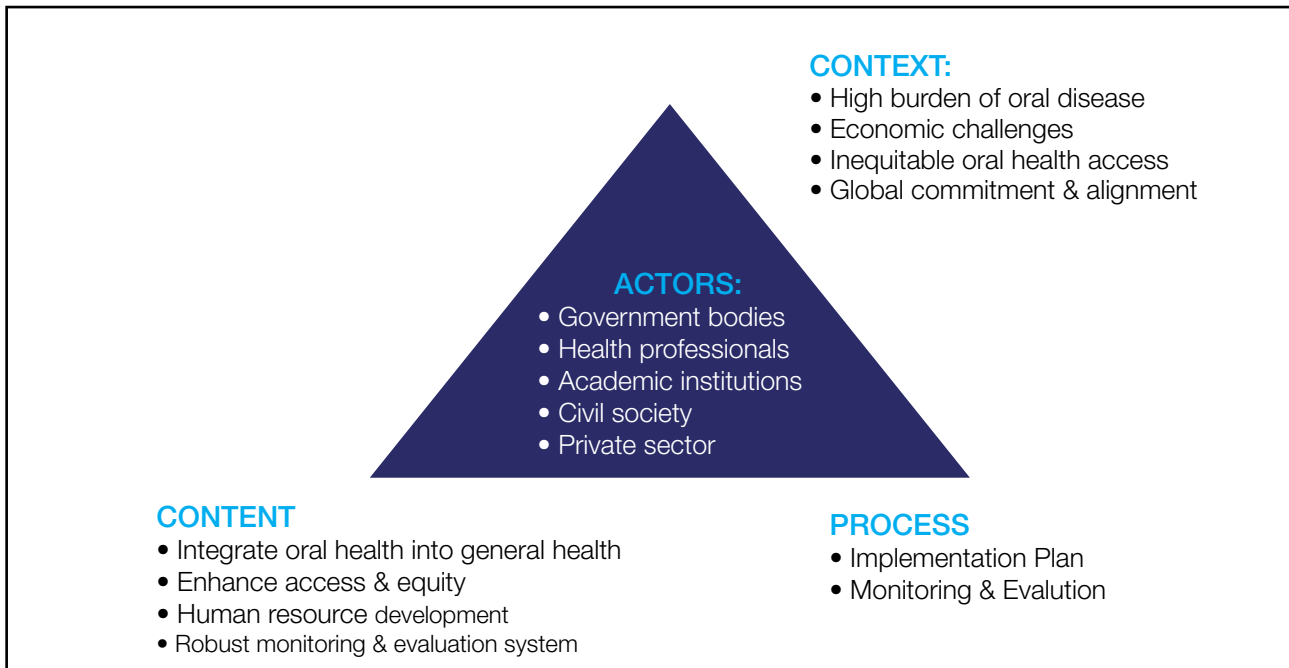


Figure 1: NOHP&S (2024-2034) – Policy Analysis

2. POLICY ANALYSIS: SOUTH AFRICA'S NATIONAL OH POLICY AND STRATEGY (2024-34)

While acknowledging the state of OH in SA, the revised National Oral Health Policy and Strategy (NOHP&S) (2024-2034) provides a critical response to the country's rising oral disease burden. However, although the policy's vision is clear and ambitious, its implementation requires careful coordination and strong leadership to overcome health system challenges.

A policy analysis was necessary to determine whether SA's NOHP&S aligns with global best practices, to evaluate its feasibility within the current healthcare landscape, and identify barriers to successful implementation. Using the Walt and Gilson Policy Triangle Framework,⁶ the analysis examined the policy's key actors, context, content, and development processes. A broad overview of the policy analysis findings is illustrated in Figure 1.

2.1 Contextual analysis

2.1.1 Historical Context

South Africa's apartheid legacy resulted in a deeply inequitable, racially segregated health system. Under apartheid, Black people, who constitute 80% of SA's population, were subjected to systemic discrimination through segregation and racist laws. Oral health services were concentrated in the private sector and urban areas, resulting in severely limited access for the majority Black population in rural and township settings. Presently, 80% of South Africans rely on the overburdened public health system, yet 93% of oral health practitioners work in private practice serving only the 20% able to afford private care.⁷

South Africa's NOHP&S was developed to address the country's high burden of oral diseases, entrenched socioeconomic inequalities, and resource constraints that continue to hinder equitable access to OH care.³ The policy operates within a complex public health environment, where local and global challenges affect its implementation feasibility.

2.1.2 High Burden of Oral Disease in SA

In its problem statements, the policy emphasises that the prevalence of oral diseases in SA remains alarmingly high, particularly among children and marginalised groups. Oral diseases such as dental caries, periodontal diseases, oral cancers, and trauma-related conditions continue to pose major public health challenges, while having limited access to timely diagnosis and treatment further exacerbate the crisis.³

Dental caries is widespread, affecting more than 60% of six-year-olds,⁹ highlighting the severe unmet need for early intervention and preventive measures such as fluoride applications and school-based programmes. Periodontal diseases and oral cancers are also rising, fuelled by modifiable risk factors including tobacco use, excessive alcohol consumption, and poor oral hygiene.³ These conditions are often undiagnosed and untreated due to limited access to dental professionals in rural and disadvantaged communities. The maldistribution of OH professionals leaves underserved areas with minimal care, exacerbating inequities.¹⁰ Furthermore, dental workforce production does not meet national needs, and insufficient incentives hinder the attraction and retention of professionals in the public sector and rural locations, contributing to persistent service gaps.¹¹

The policy further highlights the impacts of the OH complications of HIV/AIDS, with conditions such as oral candidiasis, Kaposi's sarcoma, and necrotising ulcerative gingivitis being more common among immunocompromised individuals. Therefore, this intersection between infectious diseases and OH underscores the need for integrated care models. Within the broader public health sector, policy trade-offs between efficiency and equity often result in OH being deprioritised in favour of high-profile health priorities such as HIV/AIDS, tuberculosis, and maternal-child health,^{4,12} further limiting resources available for OH programming and services.

2.1.3 Economic Challenges

The cost of treating oral diseases is among the highest healthcare expenditures worldwide, causing a significant

financial burden for both governments and individuals.¹ In SA, limited public OH funding and competing disease burdens,⁴ coupled with the fiscal constraints and economic stagnation in SA,¹³ further restrict investments in OH care. Furthermore, many public OH care facilities lack the necessary resources to provide comprehensive care, resulting in long waiting times, inconsistent service delivery, and a reliance on emergency extractions rather than preventive or restorative treatments.¹⁰

Consequently, individuals, particularly the most vulnerable and those from lower-income groups, are often forced to delay or forgo essential OH care, contributing to worsening health outcomes and an increased burden on the broader healthcare system.¹⁴ Recognising these financial and systemic challenges, the NOHP&S prioritises oral disease prevention and health promotion as a cost-effective approach to addressing OH disparities. The policy emphasises integrated healthcare as a critical strategy for improving OH outcomes by aligning OH initiatives with NCD prevention strategies, maternal and child health programmes, and other key public health interventions. By shifting the focus towards preventive and population-based interventions, the policy seeks to reduce the prevalence of oral diseases, alleviate financial pressures on the healthcare system, and ensure long-term sustainability of OH services.³

2.1.4 Inequitable OH access

Rural and underserved communities in SA face the greatest barriers to OH care. The limited availability of OH professionals in the public sector,¹⁰ inadequate infrastructure, and geographic inequalities continue to exacerbate unequal access to essential health care, including OH care services.¹⁵

There remains a significant urban–rural divide in the distribution of OH.¹¹ In many rural areas, shortages of dentists and oral hygienists result in limited access to even basic care. For example, in the Western Cape Province, less than one-third of public OH clinics offered the basic OH care package, with rural clinics particularly disadvantaged at only one-quarter, compared to 50% in the Cape Metropolitan area.¹⁰ Consequently, services are often extraction-focused, with minimal preventive interventions, further entrenching inequities.

Infrastructure and resource limitations in secondary and tertiary OH services reinforce these disparities.¹⁶ Many clinics lack essential materials and specialised equipment, resulting in long delays for advanced treatment or forcing patients to rely on costly private options. These delays worsen health outcomes, increase emergency-care demand, and escalate treatment costs for the public health system.¹⁷

2.1.5 Global Commitments and Policy Alignment

To ensure that national interventions remain evidence-based, globally relevant, and adaptable to international best practices, the SA's NOHP&S aligns with key international public health priorities. A key influence on the policy is the WHO Global Strategy and Action Plan on Oral Health (2023–2030), that emphasises the integration of OH into general healthcare systems. This strategic approach underscores the importance of preventive and population-based interventions, aimed to reduce the prevalence of oral diseases and enhance access to quality care across all demographics.³

Additionally, SA's NOHP&S aligns with the Minamata Convention on Mercury,³ a global initiative that is aimed

at phasing out mercury-containing dental amalgam. This commitment is reflected in the country's dedication to environmental sustainability, patient safety, and a move toward the adoption of modern, non-toxic dental treatment alternatives. These international commitments strengthen the NOHP&S strategic direction.

Collectively, this context demonstrates that while the NOHP&S is grounded in strong global principles and national priorities, its success depends on the health system's capacity to address persistent inequalities, resource limitations, and competing health demands. An understanding of these contextual dynamics is essential for evaluating whether the policy can be operationalised effectively and achieve its intended impact.

2.2 Policy Actors

Aligned to the comprehensive primary health care (PHC) approach, successful implementation of SA's NOHP&S relies on the involvement of multiple stakeholders, each of which play a crucial role in shaping and executing the policy.³ These actors include government bodies (such as, National Treasury), healthcare professionals, academic institutions, international partners, civil society, as well as partnerships with the private sector.

The SA National Department of Health is the central government authority with oversight on the development, implementation, and evaluation of the policy, and is responsible for resource allocation, monitoring progress, and ensuring that the strategy aligns with broader health system reforms, such as National Health Insurance (NHI).³ At provincial and district levels, health departments also play a significant role in tailoring OH services to meet local needs, addressing regional disparities, as well as ensuring that underserved communities receive adequate OH care which are responsive to their needs.³ However, the leadership and governance structures for OH at these levels are not explicitly defined by the NOHP&S, and this may lead to challenges in determining responsibility for coordinating and sustaining the implementation of the NOHP&S. It is pivotal to establish clear roles and accountability mechanisms at each level of a health system for effective execution and long-term sustainability of policies.¹⁸

Additionally, a wide range of health professionals, including dentists, dental therapists, oral hygienists, and community health workers, are tasked with service delivery as per the NOHP&S, to provide preventive and curative OH care, educate communities on oral hygiene, and manage oral diseases. However, a major stumbling block to this is the maldistribution of resources,³ particularly human resources in rural and underserved areas, where access to qualified OH professionals remains limited¹⁰ and several disparities in OH service delivery persist. For instance, a study in the Western Cape Province revealed that a low dentist-to-population ratio of 1:71,875 exacerbated the challenge of OH access, with public clinics averaging only 7.3 dentist days per month. Satellite clinics fared worse, with dentists available just 3.2 days per month.¹⁰ Without addressing these structural imbalances, existing OH inequities are likely to worsen, particularly for vulnerable populations who are the key benefactors of the NOHP&S.³

The policy proposes that Universities and Oral Health Training Institutions play an essential role in developing a workforce

that meets SA's OH needs. These institutions are responsible for equipping future dental professionals with the necessary skills and expertise to work in diverse settings, including public healthcare facilities and rural areas. As a method of addressing the workforce shortages and maldistribution, the NOHP&S emphasises reforming dental education and training programmes to produce "fit-for-purpose" professionals capable of serving in high-need communities.³ However, academic institutions' ability to meet these expectations requires careful consideration. Dental schools in SA already face significant financial, infrastructural, and staffing constraints,¹⁶ limiting their capacity to expand training output or adopt community-oriented curricula without new investment. Developing a workforce aligned to national needs will depend on universities receiving targeted funding, adequate clinical training platforms, and additional human resources to strengthen rural placements and integrate preventive, PHC-focused competencies.

Furthermore, the policy proposes that equitable access to OH services requires active engagement with civil society organisations and non-governmental organisations (NGOs) are required to facilitate with OH advocacy, education, and outreach programmes. These organisations are intended to bridge the gap between policy and implementation by raising awareness about OH, providing community-based interventions, and advocating for policy reforms that address systemic inequalities.³ However, over-reliance on NGOs remains a pitfall of SA's public health system, particularly given the fiscal pressures that constrain their operations. Organisations operating in SA are financially weak, and their sustainability vulnerable. Following the 2008 economic downturn, a significant number of NGOs ceased operations, partly due to the fragile state of SA's economy.²⁰ As such, reliance on these organisations to fill critical gaps in OH care service delivery may not work as envisaged, as their financial instability may compromise long-term sustainability and accessibility of services.

The NOHP&S suggests engendering public-private partnerships to expand access to both preventive and curative OH services. The involvement of private dental practitioners, corporate sponsors, and healthcare providers are proposed to alleviate the strain on public health resources and improve service delivery.³ However, collaboration with the private sector remains a challenge, as there are gaps in coordination and concerns regarding cost accessibility for low-income groups. Greater alignment between public health goals and private sector contributions are required to ensure sustainable partnerships that benefit all communities. Furthermore, despite its potential to play a more significant role in expanding OH care services, engagement with the private sector is limited. The lack of structured partnerships with private providers and organisations restricts opportunities for resource mobilisation and service enhancement.

Moreover, despite the broad and inclusive involvement of various stakeholders, the effectiveness of such collaborations hinges on overcoming significant challenges in co-ordination, particularly across different levels of governance. Ensuring seamless collaboration between national, provincial, and district health departments remains a persistent hurdle, often leading to fragmented implementation and inefficiencies in service delivery, as evidenced in the implementation of the previous National Oral Health Policy.⁵

Additionally, stakeholder participation is often uneven, with grassroots organisations and community-based groups frequently having limited influence in decision-making processes, resulting in policies that do not address local needs. Another critical challenge lies in ensuring accountability among all actors involved in OH governance. Without clear mechanisms to align efforts and responsibilities, achieving the policy's overarching goal of universal access to OH care may prove difficult. Therefore, addressing these systemic coordination issues is crucial to fostering an integrated and efficient OH care system that is responsive, equitable, and sustainable.

2.3 Content Analysis: The NOHP&S (2024–2034) and Global Alignment

South Africa's NOHP&S indicates a strong commitment to aligning with international OH priorities, particularly those promoted by the WHO Global Strategy and Action Plan on Oral Health (2023–2030). A comparative assessment between the two frameworks highlights points of policy convergence, areas of partial alignment, and some critical implementation gaps. Figure 2 provides a critical comparison of the two frameworks and the narrative below interrogates the implications for policy effectiveness.

2.3.1 Vision, Goals and Paradigm Shift

Conceptually, the NOHP&S embraces the WHO's vision of universal access to essential OH care and the integration of OH within general health systems. Both frameworks promote a shift from curative, hospital-centric dentistry toward preventive, population-based approaches that aim to reduce oral disease burden while improving equity in access. The NOHP&S articulates four strategic goals that reflect this shift, highlighting the need for strengthened health system capacity, improved monitoring and evaluation, better workforce planning, and equitable service delivery.³ However, inadequate funding⁴ and persistent service fragmentation¹⁰ in OH continue to hinder meaningful progress toward achieving a truly preventive and integrated model of care. Thus, while rhetorical alignment is strong, practical realisation of the NOHP&S's vision remains uncertain.

2.3.2 Integration into PHC and UHC

The WHO strongly advocates for OH to be integrated into UHC and NCD prevention strategies, recognising the shared risk factors which underpin both systemic and oral diseases.⁷ The NOHP&S closely reflects these priorities, as OH forms part of the PHC Services Programme alongside 'Nutrition and Health Promotion Interventions' (South African Government, 2020). The NOHP&S supports community-based interventions, which include fissure sealant programmes, fluoride applications, and oral health education delivered through the Integrated School Health Programme (ISHP).³ However, implementation of the School OH Policy through the ISHP is highly inconsistent and often poorly functional. Implementation is constrained by inadequate planning, limited resources, and weak school infrastructure, among others.²²

National public health measures such as the health promotion levy on sugar-sweetened beverages illustrate a broader commitment to WHO strategies aimed at reducing population-wide sugar consumption, subsequently lowering dental caries risk.²³ However, oral diseases were not explicitly included and is constantly omitted in the levy's public messaging or national media campaigns,

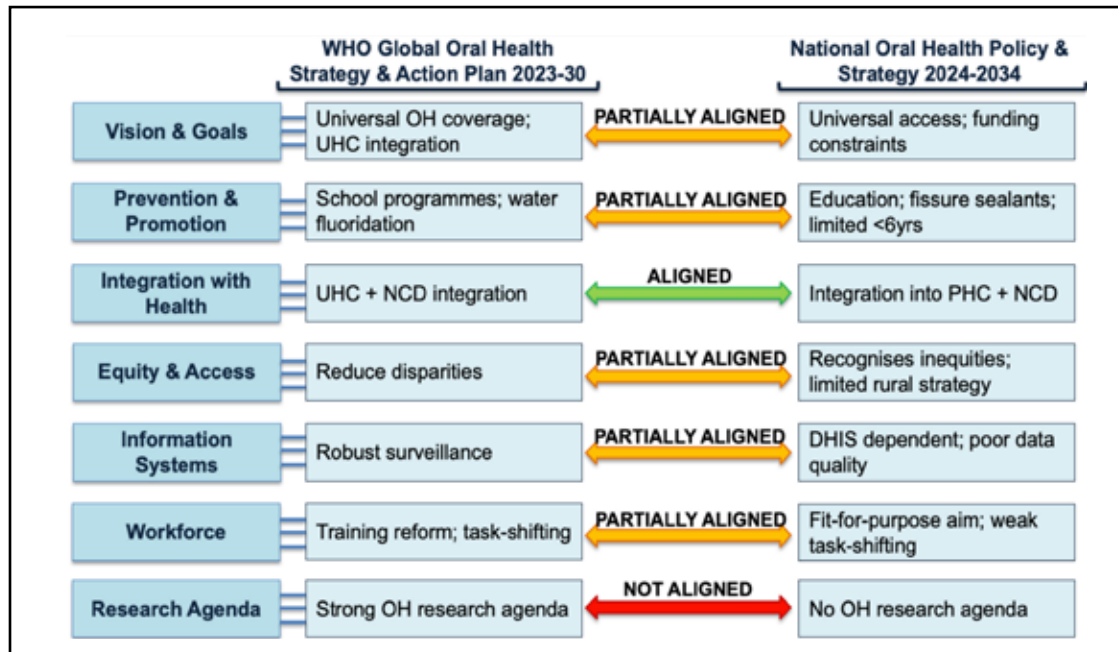


Figure 2: Alignment of Global OH Strategy and Action Plan and SA's NOHP&S (Adapted^{3,7})

reflecting the broader marginalisation of oral health within health promotion platforms. Therefore, despite these structural alignments, implementation challenges, such as limited operational guidance, under-resourced PHC teams (Maphumulo and Bhengu, 2019), and weak referral pathways,¹⁶ risk diminishing the benefits of this strategic integration.

2.3.3 Prevention and Promotion of OH

Preventive services remain a fundamental pillar of both the WHO's Global Strategy and the NOHP&S. While SA has embraced school-based oral health interventions, the exclusion of children under six-years from the ISHP programme represents a major limitation, especially considering the high prevalence of early childhood caries and its detrimental impact on developmental outcomes.^{24,25} Furthermore, the lack of community water fluoridation, despite decades of policy endorsement, represents a missed opportunity to advance cost-effective caries prevention at scale. Additionally, preventive care remains overshadowed by the urgent treatment needs that are generated by late presentation and limited community-level resourcing. This demonstrates the tension between policy aspirations of the NOHP&S and ground-level realities.

2.3.4 Equity, Access and Service Delivery Structure

Equity is a core priority in both global and SA policy frameworks. However, gaps between policy commitment and service delivery remain significant. The NOHP&S outlines a tiered OH care model intended to streamline access between primary, secondary and tertiary OH services. However, in practice, infrastructure limitations, chronic equipment shortages and inefficient referral processes hinder continuity of care, especially in rural areas.^{10,16} Without targeted investment to strengthen rural and underserved regions, inequities in OH access will persist, thereby, constraining the NOHP&S's ability to meet its stated equity goals.

2.3.5 Oral Health Workforce Capacity

The NOHP&S acknowledges long-standing OH workforce shortages and proposes interventions to improve training outputs and a more "fit-for-purpose" workforce.³ However, SA continues to face a severe maldistribution of OH

professionals, with the majority concentrated in urban private practices.¹¹ Currently, dentists make up 77% of the registered workforce, while oral hygienists, who are central to the delivery of preventive care, account for only 15% of the OH workforce.¹¹ This imbalance limits the country's capacity to shift toward prevention-focused service delivery. In contrast, the WHO strongly supports task-sharing and workforce reallocation strategies to improve accessibility and reduce cost barriers.⁷ However, these recommendations are not integrated into the NOHP&S. Without addressing workforce deployment, production and skills-mix reform in a coordinated manner, the NOHP&S risks entrenching existing disparities in service access.

2.3.6 Oral Health Information Systems and Research Agenda

Monitoring and evaluation systems are another critical area of partial alignment. While the NOHP&S identifies the DHIS as the central system for national OH surveillance, existing output-based indicators, such as service volumes for extractions, restorations and fissure sealants,³ offer limited insight into disease status, care quality, outcomes, or equity. The lack of recent national epidemiological data remains a major obstacle to evidence-informed planning, given that the last national OH survey was conducted over two decades ago.⁵ In contrast, the WHO advocates for strengthened surveillance with standardised indicators including DMFT, untreated decay rates, edentulousness, modifiable risk factors and access-related measures.²⁶ The NOHP&S recognises this gap and proposes data quality improvements and a future national survey; however, the absence of a clearly defined OH research agenda limits the potential for continuous evidence generation and learning within the system.

The NOHP&S does however demonstrate strong alignment with the WHO Global Strategy in terms of the conceptual direction and strategic intent, particularly in its commitment to prevention, PHC integration and equity.³ However, longstanding systemic constraints relating to funding, workforce disparity, surveillance weaknesses and inadequate preventive reach raise significant concerns about implementation feasibility. Without focused investment, operational reforms and strengthened governance to ensure

accountability, global alignment is at risk of remaining largely symbolic. Therefore, meaningful improvements in OH outcomes may only be realised if these policy commitments are matched by context-sensitive implementation strategies which respond directly to the realities of SA's diverse and unequal health system.

2.4 Process Analysis: Implementation, monitoring and evaluation of the NOHP&S (2024-2034)

The NOHP&S (2024-2034) was developed through a consultative and collaborative process, engaging with a spectrum of stakeholders, including provincial health departments, professional associations, training institutions, and NGOs.³ This consultative approach was aimed at enriching the policy's formulation by incorporating diverse perspectives and expertise to outline the processes that should facilitate implementation, as well as monitoring and evaluation of the NOHP&S.

Despite the structured approach of the NOHP&S, systemic inefficiencies in OH service delivery within SA's public OH clinics¹⁰ remain a significant challenge for policy implementation. While the policy outlines "strategies and an implementation plan",³ these remain broad and lack specific operational details, which make successful implementation uncertain. A policy's success ultimately depends on practical implementation,¹⁸ yet in SA, limited political will and budgetary constraints frequently delay the rollout of key initiatives, and hinder the ability of many programmes to achieve their intended impact within the proposed timeframe.¹⁵ Therefore, as emphasised by the WHO,⁷ the development of national roadmaps are essential for securing commitment, establishing priority areas, and accelerating the implementation of both national and global OH strategies.

Beyond the fragmented service delivery in OH care, a major challenge in the implementation process is the reliance on cross- and inter-sectoral coordination, which has historically been a weak link in SA's healthcare system. Research by Skeen *et al.*,⁷ suggested that strong political commitment and leadership from the health sector are necessary to advocate for inter-sectoral collaboration and improve coordination between key stakeholders. The lack of cohesion in governance structures negatively impacts policy integration, funding distribution,²⁸ and the alignment of OH initiatives with broader healthcare priorities, further complicating the implementation of the NOHP&S.

Moreover, at provincial and district levels, the absence of clearly defined OH leadership roles with the appropriate dental qualifications and authority presents an additional barrier to effective policy implementation. The NOHP&S does not explicitly outline mechanisms to support and strengthen OH leadership at these levels, leaving a significant gap in accountability and oversight. Additionally, fragmentation in governance weakens coordination between national, provincial, and district health authorities, move SA further away from achieving UHC and increases the risk of inconsistencies in policy execution, resource allocation, and service delivery.²⁹ Addressing these structural weaknesses is essential for ensuring that the NOHP&S achieves its intended outcomes and contributes to equitable, effective, and sustainable OH care services in SA.

To track progress and ensure accountability, the NOHP&S established a monitoring and evaluation (M&E) framework, which outlines timelines for regular monitoring, mid-term

reviews, and final evaluations for each goal and objective.³ The DHIS is the primary tool for monitoring, with key performance indicators KPIs that were derived from the National Clinical Data Elements and has been proposed to assess service delivery outcomes and identify areas for improvement.³ However, concerns persist regarding the effectiveness and relevance of these health indicators, as they primarily rely on basic counts rather than comprehensive quality measures. Issues related to data accuracy, completeness, and the reliability of reporting mechanisms further undermine the DHIS's potential as a robust monitoring tool. Importantly, the data collection infrastructure at different levels of government may require significant strengthening to ensure accurate reporting, meaningful evaluation, and evidence-based decision-making.

Comprehensive M&E for health strategies, such as the NOHP&S, depends on a functional OH surveillance system which is integrated into a standardised and reliable OH information management system. OH in SA has long been ineffectively addressed, in large part due to the absence of a systematic surveillance strategy.^{4,5} Therefore, public health action, as envisioned in the NOHP&S, relies on linking surveillance data to planning, resource allocation, and policy revision. However, without contextually appropriate, standardised indicators, monitoring efforts risk becoming a procedural exercise rather than a transformative one.

3. POLICY CHALLENGES, GAPS AND BARRIERS

The integration of global OH initiatives into SA's NOHP&S is hindered by a complex set of structural and systemic challenges. These include misconceptions about cost, limited technical capacity, weak health information systems, regulatory deficits and longstanding socioeconomic inequalities. Collectively, these barriers have implications for the feasibility, effectiveness and equity of OH service delivery. Figure 3 outlines the relationship between key policy gaps, their implications on implementation and their broader systemic consequences.

This figure illustrates the major policy barriers affecting oral health integration in SA's NOHP&S, the resulting implementation-level implications, and the broader consequences for health system performance and equity. The framework highlights that upstream policy weaknesses translates into downstream service delivery failures and population-level disparities. For example, the NOHP&S fails to address the affordability of essential preventive OH products, such as fluoridated toothpaste. South Africa ranks among the countries with the highest toothpaste costs relative to average income.³⁰ This creates a substantial barrier to maintaining daily oral hygiene, particularly for low-income populations. It is a critical omission in the policy, which could have considered measures such as subsidies, pricing regulations, or public-private partnerships to improve access and affordability to this essential item.

Furthermore, a key obstacle is the resistance to change, which may arise at organisational, political, and technical levels, whereby stakeholders hesitate to embrace transformative shifts in health policy. Industry opposition compounds this challenge, particularly from sectors such as the sugar industry, which are resistant to public health efforts to reduce sugar consumption. Countries with strong commercial links to these industries may oppose health

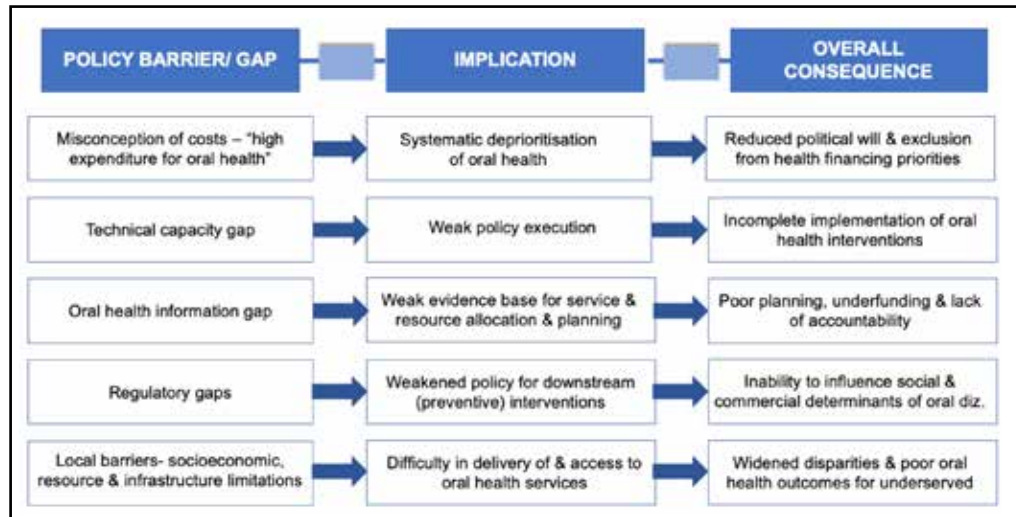


Figure 3: Policy barriers of the NOHP&S

promotion policies aimed at reducing population sugar intake. Additionally, competition among advocacy groups could impede progress, whereby established health sectors may resist incorporating new disease prevention measures, with a fear that additional health priorities could divert funding away from their causes.²

CONCLUSION

Persistent socioeconomic disparities, resource constraints, and infrastructure limitations within SA's public health system¹⁵ present major challenges to the equitable implementation of the NOHP&S. The current fragmented and predominantly extraction-based model of OH service delivery falls short of the preventive and comprehensive care envisioned in the policy. These structural barriers have created a two-tiered system, where access to OH services is largely determined by geography and socioeconomic status. This undermines SA's commitment to UHC, and may further erode the public trust in the health system's capacity to address the needs of marginalised populations. Misconceptions about cost and the poor prioritisation of oral health, combined with limited advocacy and leadership, have resulted in its continued marginalisation in health planning and budgeting. Consequently, OH continues to be chronically underfunded and excluded from major health platforms, reinforcing inequities in access and outcomes.

A shift from aspiration to implementation urgently requires a clear implementation roadmap. This roadmap must be supported by a comprehensive policy capacity analysis that assesses the feasibility of implementation across governance, financing, human resources, infrastructure, data, and community engagement. This assessment will identify systemic weaknesses, highlight opportunities for integration, and ensure strategic resource allocation.³¹ Without these foundational steps, the NOHP&S risks remaining a symbolic commitment rather than a transformative strategy for improving OH outcomes in SA.

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Non-surgical Correction of Adult Class III Malocclusion Using a Fixed Orthodontic Lower Tongue Gate with Myofunctional Therapy: A Case Report

SADJ JUNE 2026, Vol. 81 No.5 P343-P348

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ABSTRACT

Objective

To report a non-surgical approach for treating borderline skeletal Class III malocclusion in an adult patient using fixed orthodontics, a lower tonguegate appliance, and myofunctional therapy to improve occlusion, facial aesthetics, and tongue posture.

Diagnosis and treatment planning

A 34-year-old Black African female presented with the chief complaint of "lower front teeth sticking out." Examination revealed a concave facial profile, a Class III molar, and canine relationships, negative overjet of 2.5 mm, anterior open bite of 2 mm, and mild maxillary and mandibular crowding. Cephalometric findings indicated mild maxillary retrognathia (SNA 83°), mandibular prognathism (SNB 82°), and a Wits appraisal of -8.7mm. A low tongue rest position was noted.

The treatment objectives were to achieve Class I molar and canine relationships, correct overbite and overjet, control tongue posture, improve smile aesthetics, and maintain stability. The patient declined orthognathic surgery due to fear of surgical procedures, as well as the added financial burden. Treatment began with full fixed appliances (0.018" edgewise) and myofunctional therapy. Class III elastics were applied. After 12 months with minimal dental change, a lower tongue gate was fabricated to limit the anterior tongue pressure, combined with continued elastics.

Results

Within six months of lower tongue gate use, positive overjet and overbite were achieved. Cephalometric changes included improved upper incisor inclination (U1-NA from 20.5° to 26.2°), reduced lower incisor proclination (L1-NB from 26.5° to 24.0°), and Wits improvement to -6.9 mm. The soft tissue profile improved, with the nasolabial angle increasing from 78.5° to 86.0°. The patient reported improved confidence and function, with no adverse effects on speech or mastication from the tongue gate appliance.

Retention included fixed 3-3 retainers, ESSIX® appliances, and continued myofunctional exercises to improve tongue posture by a Speech and Language therapist.

Conclusion

Integrating a lower tongue gate with fixed orthodontics and myofunctional therapy can be an effective non-surgical option for adult borderline Class III malocclusion by improving the dental occlusion and facial profile through addressing the tongue posture.

Keywords

Class III malocclusion, myofunctional therapy, tongue gate appliance, non-surgical adult treatment, tongue normal position, case report

LITERATURE REVIEW

The prevalence of Class III malocclusion among US adults is 7.3% in Blacks and 4.3% in Whites. This underscores the importance of adult-specific, individualised orthodontic diagnosis, long-term treatment planning, and resource allocation for managing adult malocclusion.¹ Class III malocclusion diagnosis, prognosis, and treatment have always been a challenge for clinicians.² Normal occlusion and improved facial aesthetics can be achieved in skeletal Class III malocclusion through growth modification, orthodontic camouflage, or orthognathic surgery. Orthodontic treatment, combined with orthognathic surgery, remains a highly recommended treatment option for adult patients with moderate and severe skeletal Class III malocclusion.³ However, challenges would arise when distinguishing between borderline and surgical-orthodontic Class III malocclusion cases.⁴ The differential diagnosis of the various skeletal topographies associated with underlying Class III malocclusion is due to discrepancies in maxillary and mandibular growth, as well as to vertical and/or transverse problems.⁵ Researchers described cephalometric analysis parameters to identify the severity of Class III malocclusions, which employ skeletal analysis of the ANB angle, Wits appraisal, and soft tissue analysis, including the Ricketts Esthetic E-line.^{6,7}

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1. E Ghabrial – Conceptualisation, retrieved the case, writing, referencing and editing: Main author 70%
2. Peter Sethusa – Clinician writing and editing: Co-author 20%
3. Maxine Lundall – Clinician writing and editing article 10%

Another diagnostic challenge is differentiating between true Class III malocclusions and pseudo-Class III malocclusions, which are caused by premature occlusal contacts leading to functional forward positioning or mandibular shifting at centric occlusion.⁸ The primary differential diagnosis in patients with pseudo-Class III malocclusion occurs when the mandible is guided into a normal centric relationship, allowing for a normal overjet or an edge-to-edge position of the incisors to be achieved.⁸

The aetiology of Class III malocclusion is wide-ranging and complex, with both environmental and genetic contributions.⁹ The multifactorial aetiology is due to the expression of a distortion of normal development as a result of the interaction between innate factors or genetic heredity with environmental factors, resulting in various skeletal topographies of underlying Class III malocclusion, which result from discrepancies in the maxillary and mandibular growth along with vertical and/or transverse problems.⁵ Orofacial myofunctional dysfunction (OMD), including breathing, chewing, swallowing, sleep, tongue, and speech disorders are a promoting factor for malocclusions.^{10–12} Not only are children affected by OMDs, but a high number of adults receiving orthodontic treatment, who present with dental malocclusions and temporomandibular joint disorders, also experience symptoms of OMDs, such as chewing, breathing, and speech issues.^{13, 14} The influence of the tongue must be considered and investigated carefully, since the action of the tongue is responsible not only for open bites but also for Class III malocclusions.^{10, 14} Primožic *et al* demonstrated that individuals with Class III malocclusion exhibit significantly lower tongue posture compared to those with Class I malocclusion.¹⁵ In addition, their study revealed that tongue posture, across all skeletal classes, is intricately related to the proportional relationships between the dental and alveolar components of the maxilla and mandible.¹⁵

These findings highlight the importance of incorporating tongue posture and function evaluation into orthodontic diagnostics, particularly in the management of skeletal Class III and open bite malocclusion.¹⁶ It is imperative that the orthodontist appraise muscle activity and that they conduct their orthodontic therapy in such a manner that the finished result reflects a balance between the structural changes obtained and the functional forces acting on the teeth and investing tissues at that time.¹⁷

Artese *et al*.^{18, 19} reported that tongue gate appliances such as palatal cribs and lingual spurs are effective in disrupting abnormal tongue thrust and rest posture.^{18, 19} While cribs act as physical barriers, spurs provide proprioceptive feedback. When combined with myofunctional therapy, these appliances facilitate adaptive tongue positioning and enhance long-term occlusal stability.^{18, 19}

In this paper, a multidisciplinary orthodontic treatment management approach was applied to correct a negative overbite in an adult with a diagnosed skeletal and dental Class III malocclusion, utilising a fixed orthodontic appliance combined with a lower tongue gate appliance and myofunctional treatment performed by a Speech-Language pathology therapist.

PATIENT HISTORY

A 34-year-old adult Black African female presented with a chief complaint of “lower front teeth sticking out”. Her medical

history was non-contributory, and she reported no history of temporomandibular joint (TMJ) pain or parafunctional habits. Oral hygiene was consistently maintained at a reasonable level, with no active caries or periodontal disease noted at the time of presentation. The patient reported that her malocclusion had been present and untreated since adolescence.

CLINICAL EXAMINATION

The patient's profile was concave (Figure 1). The lower lip was prominent, and the lips were incompetent. The vertical facial proportion was moderate, and no asymmetries were observed. In both centric occlusion (CO) and centric relation (CR), molar and canine relationships were Class III, and the incisors had an anterior cross bite with a negative overjet of 2.5 mm. The curve of Spee was mild with an open bite of 2 mm in the 22 area (Figure 1). A space shortage of 4 mm was found in the maxillary arch and 2 mm in the mandibular arch, with a Bolton discrepancy of 0.80 in the anterior segment and 0.95 in the overall arch. These figures suggest a discrepancy in tooth size in the maxillary arch owing to the small size of the lateral incisors. A lower tongue rest position, without a tongue tie, was noticed and confirmed by the patient when asked where the tongue tip rested. The absence of a diagnosis of functional shift and the presence of a lower tongue rest position direct the treatment towards addressing the underlying myofunctional disorder, which affects skeletal and dental relationships directly.

The pre-treatment cephalometric, characterised by mild maxillary retrognathia (SNA 83°) and mandibular prognathism (SNB 82°). The Wits (-8.7 mm) indicated CL III skeletal relationship. Vertical dimension cephalometric analysis revealed an SN-GoME angle of 37.0°, and the Y-axis of 72.0°. Increased lower facial height to 60.2% (Table I), suggesting a mild vertical growth pattern. Furthermore, the maxillary incisors were retroclined (U1-NA 20.5°), while the mandibular incisors were proclined (L1-NB 26.5°) as characteristics of skeletal Class III malocclusion (Table I). The cephalometric soft tissue measurements, a facial contour angle of -1.3°, and a Holdaway angle of 10.6°, indicated a protrusive lower jaw. The distance from the lower lip to the E-line was 3.7 mm, also indicating a protrusive lower lip, consistent with the CLIII facial profile.

TREATMENT OBJECTIVES

- (1) to establish Class I canine and molar relationships.
- (2) to control the tongue posture;
- (3) to correct overbite and overjet;
- (4) to provide an aesthetic smile; and
- (5) to reduce relapse tendency.

TREATMENT ALTERNATIVES

The first treatment option was to prepare the patient for an orthodontic fixed appliance in combination with orthognathic surgery. The second option, a non-surgical option, uses Class III mechanics combined with myofunctional therapy. According to the treatment progress evaluation, a lower tongue gate could be recommended. The patient agreed on the non-surgical option, which has been commenced as follows:

TREATMENT PROGRESS

1. Orthodontic combined with myofunctional treatment phase

- Full fixed appliances (0.018" edgewise) were bonded in both arches.

- The myofunctional therapy was provided by a speech therapist and consisted of a structured programme of approximately six to seven sessions aimed at correcting abnormal oral habits and tongue posture. Therapy progressed in stages, beginning with assessment of nasal breathing and bite function, followed by training in correct tongue-tip and blade positioning, bolus control during swallowing, saliva management, liquid swallowing, and, later, structured food-chewing patterns. A reinforcement phase of approximately 8–10 weeks was then used to help establish the new functional habits and encourage self-monitoring. Orthodontic input involved supporting tongue posture correction, monitoring dental changes, and coordinating management with the speech therapist to improve functional and occlusal outcomes
- After the 7s were bonded, advancement to 0.017x0.022" stainless steel and Class III elastics (3/16", 4.5 oz.) were used to correct Class III malocclusion.
- After 12 months, re-evaluation of the treatment progress showed no improvement in the Class III discrepancy, and a lower tongue gate appliance was discussed as a last resort to avoid the surgical option.

2. Tongue gate appliance placement

- An intraoral scan was obtained, and the lower tongue gate was laboratory-manufactured
- The design included a fixed lower tongue gate wire along the lingual surface of the mandibular incisor teeth and soldered to the lower first molar bands. (Figure 4)

3. Inter-arch mechanics: Class III correction

- Lower tongue gate was cemented on the lower first molars (Figure 4) and continuation of Class III elastics (3/16", 4.5 oz.) to correct the Class III molar and canine relationship.
- The Class III malocclusion was corrected within six months using a lower tongue gate and

- Class III elastics, resulting in a Class I molar and canine relationship, as well as a positive overjet and overbite.

4. Finishing and retention planning

- After creating mesial and distal spaces for teeth 12 and 22, the patient was referred to a dentist for the build-up of 12 and 22 to correct the Bolton discrepancy.
- Finishing and detailing were performed using light elastics and arch coordination.
- A retention protocol with a fixed 3-3 retainer and ESSIX® retainers was prescribed, along with myofunctional exercises to maintain results.

An informal post-treatment discussion with the patient was conducted, focusing mainly on comfort, adaptation to the appliance, and the patient's perceived benefits from the lingual tongue gate appliance. The patient reported positive adaptation to the appliance and noticed improvement in biting function

TREATMENT RESULTS

The treatment plan was a satisfactory non-surgical alternative, and the treatment objectives were achieved (Figure 2 and Table 1). Correction of malocclusion was achieved through skeletal and dentoalveolar adjustments. A Class I canine and molar relationship was established with good alignment. A positive overjet and overbite were established. The teeth position was controlled while the mandibular incisors were retracted, resulting in improved incisor inclination after treatment. The maxillary incisors were slightly proclined, resulting in an improvement of upper lip prominence and a better facial profile was achieved. Skeletal cephalometric measurements showed improvement, which may be attributed to corrected tongue posture and functional adaptation contributing to slight positional changes, including possible condylar repositioning and improvement in the

Table 1: Pre-treatment and post-treatment cephalometric measurements

	Measurement	Norm	Pre-treatment	Post-treatment
Maxilla	SNA (°)	84.7°	83.0°	83.0°
	Convexity (mm)	5.7	1.2	2.0
Mandible	SNB ° ()	81.0°	82.0°	81.0°
	Facial Angle (°)	88.3°	95.5°	94.4°
	Pog-NB (mm)	2.4	-0.9	-2.8
Intra-arch	ANB (°)	1.6°	1.0°	2.0°
	Wits (mm)	-1.0	-8.7	-6.4
Vertical dimension	SN-GoME/MPA ()	32.0°	37.0°	39.0°
	Y-Axis (°)	67.0°	72.0°	72.0°
	UFH (%)	46.0	39.8	39.9
	LFH (%)	54.0	60.2	60.1
Dental	U1-NA (°)	22.8°	20.5°	26.2°
	U1-NA (mm)	4.3	5.6	8.0
	L1-NB (°)	25.3°	26.5°	24.0°
	L1-NB (mm)	4.0	8.2	7.0
	Interincisal Angle (U1-L1)	123.0°	132.2°	127.6°
Soft tissue	Facial Contour Angle (°)	-9.5°	-1.3°	-3.3°
	Lower lip to E-line (mm)	5.0	3.7	4.1
	Holdaway angle (°)	8.0°	10.6 °	11.0°
	Nasolabial Angle (°)	102.0°	78.5°	86.0°

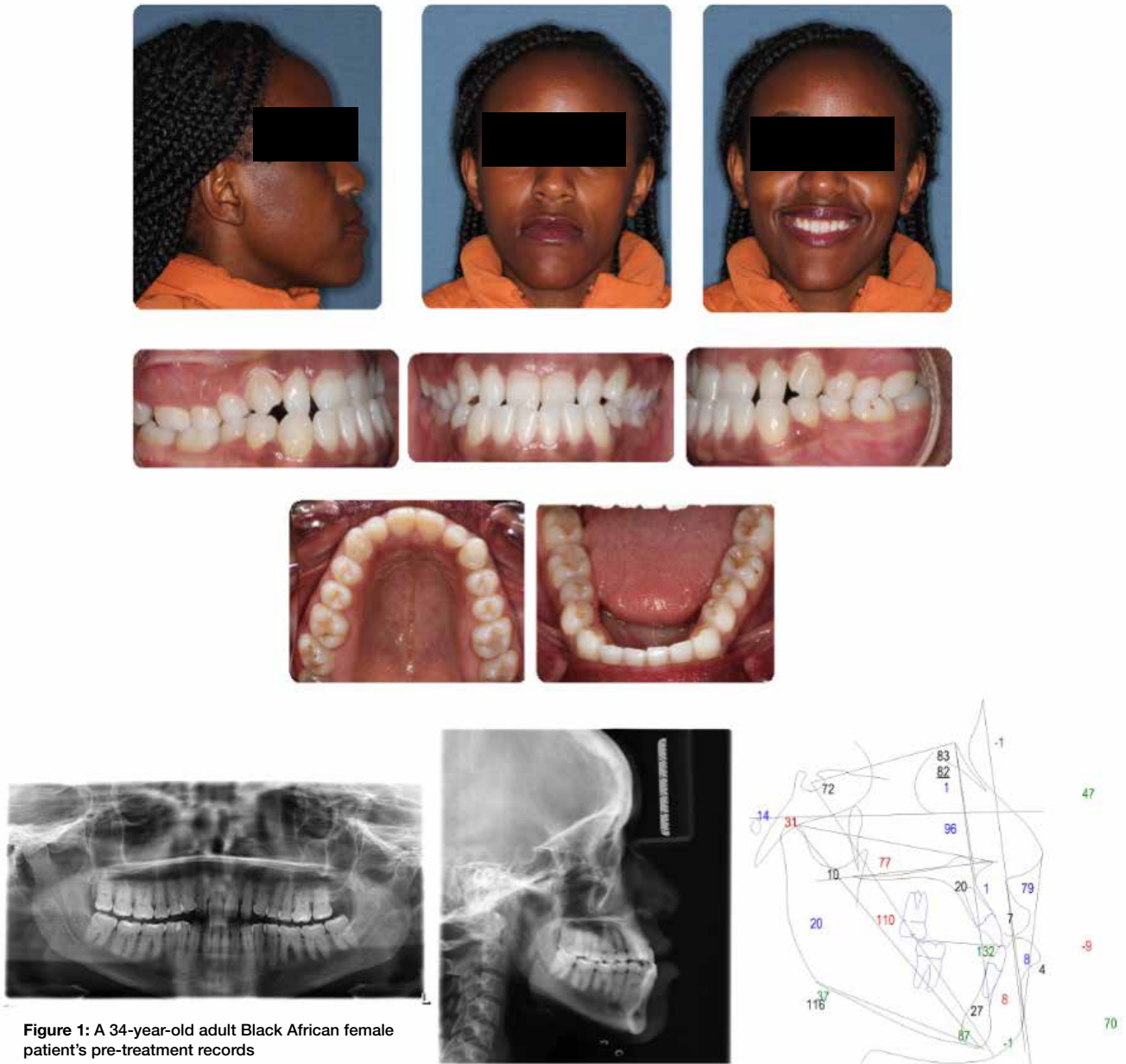


Figure 1: A 34-year-old adult Black African female patient's pre-treatment records

Class III relationship. No adverse TMJ effects were observed following treatment in the present case.

DISCUSSION

Assessing orofacial myofunctional disorder (OMD), researchers and clinicians employed various assessment methods, such as the Orofacial Myofunctional Evaluation with Scores (OMES), which comprises three subscales: appearance and posture, mobility, and function.¹⁴ Others use clinical evaluation, observing the lips and the position of the tongue during deglutition and rest, as well as the lingual frenulum and tongue position during the pronunciation of established phonemes.¹¹ In this case, we asked the patient about the tongue tip resting position and clinically observed its appearance and posture, noting any deviation from the normal resting position, where the tongue tip typically rests approximately 5 mm behind the upper incisors at the incisive papilla.²⁰

The treatment protocol for controlling tongue posture in CLIII malocclusion aligns with that of Arat and Arman, who use a tongue crib to alter tongue posture, which contributes to mandibular protrusion, increases mandibular length, and

promotes the development of anterior cross bite.²¹ In addition, in agreement with Zhao *et al.*, effective management of Class III malocclusion requires the integration of behavioural modification and myofunctional therapy to correct perioral muscular dysfunction.^{22,23}

The lower tongue gate, in this case, demonstrated stable results as it not only obstructs the tongue pressure of the patient towards the lower anterior teeth but also alters the tongue muscular activity, aligning with the findings from Taslan *et al.*, who concluded that tongue gate appliance wear results in a disturbance in intraoral pressure equilibrium and shows tongue adaptation to the new tongue resting and swallowing positions created by the appliance.²⁴ The tongue gate effect could be explained by limiting the contractions of the mylohyoid muscles, thus preventing protraction of the mandible.²⁵ This explanation of the CLIII correction also justifies diagnosing this case as a pseudo-Class III malocclusion.²⁶

A post-treatment cranial base superimposition of the lateral cephalometric radiograph with the pre-treatment tracing revealed predominantly horizontal posterior displacement

of the mandible (Figure 2). Dentally, both upper and lower incisors exhibited protraction, which contrasts with the typical camouflage treatment pattern involving maxillary incisor flaring and mandibular incisor retraction.²

Myofunctional therapy combined with fixed orthodontic appliances did not fully correct the malocclusion. Nonetheless, it would contribute to post-treatment stability after the use of a tongue gate appliance, consistent with findings reported in previous studies.^{19, 27, 28} This case report highlights the importance of multidisciplinary collaboration in managing malocclusion.¹⁹ In agreement with Deregibus, effective coordination between the orthodontist and the speech-language therapist is essential for addressing both simple and complex malocclusions in growing and non-growing patients.¹¹

Despite the advantages of using a lower fixed tongue gate, a key limitation is the patient's compliance and tolerance, which can affect the success of the treatment outcome.²⁰ Nine patient interviews were conducted with patients who received lower tongue gates to assess their experience with wearing the device. Of the participants, 86% reported an improvement in their bite alignment after using the lingual tongue gate appliance. In 92% of individuals, underbite and

overbite were reduced; 86% reported no adverse effect on masticatory function, and 92% stated that the lingual tongue gate appliance improved their confidence due to noticeable bite improvement. In agreement with Shams, the tongue gate appliance demonstrated similarities to tongue spurs in terms of speech adaptation, faster adjustment, eating comfort, aesthetics, and pain tolerance.²⁹ Notably, none of the interviewed patients expressed a desire to discontinue using the appliance due to the improvements achieved. Furthermore, prior patient education on the benefits of modifying tongue posture was reported to enhance acceptance and tolerance of the lingual tongue gate.

Clinicians should take into consideration the mandibular symphysis dimensions when treating patients with a vertical facial pattern as these patients are more likely to have narrow mandibular symphysis dimensions and may require surgery or corticotomy.³⁰ Such growth patterns have a tendency of rotating the mandible downward and backward leading to the development of an anterior open bite malocclusion.³¹

Orthodontic services should therefore be comprehensive, delivering appropriate treatment in response to specific situations, resulting in the efficient treatment of non-skeletal and skeletal problems.³²

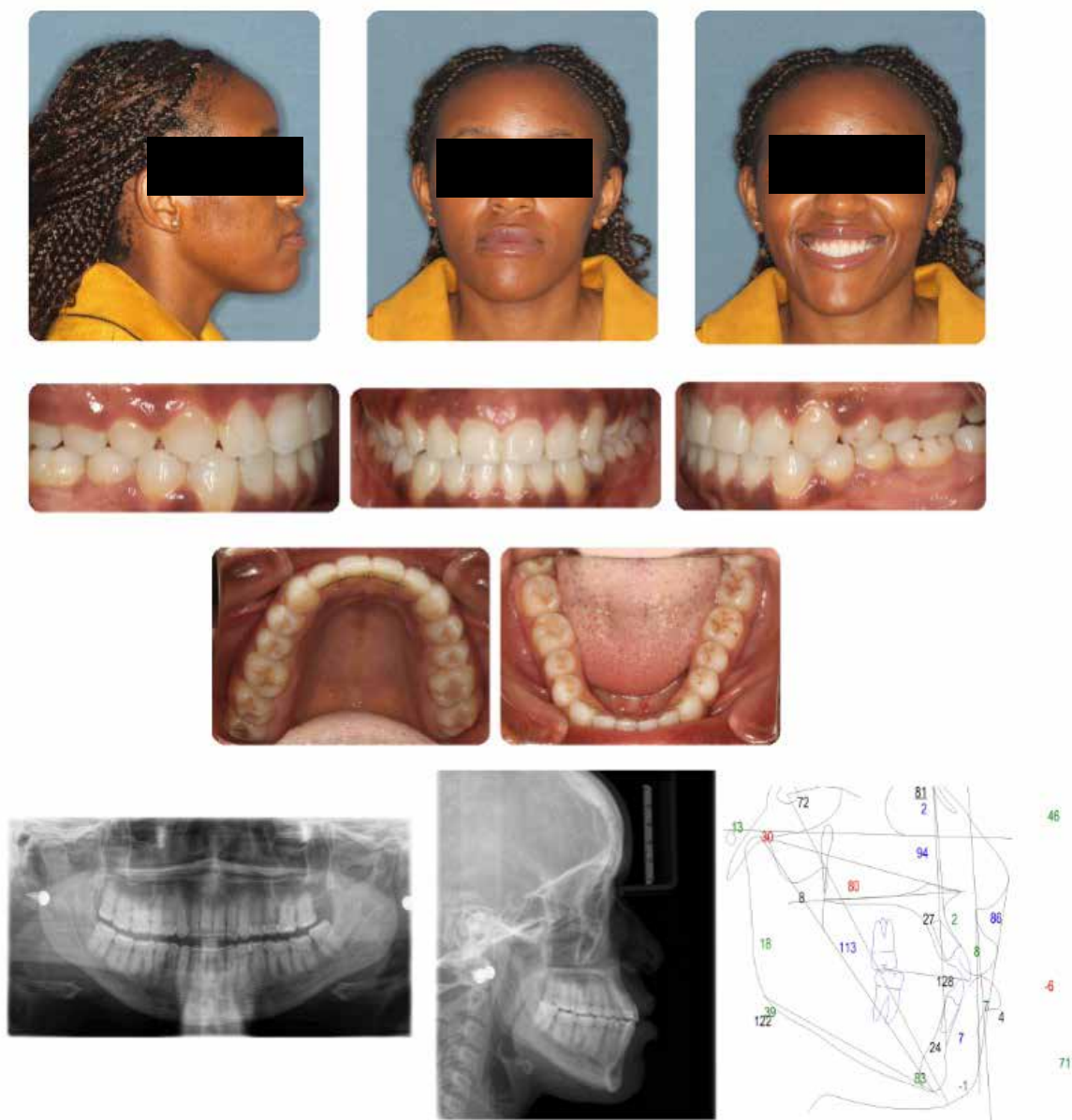


Figure 2: Post-treatment records



Figure 3: Intraoral lingual tongue gate appliance

CONCLUSION

This case report highlights a successful multidisciplinary approach between the orthodontist and the speech and language therapist in managing a borderline Class III malocclusion in an adult patient. The combination of a fixed lower tongue gate appliance, fixed orthodontics, and myofunctional therapy resulted in significant improvements in occlusal relationships, facial aesthetics, and post-treatment stability, thereby avoiding the need for surgery. The lower fixed Tongue Gate appliance was well tolerated and effective in modifying tongue posture, contributing to favourable mandibular repositioning. Long-term retention and regular follow-up monitoring of tongue posture remain essential for maintaining treatment stability. Overall, patient tolerance was high, and both functional and aesthetic outcomes were positive.

This report underscores the importance of adopting a multidisciplinary and functional approach in dental practice, moving beyond symptomatic treatment to address the underlying causes of skeletal and dental discrepancies, and restore optimal orofacial function.

LIMITATIONS AND CHALLENGES

While this case report presents valuable insights into the success of using a lower fixed tongue gate in combination with orthodontic treatment and myofascial therapy, it remains inherently limited in its contribution to evidence-based practice. Case reports represent the lowest level of clinical evidence due to their descriptive, non-comparative nature and lack of control over confounding variables.

Declaration of patient consent

The authors certify that they have obtained the appropriate patient consent form. In the form, the Patient gave her consent for images and/or other clinical information to be reported in the journal. The patient understood that their names and initials will not be published, and that due efforts will be made to conceal their identity; however, anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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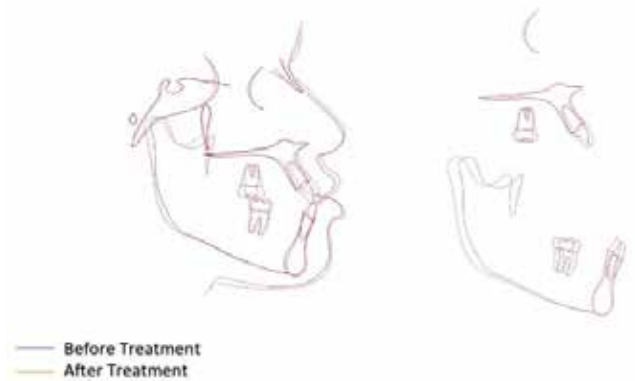


Figure 4: Superimposition (on the SN plane and registering on sella) of lateral cephalometric radiographs before and after treatment

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What's new for the clinician – summaries of recently published papers (June 2026)

SADJ JUNE 2026, Vol. 81 No.5 P349-P351

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1. DOES ENDODONTIC TREATMENT MODIFY SERUM INFLAMMATORY MARKERS OF CARDIOVASCULAR RISK IN INDIVIDUALS WITH ASYMPTOMATIC APICAL PERIODONTITIS? A SYSTEMATIC REVIEW AND META-ANALYSIS

Cardiovascular disease (CVD) remains the leading cause of mortality globally, responsible for approximately 32% of all annual deaths¹. The pathogenesis of atherosclerosis and subsequent cardiovascular events is increasingly understood as driven not only by traditional risk factors – smoking, hypertension, dyslipidemia, and diabetes but also by chronic low-grade systemic inflammation. Inflammatory biomarkers such as C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF- α) have emerged as independent predictors of cardiovascular risk, with elevated levels correlating strongly with endothelial dysfunction, plaque instability, and adverse cardiac outcomes.¹

Over the past two decades, the oral-systemic health paradigm has gained substantial traction, with particular attention devoted to the contribution of chronic oral infections to systemic inflammatory burden. While periodontal disease has been the most extensively studied oral condition in this context, asymptomatic apical periodontitis (AAP – a chronic inflammatory lesion of the periapical tissues resulting from pulpal necrosis – has recently attracted growing scientific interest. AAP is highly prevalent; epidemiological data suggest that at least one tooth with periapical radiolucency is present in approximately half of the global adult population¹. Crucially, AAP is frequently undiagnosed and untreated because it often progresses without clinical symptoms, representing a persistent, subclinical inflammatory nidus.

The biological plausibility linking AAP to systemic inflammation rests on three principal pathways: (i) transient bacteremia arising from the infected root canal system, permitting hematogenous dissemination of endodontic pathogens; (ii) systemic absorption of bacterial toxins and byproducts (e.g., lipopolysaccharides); and (iii) the sustained release of pro-inflammatory cytokines and mediators from the periapical lesion into the systemic circulation. Studies have documented elevated serum levels of IL-1 β , IL-6, IL-18, TNF- α , and CRP in individuals with AAP compared with healthy controls [8,9], suggesting that this “silent” infection may contribute to the maintenance of a chronic low-grade inflammatory state implicated in atherogenesis.

Whether endodontic treatment – root canal therapy or apical surgery – can reverse these systemic inflammatory perturbations remains a critical, clinically relevant question. Given the inconclusive nature of the evidence and the substantial public health implications, Silva Araújo and colleagues (2026)¹ conducted this updated systematic review and meta-analysis to evaluate whether endodontic treatment modulates serum inflammatory markers associated with cardiovascular risk in individuals with AAP.

METHODOLOGY

This systematic review and meta-analysis was conducted according to PRISMA 2020 guidelines and prospectively registered with PROSPERO. The authors employed a comprehensive PICO-driven search strategy across multiple electronic databases – PubMed/MEDLINE, Embase, Web of Science, Scopus, and the Virtual Health Library (VHL) – supplemented by grey literature sources (CAPES, ProQuest, Google Scholar) and manual screening of reference lists. The search was initially performed between October and November 2022, with an update in September 2025, imposing no language or date restrictions.

Eligibility criteria were deliberately broad to capture the limited available evidence: observational studies (cohort, case-control) and experimental designs (randomised and non-randomised clinical trials, including before-and-after studies) were included if they evaluated endodontic treatment effects on serum inflammatory markers in participants with AAP. Exclusion criteria appropriately eliminated cross-sectional studies, case reports, reviews, and studies involving acute endodontic conditions, systemic comorbidities, or uncontrolled behavioral risk factors that could confound inflammatory marker measurements.

Two independent reviewers conducted all screening, data extraction, and risk-of-bias assessments, with discrepancies resolved by a third reviewer. Risk of bias was evaluated using the Newcastle–Ottawa Scale (NOS) adapted for intervention studies, with studies scoring 7–9 stars classified as low risk, 4–6 as moderate risk, and 0–3 as high risk. The certainty of evidence was appraised using the GRADE approach. Statistical analysis employed a random-effects model with Mantel–Haenszel estimation to calculate pooled mean differences (MD) and 95% confidence intervals (95% CI). Heterogeneity was quantified using Cochran's Q-test and I² statistics.

Results

The systematic search yielded 6,295 records. Following duplicate removal, title/abstract screening, and full-text evaluation, 16 studies were assessed for eligibility and eight were included in the qualitative and quantitative synthesis. Two additional studies were identified through manual reference screening.

The included studies exhibited considerable methodological diversity: four employed a hybrid before-and-after design with cross-sectional healthy controls; two were before-and-after studies without internal controls; and two were preliminary intervention studies without controls. Sample sizes ranged from 11 to 115 participants (ages 18–75 years). Endodontic

protocols varied: six studies used conventional nonsurgical root canal treatment, one combined nonsurgical and surgical approaches, and one compared nonsurgical retreatment with apical microsurgery. Follow-up periods ranged from 7 days to 12 months. Twenty-three distinct inflammatory markers were evaluated, with CRP (7 studies), IL-1 (2), IL-6 (2), TNF- α (2), ICAM-1 (2), VCAM-1 (2), and complement C3 (2) being most frequently assessed.

All eight included studies were rated as having moderate risk of bias (NOS scores 4–6). According to GRADE, the certainty of evidence for all meta-analysed outcomes was rated as very low primarily due to non-randomized designs, lack of random allocation, and substantial heterogeneity and imprecision.

For studies incorporating control groups ($n=4$), all used healthy external controls. For the four studies lacking controls, the authors employed two strategies: (1) values from control groups of other included studies, and (2) established reference values for healthy populations. This methodological approach enabled inclusion of all studies in quantitative syntheses.

The pooled analyses suggested potential reductions in key inflammatory markers following endodontic treatment: C-reactive protein (CRP): pooled Mean Difference (MD) = 0.05 (95% CI: -0.01, 0.10) for self-controlled designs; pooled MD = 0.76 (95% CI: -0.15, 1.67) for external control designs. The confidence intervals included values approaching control group levels.

Interleukin-6 (IL-6): pooled Mean Difference (MD) = 0.81 (95% CI: -0.27, 1.90) for self-controlled designs, with post-treatment levels trending toward healthy control values.

Tumor necrosis factor-alpha (TNF- α): pooled Mean Difference (MD) = 1.04 (95% CI: -0.38, 2.46) for self-controlled designs, similarly approaching control levels post-intervention.

No significant differences were observed for the adhesion molecules ICAM-1; [MD = 32.15 (95% CI: 9.32, 54.99), self-control] or VCAM-1 [MD = 0.00 (95% CI: -0.00, 0.01), self-control] between groups before or after intervention.

Heterogeneity was substantial across all analyses ($I^2 > 50\%$, $p < 0.05$) and persisted despite subgroup analyses stratifying by control type (self-controlled vs. external control).

Conclusion

Silva Araújo and colleagues concluded that, despite limited and very low-certainty evidence, endodontic treatment appears to reduce serum levels of CRP, IL-6, and TNF- α in individuals with asymptomatic apical periodontitis, with post-treatment values approaching those of healthy controls. The authors appropriately temper this conclusion, emphasising that the high heterogeneity, moderate risk of bias across all included studies, and very low GRADE ratings preclude definitive causal inference. No effect was demonstrated for the endothelial adhesion molecules ICAM-1 and VCAM-1.

Implications for Practice

The findings provide modest support for the proposition that root canal treatment may confer benefits beyond local infection control and tooth preservation. Clinicians should recognise that untreated AAP represents not merely a localised dental pathology but potentially a contributor to systemic inflammatory burden. However, the very low certainty of evidence means that endodontic treatment should not be promoted primarily as a cardiovascular risk reduction strategy; rather, the possible systemic benefits should be considered an ancillary advantage of appropriate local therapy.

In summary, while this systematic review offers a tentatively encouraging signal that endodontic treatment may attenuate systemic inflammatory markers associated with cardiovascular risk, the evidence remains insufficient to alter clinical guidelines or justify treatment decisions on systemic grounds alone. It does, however, reinforce the broader principle that oral health is inseparable from systemic health and provides a compelling rationale for continued research investment in this domain.

Reference

1. Silva Araújo, R., Abreu Fonseca Thomaz, E.B., da Silva Magalhães, E.I. *et al.* Does endodontic treatment modify serum inflammatory markers of cardiovascular risk in individuals with asymptomatic apical periodontitis? a systematic review and meta-analysis. *Clin Oral Invest* 30, 214 (2026)

2. COMPARATIVE EVALUATION OF THE CYTOTOXIC EFFECTS OF FLUORIDATED AND NON-FLUORIDATED TOOTHPASTE ON THE BUCCAL MUCOSA: A 12 WEEK FOLLOW UP – A RANDOMISED CONTROLLED STUDY

Fluoride remains the cornerstone of modern caries prevention, with its incorporation into toothpastes, mouthwashes, varnishes, and professional gels representing one of public health dentistry's most successful interventions. The World Health Organisation, dental associations worldwide, and extensive systematic evidence consistently support the use of fluoride dentifrices for reducing dental caries incidence across all age groups¹. Standard fluoride concentrations in over-the-counter toothpastes typically range from 1,000 – 1,500 ppm, while prescription formulations may exceed 5,000 ppm. Despite decades of proven efficacy, fluoride safety—particularly at higher concentrations and with chronic exposure—continues to generate scientific debate and public concern.

The oral mucosa serves as the primary interface between the external environment and systemic circulation, functioning

as both a protective barrier and a site of active absorption. Buccal epithelial cells, in particular, are exposed to topical agents during oral hygiene procedures and can accumulate fluoride, potentially serving as a long-term reservoir¹. This biological reality raises legitimate questions about whether routine, twice-daily exposure to fluoridated toothpaste over years or decades may exert subtle cellular effects that remain undetected by conventional clinical examination.

Micronucleus formation in exfoliated buccal cells has emerged as a validated, minimally invasive biomarker for genotoxicity and chromosomal instability. Micronuclei originate from acentric chromosome fragments or whole chromosomes that fail to segregate during mitosis, reflecting DNA damage, impaired DNA repair, or mitotic spindle dysfunction¹. The buccal micronucleus cytome assay, typically employing Papanicolaou or Giemsa staining, offers a practical method

for monitoring environmental and occupational genotoxic exposures in human populations. Beyond micronuclei, nuclear abnormalities – including binucleation, nuclear buds, karyorrhexis, and pyknosis – provide complementary information about cytotoxicity, chromosomal loss, and apoptotic processes.

Previous investigations into fluoride genotoxicity have yielded inconsistent findings. In vitro studies and animal models have reported DNA strand breaks, chromosomal aberrations, and micronucleus induction at various fluoride concentrations. However, human in vivo evidence remains limited and contradictory. Some researchers have identified increased micronuclei frequencies in populations consuming high-fluoride drinking water, while others found no genotoxic effect from fluoride varnish applications or standard toothpaste use. This inconsistency likely reflects variations in fluoride formulation, concentration, exposure duration, tissue type examined, and methodological rigor.

Compounding the complexity, commercial toothpastes contain numerous excipients beyond fluoride—abrasives (silica, calcium carbonate), surfactants (sodium lauryl sulfate), humectants, binders, flavoring agents, and preservatives – that may independently or synergistically influence mucosal cell integrity. Sodium lauryl sulfate, in particular, has been associated with mucosal irritation, desquamation, and nuclear morphological changes in prior studies [8]. Disentangling fluoride-specific effects from formulation-dependent effects represents a significant methodological challenge.

The growing consumer interest in “natural,” fluoride-free oral care products has intensified the need for robust comparative safety data. While non-fluoridated alternatives containing hydroxyapatite, essential oils, or herbal extracts have gained market share, their relative biological safety profiles remain inadequately characterised. Clinicians require evidence-based guidance to counsel patients – particularly those with mucosal sensitivity, existing oral pathologies, or heightened concern about chemical exposure – on dentifrice selection without compromising caries prevention.

Against this backdrop, Ravindran and colleagues conducted a 12-week randomised controlled trial comparing the cytotoxic effects of a fluoridated toothpaste (1,400 ppm sodium fluoride) versus a non-fluoridated alternative on buccal mucosal cells. This study addresses an important gap by providing prospective, parallel-group human data on a clinically relevant exposure scenario.

Methodology: This prospective, double-blind, parallel-group randomised controlled trial enrolled 40 systemically healthy adults aged 18–50 years from a single dental institution in India. Participants were randomly allocated via envelope method to either a fluoridated toothpaste group (Parodontax, 1,400 ppm fluoride as sodium fluoride 0.31% w/w; n=20) or a non-fluoridated group (n=20). Exclusion criteria appropriately eliminated smokers, alcohol consumers, pan masala users, pregnant or lactating women, patients undergoing radiotherapy, those with systemic illness, and individuals using additional fluoride products or undergoing dental treatment that could confound mucosal status.

The intervention required twice-daily brushing for two minutes using the modified Bass technique with a provided soft-bristled manual toothbrush and pea-sized toothpaste quantity

over 12 weeks. Compliance was monitored through periodic follow-up visits and verbal confirmation, though objective measures (e.g., returned tube weighing) were not employed. No washout period preceded the intervention, and baseline cytological assessments were not performed—a significant methodological limitation. Post-intervention buccal mucosal cells were collected via Cytobrush, fixed in 95% alcohol, and stained using the Papanicolaou method. Micronuclei frequency, cellular changes (binucleation, nuclear buds), and nuclear alterations were quantified microscopically with ImageJ software analysis.

Results

The study achieved balanced baseline demographics with a mean participant age of 34.4 years and no significant between-group differences in age or gender distribution. Intragroup analysis revealed no statistically significant increase in cellular changes for either the fluoridated ($p=0.087$) or non-fluoridated ($p=0.370$) groups over the 12-week period. However, intergroup comparison demonstrated a statistically significant increase in cells with cellular changes in the fluoridated group ($p=0.048$), suggesting a fluoride-associated effect.

Nuclear changes were not statistically significant within the fluoridated group ($p=1.000$) but reached significance within the non-fluoridated group ($p=0.033$)—a counterintuitive finding. The intergroup comparison showed no significant difference ($p=1.000$).

The most robust finding was a highly significant difference in micronuclei frequency between groups ($p=0.0001$), with the fluoridated group exhibiting elevated frequencies. A strong negative correlation existed between toothpaste type and micronuclei count ($r=-0.853$, $p=0.000$), indicating that non-fluoridated toothpaste use was associated with fewer micronuclei. A moderate negative correlation between toothpaste type and cellular changes ($r=-0.361$, $p=0.022$) further supported this pattern.

Neither gender nor age significantly influenced micronuclei or cellular changes. A weak negative correlation between gender and nuclear changes ($r=-0.326$, $p=0.040$) suggested minor sex-related differences in nuclear alterations, though this finding was isolated and of uncertain clinical relevance.

Conclusion: The authors conclude that fluoridated toothpaste use over 12 weeks is associated with significantly increased micronuclei frequency and cellular changes in buccal mucosal cells compared with non-fluoridated alternatives, implying cytogenetic damage. They acknowledge that nuclear changes were paradoxically significant only in the non-fluoridated group, and that intergroup differences in nuclear changes were absent. The study emphasises that while fluoride's caries-preventive benefits are well-established, its potential mucosal cytotoxicity warrants consideration, particularly with prolonged exposure to higher concentrations.

Implications for Practice

The statistically significant increase in micronuclei frequency in the fluoridated group represents the study's most compelling finding. Micronuclei are established biomarkers of chromosomal damage with recognised relevance to carcinogenesis risk assessment. However, the clinical significance of elevated buccal micronuclei from a 12-week toothpaste exposure remains uncertain. The buccal mucosa

The mark of our ethics on patient care

SADJ JUNE 2026, Vol. 81 No.5 P352-P353

Dr Martin Foster, Dentolegal Consultant at Dental Protection, explores how 'ethical fingerprints' leave marks that could cause trouble for dental practitioners and patients.

We are no strangers to the concept of fingerprint identification as a means of establishing who was where and what they did. Fingerprinting has a surprisingly long history. The Ancient Babylonians recorded in clay the 'prints' of arrested felons. In the modern era, from the 1890s fingerprints have been used in evidence to tie an individual to a place or an action. (Interestingly, one of the first cases which turned on fingerprint evidence, that of Henri Scheffer in France in 1902, involved a murder on the premises of a dentist.)

What are ethics?

Ethics can be thought of as the framework of principles accepted by an individual or a group as guiding acceptable, expected conduct. It is a complex area involving the concepts of conscience, belief systems, right and wrong, and codes of behaviour. We may do our best to behave ethically but we are all human. Sometimes people do the 'wrong' thing through self-interest, convenience, pressure or succumbing to temptation. Circumstances can also lead to an individual doing a bad thing but for what seems like a good reason. We have all seen (and enjoyed) films where the 'baddies' get their comeuppance as a result of the 'goodie' doing something that is not merely ethically questionable but is just downright bad – but somehow, we don't mind this because it seems ok in the circumstances.

So, it is possible to recognise something as 'bad' while at the same time excusing or even condoning it. From this it is not too much of a stretch to suggest that given the right circumstances we are all capable of straying. Is it more moral to observe the rules or to help a loved one in need? This is the stuff of ethical dilemmas that often involve choices which are not simple.

Whose interests matter most?

In clinical practice there is an expectation that we put our patients' best interests first, but does that mean sacrificing our own? As a business, a practice needs to stay solvent and it is in nobody's interests if the practice is not run in a sustainable fashion. Dentistry straddles a tricky fault line. There is a need to combine effective healthcare with commercially efficient operating. The demands of these two potentially conflicting drivers can create an intense ethical pressure on the clinician. In the commercial field, goods and services can be thought of as falling into three categories. Search, Experience and Credence.

"Search" purchases are those where a consumer makes the purchase based upon the known usefulness of the item (e.g. a car or a kettle). "Experience" purchases are, as the name suggests, based upon previous knowledge and exposure to that good or service (e.g. a meal or hair appointment). "Credence" purchases are where the consumer has limited understanding of the details or benefit of what is recommended and has to rely upon the advice of the technical expert. The information asymmetry makes the consumer reliant upon trusting the expert.

This may be good for the expert but with such settings there is the risk of temptation to provide less than ideal recommendations. A faulty computer, for example, might not need quite as much work as has been suggested and the consumer is at the mercy of the integrity of the provider. Knowledge is power

In the dental setting it can sometimes manifest as either under-treatment, where the patient really requires an intervention that is complex, time-consuming or technically challenging but only receives much simpler treatment, or over-treatment where the intervention suggested is more than the situation really warrants.

Where one party has the upper hand in terms of information there can be a temptation to act in his or her own interest. A practitioner keeping a business afloat can be torn between putting patient interests first and the demands of running a business successfully. There can be a conflict between the interests of the parties, which needs to be recognised.

There are distorting factors at play in ethical decision-making. These can include imperatives to hit certain targets, to upsell, to increase throughput or concentrate on high value treatments. Working at a loss will obviously be unsustainable for any business but commercial viability should not come at the cost of ethical sacrifice, as there are risks for both patients and clinicians.

One risk is from raised expectations and the patient not having the full picture regarding options. Credence involves trust and the information asymmetry mentioned above can create circumstances where patient choice can be distorted.

The public is hugely influenced by advertising and marketing. There are ever-increasing expectations around aesthetic dentistry. Some patients feel this will have transformative effects and improve not just their smile but their opportunities, life choices and popularity. Impressive as your dentistry might be, meeting these sorts of aims is a bit of a tall order. Although you may not want to deflate their dreams it is important to manage patient expectations with very clear communications. What we know is that failure in communication is a predominant factor in the vast majority of dental complaints and claims.

A particular risk from the demands brought to the practice by patients is that of patient-led care with a focus on high value treatment. With a willing consumer, the provider of credence purchases can easily, and inadvertently, move into the realm of over-selling, over-promising and over-treatment. The combination of wanting to accommodate a patient's wishes, stretching our technical skills and needing to pay the bills can be a powerful mix. It can lead to going along with, or even encouraging, unwise patient choices. The result can be beautifully executed overtreatment or a 'disappointment gap' between expectation and delivery. Dentists are subject

to the realities of business but need active ethical awareness to eliminate behavioural bias and be aware of hidden temptations.

How does a clinician keep their fingerprints 'ethical'?

Start by asking yourself what is driving a clinical decision. Is it clinical need? The patient? You? The practice? Or is it financial pressures? Are expectations realistic in terms of treatment outcomes, comparative benefits and your own abilities? Is what is proposed a good thing, being done for the right reason, and is this the best option for this patient at this time?

When discussing treatment, stop to consider if the advice presented is accurate and fair, if alternatives, risks and benefits have been presented clearly and that you are satisfied that what is proposed is within your ability, is in the best interests of the patient and is what you would want for yourself.

Our ethical fingerprints reflect our behaviour and choices. Behaviour is susceptible to the pressure of circumstances and none of us are immune to temptation. The risk of our decisions being distorted by various pressures can be reduced simply by recognising this.

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.



is a rapidly renewing epithelium with substantial regenerative capacity, and transient cytogenetic changes may not translate to persistent pathology or systemic risk. Without long-term follow-up or outcome data, these findings should be regarded as hypothesis-generating rather than practice-changing.

Dental practitioners must weigh the substantial, evidence-based caries-preventive benefits of fluoride against the tentative safety signals identified in this study. Caries remains one of the most prevalent chronic diseases globally, and fluoride toothpaste is a primary prevention tool with proven population-level impact. Abandoning or broadly discouraging fluoride use based on a single small study with methodological limitations would be premature and potentially harmful. Instead, clinicians should engage in individualised risk assessment: patients with high caries risk, limited access

to dental care, or established fluoride tolerance should continue standard fluoride regimens. Conversely, patients with documented mucosal sensitivity, recurrent aphthous stomatitis, or strong preference for fluoride-free products may be counseled about non-fluoridated alternatives, with the understanding that caries risk may increase and enhanced preventive monitoring may be warranted.

In summary, this study raises pertinent questions about the biological safety of chronic fluoride exposure at standard toothpaste concentrations but does not provide sufficient evidence to modify established clinical practice.

REFERENCE

1. Ravindran R, Elumalai A, Vijayarangan A, *et al.* Comparative evaluation of the cytotoxic effects of fluoridated and non-fluoridated toothpaste on the buccal mucosa: A 12-week follow-up—a randomized controlled study. *Clin Oral Invest* 2026;30:209.

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CPD questionnaire

Evaluation of canine retraction rate in adult orthodontic patients using miniscrew-facilitated micro-osteoperforation: a split-mouth randomized clinical study

1. **Select the CORRECT answer. What is one significant advantage of micro-osteoperforation over surgically assisted orthodontic techniques?**
 - A. It is less invasive and can be repeated
 - B. It requires fewer visits
 - C. It is more expensive but more effective
 - D. It eliminated the pain completely
2. **Select the CORRECT option. What factor may contribute to the decrease in retraction rate after 8 weeks**
 - A. The patient's pain tolerance increased
 - B. The MOP application became less effective with time
 - C. The NiTi coil spring force may have decreased as the distance between the teeth decreased
 - D. The wire material became more flexible
3. **Which answer is CORRECT. What is the estimated average rate of tooth movement in conventional orthodontics?**
 - A. 0.5mm/week
 - B. 1mm/4 weeks
 - C. 2mm/4 weeks
 - D. 0.01mm/day
4. **Choose the CORRECT answer. What factor is commonly associated with prolonged orthodontic treatment time?**
 - A. Poor oral hygiene
 - B. Loss of patient cooperation
 - C. Frequent appliance adjustments
 - D. Lack of orthodontic expertise
5. **Which statement is CORRECT. Why is there still no consensus over the effectiveness of MOP in orthodontic treatment**
 - A. It has not been studied in enough clinical settings
 - B. It is a costly procedure
 - C. It causes significant side effects
 - D. Its effects on tooth movement are inconsistent across studies

Preventive oral health knowledge, attitudes and practices of patients attending selected private dental practices in Pretoria, South Africa

6. **Which option is CORRECT. What was the primary aim of the study conducted in selected private dental practices in Pretoria?**
 - A. To evaluate the prevalence of dental caries in children
 - B. To determine patients' preventive oral health knowledge, attitudes, and practices
 - C. To compare public and private dental practices in oral care delivery
 - D. To assess dentists' perceptions of oral hygiene behavior
 - E. To measure fluoride levels in drinking water

7. **Select the CORRECT statement. According to the study, which group demonstrated significantly better oral health practices?**
 - A. Males without medical aid
 - B. Participants over 60 years of age
 - C. Females, tertiary-educated individuals, and medical aid members
 - D. Adolescents aged 18–19
 - E. Participants with incomplete primary education
8. **Choose the CORRECT percentage. What percentage of participants reported brushing their teeth twice daily?**
 - A. 51%
 - B. 64%
 - C. 74.5%
 - D. 83%
 - E. 89%
9. **Which answer is CORRECT. What was the most common source of oral hygiene instruction among respondents?**
 - A. Parents
 - B. Visual media
 - C. Friends
 - D. Dentists
 - E. Teachers
10. **Choose the CORRECT statement. Which of the following statements best reflects the study's key conclusion?**
 - A. Oral health knowledge had no significant association with education level.
 - B. Preventive oral health practices were uniformly distributed across all demographics.
 - C. Sociodemographic factors such as education, gender, and medical aid membership significantly influence preventive oral health behaviors.
 - D. Participants showed limited awareness of the role of gingivitis in oral disease.
 - E. Preventive behaviors were primarily driven by economic status alone.

End of an Era or a Premature Goodbye? Dental Amalgam's Place in the Curriculum

11. **Select the CORRECT answer. Which association has affirmed the use of dental amalgam for the general population without allergies and renal diseases.**
 - A. World Health Organization (WHO)
 - B. United Nations Environment Program (UNEP)
 - C. South African Dental association (SADA)
 - D. American Dental Association (ADA)
 - E. International Association of Dental Research (IADR)
12. **Choose the CORRECT option. What was the predominant reason for Japan to stop the teaching of dental amalgam?**
 - A. Conservation of tooth structure
 - B. Ease of handling of resin composite
 - C. Fear after the Minamata poisoning incident in the mid-1950s.
 - D. Patient preference

13. Select the CORRECT percentage. What percentage of high-income countries reported having regulations for dental amalgam waste disposal in dental facilities and dental schools.

- A. 70%
- B. 71%
- C. 72%
- D. 73%
- E. 74%

14. Which option is CORRECT. Who initiated a campaign called the Abuja Declaration?

- A. Pakistan
- B. Saudi Arabia
- C. Malaysia
- D. Nigeria
- E. Kenya

Policy Analysis of South Africa's National Oral Health Policy and Strategy (2024-2034)

15. Select the CORRECT option. What is a major barrier to effective oral health service delivery in rural South Africa?

- A. Over-saturation of dental professionals
- B. Lack of demand for dental services
- C. Maldistribution of oral health professionals
- D. Excessive preventive infrastructure

16. Which answer is CORRECT. What weakness undermines the effectiveness of the District Health Information System (DHIS) as a monitoring tool?

- A. Too many quality indicators
- B. Lack of user access
- C. Reliance on basic counts and poor data accuracy
- D. Unnecessary use of real-time analytics

Determinants and barriers to oral Health services Utilization at Katutura Hospital, Namibia

17. Select the CORRECT option. According to Andersen's behavioural model referenced in the study, which factor plays a central role in determining whether individuals seek care?

- A. Genetic predisposition
- B. Perceived need
- C. Cultural practices only
- D. Type of dental procedure available

18. Which answer is CORRECT. A patient reports dissatisfaction with previous dental fillings and opts for extraction instead. This reflects which underlying issue identified in the study?

- A. Overutilisation of dental services
- B. Negative perceptions of restorative care
- C. Lack of dental equipment
- D. High awareness of preventive care

What's new for the clinician. Evidence-based Dentistry

19. Select the CORRECT answer. In the 12-week randomized controlled trial by Ravindran et al., which outcome showed a highly significant difference between the fluoridated and non-fluoridated toothpaste groups ($p = 0.0001$)?

- A. Cellular changes (binucleation, nuclear buds)
- B. Nuclear alterations (karyorrhexis, pyknosis)
- C. Micronuclei frequency
- D. Gender-related differences in nuclear changes

20. Which option is CORRECT. What was the fluoride concentration in the fluoridated toothpaste group used in the study?

- A. 1,000 ppm as sodium monofluorophosphate
- B. 1,400 ppm as sodium fluoride
- C. 5,000 ppm as stannous fluoride
- D. 250 ppm as sodium fluoride

The mark of our ethics on patient care

21. Select the CORRECT statement. According to the article, what are ethics?

- A. A set of legal rules enforced by the government
- B. A framework of principles that guides acceptable and expected conduct
- C. A list of professional qualifications required for dentists
- D. A method of identifying criminals through fingerprints

22. Which of the following is CORRECT. In clinical practice, what is the primary ethical expectation of dental practitioners?

- A. To maximise the practice's profits
- B. To prioritise patients' best interests
- C. To perform only cosmetic procedures
- D. To avoid treating complex cases

23. Select the CORRECT answer. Which type of purchase requires consumers to rely mainly on the advice of a technical expert due to limited knowledge?

- A. Search purchase
- B. Experience purchase
- C. Credence purchase
- D. Impulse purchase

24. Select the CORRECT statement. According to the article, failure in communication is an important factor in which of the following?

- A. Reduced treatment costs
- B. Increased patient referrals
- C. Dental complaints and claims
- D. Improved patient satisfaction

25. Choose the CORRECT answer. Which of the following is identified as a factor that can distort ethical decision-making?

- A. Patient education programmes
- B. Financial pressures and sales targets
- C. Professional development courses
- D. Evidence-based treatment guidelines

Instructions to authors

THE SOUTH AFRICAN DENTAL JOURNAL

SADJ



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2. Drafting the work or revising it critically for important intellectual content, AND
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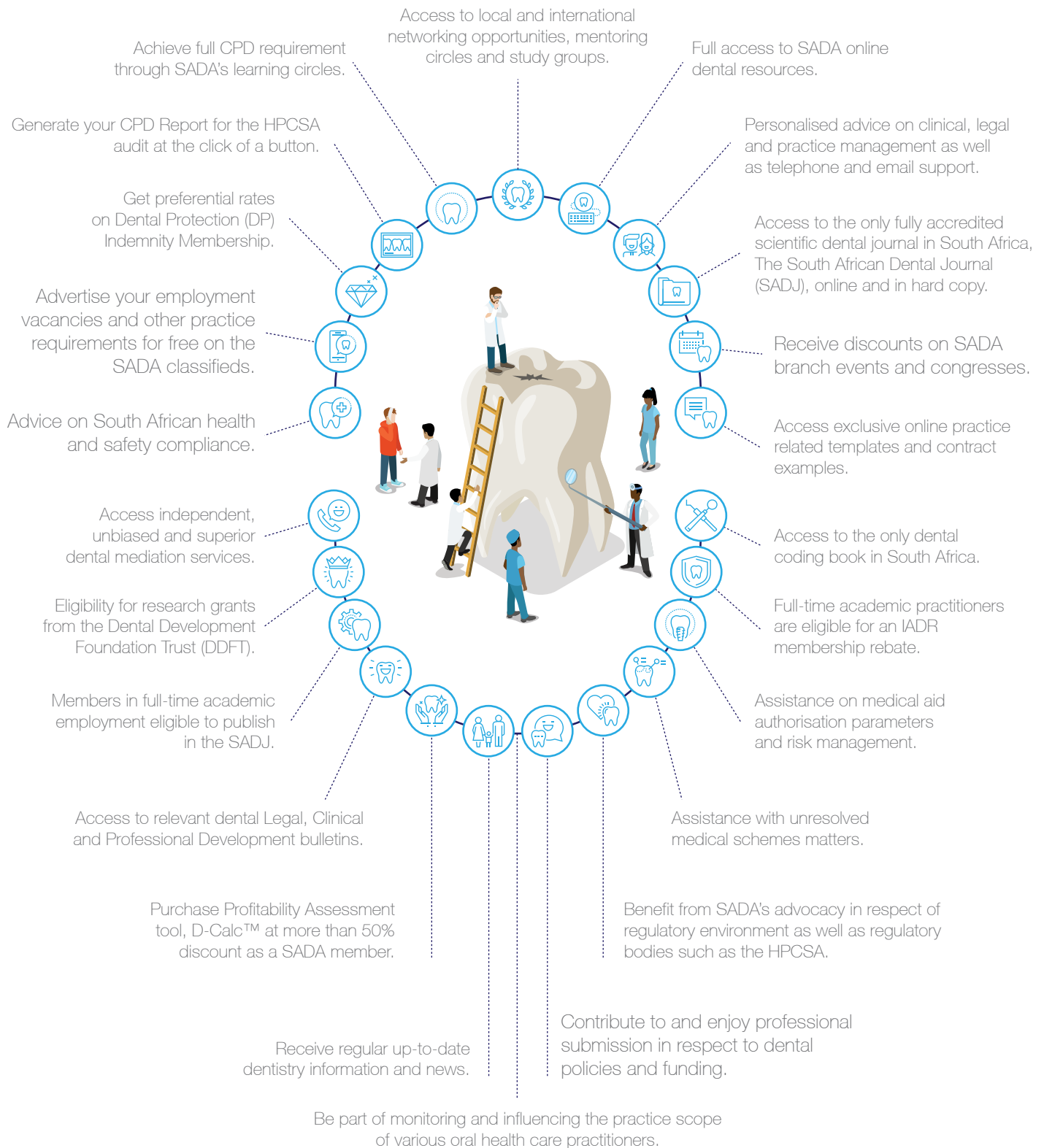
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