Port Harcourt Medical Journal

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Contents

Editorial

Artificial intelligence in healthcare
Richard Chinedu Echem 1

Review Article

Emergence of artificial intelligence in dentistry across global regions: focus on Africa and the West African subregion
Oladimeji Adeniyi Akadiri, Kesiena Seun Yarhere 3

Original Articles

Maternal "near miss" and maternal mortality at a tertiary health facility in Delta State, South-South Nigeria
Williams Obukohwo Odunvbun, Jerry Kunle Isogun, Amos Ekoh, Felix Eseoghene Ogbeh 11

Comparing the effectiveness of tetracycline sclerotherapy versus placebo in the prevention of postmastectomy seroma among female patients in a tertiary hospital in Southern Nigeria
Alexander Ilo Arekhandia, Raymond Atah Eghonghon, Omorodion Omoruyi Irowa, Clement Odigie Osime 20

Dental pain and oral health-related quality of life of patients attending a Nigerian tertiary hospital - a cross-sectional study
Grace Onyenashia Alade, Ayamma Udo Umanah 29

Pattern of lip competence and its association with malocclusion traits: a retrospective analysis of cases seen at a tertiary institution
Sylvia Simon Etim, Chukwudi Ochi Onyeaso 39

Correlation between third molar impaction and mandibular anterior segment crowding
Onyinye Dorothy Umeh, Adaku Letitia Ben-Okoye, Sylvia Simon Etim, Ifeoma Linda Utomi 46

Comparison of SIGN interlocking nailing and compression plating in the treatment of aseptic non-union of femoral shaft fractures
Mike Tochi Achor, Richard Chinedu Echem 51

Case Reports

Assessment of readiness to wean an elderly patient from mechanical ventilation using clinical and diaphragmatic ultrasound predictors: a case report
Sylvanus Ojum, Joy Omiepirisa Dayi 63

Home massage tool induced acute thoracic spinal epidural haematoma – a case report
Aighobahi George Akpede, Ali Elijah Usiholo, Ekiomado Igue Eki-Udoko 68

Anaesthetic management of superior vena cava syndrome in a 14-year-old undergoing mediastinal mass excision: a case report
Olubusola Temitope Alagbe-Briggs, Ayanate Oruobu-Nwogu 74

Graduating List 80

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Editorial

Artificial intelligence in healthcare

Artificial intelligence (AI) has become a buzzword these days.[1,2] AI represents the simulation of human intelligence in machines designed and programmed to think and learn like people. [2] In essence, AI refers to the ability of computers to perform tasks that typically require human intelligence, such as reasoning, problem-solving, and learning.[1] The World Health Organization (WHO) has proposed that AI be seen as the performance by computer programmes of tasks that are commonly associated with intelligent being.[3]

AI has found applications across various sectors, including academia, government, industry, social, and economic service organizations.[1] The healthcare field is no exception to the application of AI with the rapid development of algorithms and computational models that enable machines and systems to perform tasks such as natural language processing, pattern recognition, problem-solving, and decision-making.[1] Hence, it can be opined that AI is a powerful and disruptive area of computer science, with the potential to fundamentally transform the practice of medicine and the delivery of healthcare.[4]

The term artificial intelligence (AI) was first used by John McCarthy at the Dartmouth Conference in 1956,[5,6] and since then the field has been constantly explored and AI has now become an all-pervading influencer on how we do things, from the very simple to the most complex.[5]

Healthcare systems around the globe face significant challenges in achieving the 'quadruple aim' for healthcare which are to improve population health, improve the patient's experience of care, enhance caregiver experience and reduce the rising cost of care.[4]

AI has had profound impact on diagnosis, treatment and healthcare delivery. The applications in healthcare include transformative diagnostics, personalized treatment strategies and enhanced patient care among others. [1-6]

In the area of transformative diagnostics, AI leverages on machine learning algorithms to analyze vast data sets quickly and accurately. [1-6]

In this regard, it has found its place in imaging and radiology demonstrating remarkable proficiency in image interpretation as well as enhancing the early detection of cancers. [1-6] AI has also made substantial strides in pathology and laboratory medicine as it accelerates the diagnostic process and reduces the likelihood of human error. [1-6]

In personalized treatment strategies, AI has been at the forefront. Through the utilization of big data and predictive analytics, AI can analyze individual patient data to tailor treatment plans that are more effective with fewer adverse effects. [1-6] AI has accelerated the drug discovery and development process, allowing researchers to target specific biological mechanisms with better precision. [1-6] AI has contributed to the optimization of therapeutic approaches with AI systems having the capability to adapt treatment plans in real time. [1-6]

AI has also enhanced patient care experience. It has been utilized in remote patient monitoring enabling early intervention in case of deteriorating health, reducing hospital readmissions and enhancing overall patient wellbeing.[1-6] Through predictive analytics, AI can anticipate potential risks, predict likelihood of future health issues , enabling healthcare professionals to implement preventive measures.[1-6]

Despite these applications, concerns have been raised as it relates to the adoption and deployment of AI in the healthcare sector. These include ethical and privacy, social sustainability, governance, technical, unreliability and trustworthiness as well as healthcare providers and professional liability challenges among others. [1-6]

In this issue, Akadiri and Yarhere [7] through a narrative review compared the development and implementation of AI in dental practice across major global regions with a view to identifying strategic priorities for accelerating responsible and equitable AI adoption with a focus on Africa and the West African subregion. They note that West Africa remains at an early stage of adoption, characterized by significant oral health needs, limited digital infrastructure,

scarce research, and minimal clinical deployment in contrast to high-income regions. They conclude that bridging this gap will require investment in digital infrastructure, context-appropriate AI applications, local data development, capacity building, and ethical governance frameworks. It is hoped that the outlook will change over time.

REFERENCES

1. Dabhadkar SV. Artificial Intelligence in healthcare: embracing the future. Bharati Vidyapeeth Med J 2024; 4(1): 1-3.
2. Khubchandani J, Banerjee S, Yockey RA, Batra K. Artificial intelligence for medicine, surgery, and public health. J Med Surg Public Health 2024; 3: 100141.
3. Panteli D, Adib K, Buttigieg S, Goiana-da-Silva F, Ladewig K, Azzopardi-Muscat N, et al. Artificial intelligence in public health: promises, challenges, and an agenda for policy makers and public health institutions. Lancet Public Health 2025;10(5):e428-e432.
4. Bajwa J, Munir U, Nori A, Williams B. Artificial intelligence in healthcare: transforming the practice of medicine. Future Healthc J 2021;8(2):e188-e194.
5. Venkatesh P. On artificial intelligence in healthcare. Indian J Ophthalmol 2025;73(6):777-778.
6. Singh C, Gulia A, Bansal N. Artificial intelligence in healthcare: pros and cons. Indian J Med Sci 2023;75(2):35.
7. Akadiri OA, Yarhere KS. Emergence of artificial intelligence in dentistry across global regions: focus on Africa and the West African subregion. Port Harcourt Med J 2026;20(1):3-10.

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Review Article

Emergence of artificial intelligence in dentistry across global regions: focus on Africa and the West African subregion

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Abstract

Background: Artificial intelligence (AI) is transforming diagnostic and therapeutic pathways in dentistry, although the pace and extent of its adoption vary significantly across regions.
Aim: This article compares the development and implementation of AI in dental practice across major global regions and identifies strategic priorities for accelerating responsible and equitable AI adoption in West Africa.
Methods: A structured search of the global literature was conducted to identify English-language publications on AI applications in dentistry from 2015 to the present. Searches were performed across major scholarly databases using combinations of keywords related to AI and dentistry. Retrieved publications were screened using predefined eligibility criteria and subjected to narrative review to extract information on domains of AI application, stages of implementation, digital infrastructure readiness, regulatory context, and regional adoption patterns. A comparative thematic synthesis was then conducted to categorize regions by stage of AI emergence and to identify key drivers and barriers to adoption.
Results: The initial search yielded 1,125 publications. After abstract screening and eligibility filtering, 109 publications remained, and full-text review identified 16 core articles for analysis. High-income regions demonstrate rapid progression from proof-of-concept models to clinically integrated AI tools. In contrast, West Africa remains at an early stage of adoption, characterized by significant oral health needs, limited digital infrastructure, scarce research, and minimal clinical deployment.
Conclusion: Bridging this gap will require investment in digital infrastructure, context-appropriate AI applications, local data development, capacity building, and ethical governance frameworks.

Keywords: Artificial intelligence, dentistry, oral health, diagnostic imaging, orthodontic planning, oral cancer screening, digital dentistry, West Africa

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INTRODUCTION

Artificial intelligence (AI) is rapidly emerging as a transformative tool in dentistry, influencing diagnostic processes, treatment planning, healthcare delivery, and dental education, particularly, in high-income countries.[1] While North America, Europe and parts of Asia–Pacific report a rapid adoption of AI-enhanced imaging, predictive models and digital workflows, evidence from Africa, particularly West Africa, shows a much earlier stage of engagement, constrained by structural barriers in oral health systems and digital infrastructure.[1,2] This study aims to analyze and compare the emergence, scope, and maturity of artificial intelligence (AI) applications in dentistry across major world

subcontinents, with particular emphasis on Africa and the West African subregion. The specific objective is to identify contextual drivers, barriers, and strategic priorities required to accelerate responsible and equitable AI adoption in West African dental practice.

METHODOLOGY

A structured literature search through the electronic databases of PubMed/MEDLINE, Scopus, Web of Science, Google Scholar, as well as web resources containing market intelligence reports, policy documents, WHO regional oral health reports and other Institutional and regulatory bodies' publications was conducted. The search strategy comprises a wide range of search terms combined using Boolean operators such as "Artificial intelligence" AND "dentistry"; "AI in oral health"; "Machine learning" AND "dental imaging"; "AI" AND "oral cancer screening", "Digital dentistry" AND "Africa"; "AI adoption" AND "West Africa". The search period was limited to 2015–2026 to capture AI evolution in dentistry within the last decade. Citation tracking was performed primarily through backward citation searching, with additional manual screening of related references where relevant. To streamline the scope of the review, the following eligibility criteria were defined: publications in English language; articles addressing AI applications in diagnostics and therapeutic dentistry, including but not limited to orthodontics, endodontics, oral oncology, workflow management, or dental education; and publication types including systematic reviews, narrative reviews, observational studies, market reports, adoption reports, or regulatory policies related to AI in dentistry.

Selected publications were then subjected to narrative review to extract relevant information, including domains of AI application in dentistry, stages of implementation, digital infrastructure readiness, regulatory contexts, and regional adoption patterns. Articles that sparsely contributed to the information of interest were further excluded leaving only 16 articles which form the core evidence base for this narrative review. A comparative thematic synthesis was subsequently performed to categorize regions according to their stage of AI emergence and to identify key drivers and barriers influencing adoption. The findings of the narrative review are discussed in the subsequent subsections.

Global development of AI in dentistry

Recent systematic and anecdotal literature reviews indicate that the utilization of AI in dentistry is garnering heightened focus on caries diagnosis, periodontal assessments, endodontic evaluation, orthodontic planning, oral cancer screening, educational interventions, and orthodontic care instruments.[3,4] Machine learning approaches including deep learning (DL), convolutional neural networks (CNNs), and related models have demonstrated diagnostic performance comparable to or exceeding that of human experts.[5,6] Market analyses indicate rapid expansion of the digital dentistry sector. This was worth about USD 6 billion in 2024 and is expected to be worth more than USD 19 billion by 2034, with a Compound Annual Growth Rate CAGR of about 12–13%. [1] There is wide variation in AI adoption and investment rates in correlation to the socioeconomic conditions, existing regulatory policies, and digital maturity of the various region/subcontinents.[1,2]

Regional adoption overview

According to a 2024 summary of usage statistics and market trends,[1] approximately 35% of dentists worldwide have adopted some form of AI or digital automation in practice with varying degrees of coverage across regions. North America accounts for the largest market share and clinical adoption, with an implied 18% of U.S. dental professionals using AI modules as part of their workflows, especially in imaging and diagnostics.[1] Asia–Pacific has mixed but increasing penetration, notably in Australia and New Zealand with intraoral scanner penetration greater than 50%, to underpin AI-powered digital workflows.[1] Europe is said to be seeing slow and steady development, especially in countries with better health

systems, though fine quantitative uptake data is scarce.[1]

On the other hand, the extent of adoption for the Middle East and Africa is underexplored and studies indicate that AI use in dentistry remains largely investigational rather than part of routine clinical practice.[1,7] This discrepancy highlights a global "AI divide" in oral health similar to wider digital health inequalities.[2,7] Current state of AI development and practice integration globally by regions and subcontinents are summarized in Table 1 and the current emergence curve in figure 1 demonstrates the current development trajectory.

AI in dentistry: North America, Europe, and Asia-Pacific

Systematic literature review and the evidence base show that the vast bulk of published AI dental applications originate in North America, Europe and East Asia.[1,4,5] AI applications in these regions have evolved from proof-of-concept models to clinical decision-support systems embedded into radiology platforms, orthodontic planning software, and oral cancer screening tools. [1,3,4,5,8]

Diagnostic and clinical decision-support functions represent only part of the expanding spectrum of AI applications in dentistry. These applications include the automated detection of dental caries and radiographic lesions through the analysis of dental imaging (periapical, bitewing and panoramic), enhancing accuracy during diagnostic assessment.[4,8] Artificial intelligence (AI) is being applied to screen the periodontal bone defects and periapical aberrations that contribute in diagnosis and intervention early.[9] AI is also being used for cephalometric landmarking and the classification of malocclusions when working in the orthodontics field.[10-12] Other AI tools assist in the early detection of oral cancer and malignant disease, by analyzing photographic and histological images thereby supporting prompt intervention.[4,5,13] In addition to diagnosis, AI is used for workflow optimization for dental practices; the organization of schedules and risk triage (which are possible with predictive analysis) and this results in improved efficacy for the quality of patient care.[5,14]

Table 1. Indicative regional emergence of AI in dentistry

Region/Sub continent	Evidence of AI use in dentistry	Market/adoption signal
North America	Widespread AI imaging, diagnostics, practice-management tools.	Largest AI-in-dentistry market share; ~18% U.S. dentists using AI modules.
Europe	Integration in diagnostics, imaging, education; multiple trials.	Gradual uptake; strong regulatory and research ecosystem.
Asia–Pacific	Rapid rise of digital dentistry growth; AI in imaging, planning, education.	High scanner penetration (>50% in Australia/NZ).
Latin America	Emerging research; limited quantitative data.	Early adoption; localized pilots and academic projects.
Middle East	Growing interest; AI in imaging and oral cancer screening.	Early market growth; pockets of high-tech adoption.
Africa (overall)	Scattered pilots in oral cancer screening and digital tools.	Very limited adoption; nascent, exploratory stage.
West Africa (subregion)	Virtually no routine AI in dental practice reported; major service gaps.	No dedicated AI-dentistry market data; structural constraints dominate.

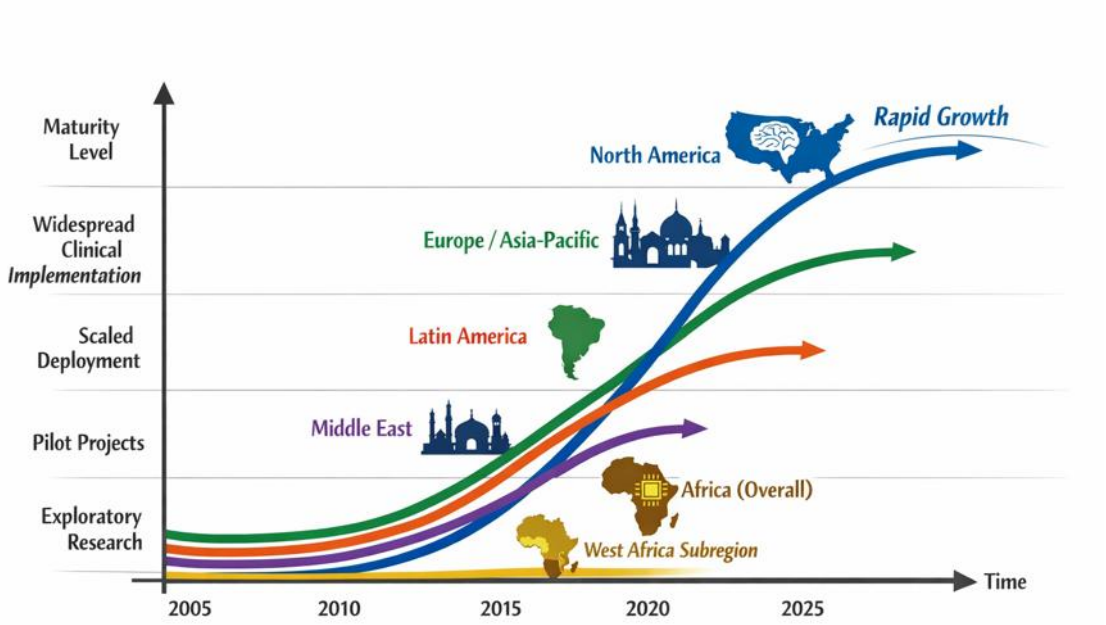

Fig. 1. AI Emergence Profiles in Dentistry across World Subcontinents

These are increasingly being integrated into commercial software, helped by a strong regulatory journey (FDA and CE, etc.) as well as a lot of venture capital.[1] Moreover, educational applications are also rapidly expanding, including AI-enhanced simulation tools such as virtual training environments, radiographic interpretation systems, and simulation platforms used for clinical training and skill development. [1,5]

AI in oral health and dentistry in Africa

Unaddressed oral disease continues to be a significant burden across Africa as well as a serious shortage of both oral health professionals and facilities. A narrative review[15] of dentistry in West Africa identified low dentist-to-population ratios, uneven service distribution, and limited training capacity, all of which contribute to restricted access to dental care. In the context of this, digital health tools – inclusive of AI– are perceived as accelerators for public oral health of the community, however, the evidence base so far is limited.[7] Using global AI–oral cancer literature as a reference, the authors argue that AI models have demonstrated sensitivity and specificity scores of ≥ 90% for detecting oral cancer and potentially malignant lesions,[5,16,17] offering comparable (and potentially better) results than experienced humans. They do note that most of these models originated outside the continent, and were not widely used or validated in African conditions. This same review emphasizes the potential implications of AI-assisted diagnostic tools in areas with limited access to radiologists, pathologists, and dental surgeons, where those on the frontline can take photographs and provide decision support via mobile devices to community health workers. However, there are very few fully operational AI based dental systems in African primary or specialist care, therefore the continent remains at the theoretical stage of an aspirational, piloting, (not on a large scale) project .[1]

The current status and gap in the West African subregion

West Africa typifies the structural barriers to deploying AI in dentistry. A review of regional dentistry describes the changes in services, persistent high burdens of caries and periodontal disease, finite provision of specialists and limited numbers of specialists and poorly resourced training academy.[11] Digital health infrastructure, although expanding, remains fragmented and uneven, with most countries still lacking adequate electronic health record systems and routine

digital imaging infrastructure within public dental health service areas.[1,6,18]

There have been no large-scale reviews in the indexed literature of AI based dental diagnostics/practice management tools or apps, using AI-enhanced dental tools and related practices in West Africa in West African dental medicine, in this regard .[1] The vast majority of innovation work in the region is centered on broadening basic preventive and restorative dental services, integrating oral health within universal health coverage and enhancing the capacity for dental professional training, rather than the development or implementation of sophisticated AI tools.[6,11] The vast majority of digital tools when mentioned exist include teledentistry, mHealth, and simple decision-support systems but not AI models fully trained as part of imaging analysis or practice management environment.[6] This underscores a deficiency in West Africa when compared to the wider western world (North America and Europe),one that comes from various stratified gaps such as, but not limited to, basic service coverage, digital infrastructure, research, capital, and regulatory. Key drivers and barriers influencing AI adoption in dental care worldwide are shown in Table 2.

What aspects are required for accelerating the evolution of AI in West African dentistry?

1. Basic digital and data infrastructure

AI systems need high-quality, digital, well-annotated clinical data. Because of this, dental offices need to enhance their equipment and technology for digital radiography as well as appropriate facilities to store data without risk, such as basic EHRs. De-identified regional and national image repositories (for disease-related factors such as caries, periodontal disease, and oral potentially malignant disorders) would generate training and validation datasets with a focus on West African settings.

2. Context-appropriate AI use-cases

Because resource constraints exist in West African dentistry, AI adoption ought not at first to mimic complex use cases as seen in Western countries but rather should aim at high-impact, feasible applications. Specific focus areas for AI are mobile triaging tools with emphasis on early detection of oral cancer and severe dental infections, at a community level.

Table 2. Key drivers and barriers influencing AI emergence in dentistry by region

Factor	High-income regions (NA/EU/EA)	Africa/West Africa
Baseline dental infrastructure	High specialist density, widespread imaging and EHR.	Low workforce density, limited imaging and records.
Digital readiness	Mature broadband, cloud, and cybersecurity frameworks.	Variable connectivity; limited secure health IT.
Research and industry	Strong academia–industry partnerships; VC funding.	Sparse local AI-dentistry research; minimal industry.
Regulation and policy	Active pathways for AI device approval.	Emerging digital health policies; limited AI-specific rules.
Financing	High per-capita health spending; insurance coverage.	Out-of-pocket dominance; constrained public budgets.
Data availability	Large, annotated image repositories.	Fragmented, non-digitized records; few datasets.

Moreover, basic radiographic decision-support systems can guide general practitioners in interpreting digital radiographs, which may be especially valuable in contexts where specialists are scarce. Predictive tools for community risk stratification can deepen the range of activities that can be targeted for educational outreach, in order that school-based oral health programs may prosper in school-based services. These use cases are suitable for the region's disease burden and the availability of skilled workers and can complement existing mobile health (mHealth) and telehealth programs.

3. Capacity building and South–South/North–South collaboration

Educating dental professionals, policymakers, and informatics teams on AI literacy is critical to enable them to critically evaluate tools, co-design implementations, and prevent dependence on "black boxes". Coherently, collaborative research networks connecting West African dental schools with AI research clusters both in Africa and abroad can facilitate collaborative model building, transfer learning on African datasets, and skill sharing.

4. Governance, ethics, and equity by design

Good governance frameworks will need to deal with data protection, consent, algorithmic bias, liability, and sustainability. They will also need to be more complete so that they don't make existing inequalities worse. AI systems that utilizes only Western datasets are likely to make inaccurate classifications and unsafe suggestions because West African patients would have some nuanced differences from patients in different parts of the world. This underscores the importance of consistent audits and human oversight.

5. Financing and innovation ecosystems

We need specific funding sources from governments, development partners, and impact investors to pay for pilot projects, infrastructure improvements, and local health-tech startups that work on dental AI. Embedding AI elements into current oral health and primary care programs (not standalone "AI projects") could increase sustainability and integration.

Limitations of the Study

This study has several limitations that should be considered when interpreting the findings. First, the review was conducted as a narrative synthesis rather than a formal systematic review or meta-analysis. Although a structured search strategy and eligibility criteria were applied, the final evidence base was limited to 16 core articles. As a result, the findings primarily provide a conceptual overview of global AI development in dentistry rather than a quantitative assessment of adoption patterns. The relatively small number of included studies may also limit the generalizability of conclusions regarding regional implementation trends.

A second limitation relates to the restriction of the literature search to English-language publications and the limited availability of indexed research on AI applications in dentistry within Africa and the West African subregion. Important studies, pilot projects, or policy documents published in local languages, institutional reports, or non-indexed sources may therefore not have been captured. This constraint reflects the broader scarcity of documented AI implementation in African dental systems and may result in an underrepresentation of emerging regional initiatives.

CONCLUSION

AI in dentistry is evolving rapidly in North America, Europe, and certain regions of Asia-Pacific, advancing from pilot studies to clinically relevant diagnostic, clinical and educational tools and supported by robust markets and regulatory environments.

AI-related activity in dentistry within Africa and West Africa in particular, is largely exploratory and limited to scattered pilot studies and research initiatives, with very limited routine clinical deployment. Regulatory frameworks for AI in healthcare are still emerging across many African countries, and comprehensive AI-specific

policies remain under development in most jurisdictions.

Closing this gap will take strategic investment in digital infrastructure, context-appropriate use-cases, regional access to data, capacity building, and ethical governance, such that AI will be a tool to diminish, rather than exacerbate, oral health inequities in the subregion.

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There are no conflicts of interest.

REFERENCES

1. HealthfulHelps Editors. Artificial intelligence and dentistry usage statistics 2024. December 2024 . Available from: https://healthfulhelps.com/artificial-intelligence-and-dentistry-usage-statistics-2024/](https://healthfulhelps.com/artificial-intelligence-and-dentistry-usage-statistics-2024/. Accessed 20th February 2026.
2. InsightAce Analytic. AI in dentistry market size, revenue, trends report 2026 to 2035 . Last updated 18th February 2026. Available from: https://www.insightaceanalytic.com/report/ai-in-dentistry-market/3004 . Accessed 20th February 2026.
3. Jha Kukreja B, Kukreja P. Integration of artificial intelligence in dentistry: a systematic review of educational and clinical implications. Cureus 2025;17(2):e79350.
4. Gao S, Wang X, Xia Z, Zhang H, Yu J, Yang F. Artificial intelligence in dentistry: a narrative review of diagnostic and therapeutic applications. Med Sci Monit 2025;31:e946676.
5. Tyagi M, Jain S, Ranjan M, Hassan S, Prakash N, Kumar D, et al. Artificial intelligence tools in dentistry: a systematic review on their application and outcomes. Cureus 2025;17(5):e85062.
6. Sabri O, Al-Shargabi B, Abuarqoub A. The role of artificial intelligence in improving diagnostic accuracy in medical imaging: a review. Comput Mater Contin 2025;85(2):2443–2486.
7. Lubanga AF, Kafera G, Bwanali AN, Choi Y, Lee C, Ham E, et al. Embracing change, moving with time: exploring the role of digital technologies and accelerators in promoting community oral health in Africa. Front Oral Health 2025;6:1443313.
8. Farhadi Nia M, Ahmadi M, Irankhah E. Transforming dental diagnostics with artificial intelligence: advanced integration of ChatGPT and large language models for patient care. Front Dent Med 2025;5:1456208.
9. Khubrani YH, Thomas D, Slator PJ, White RD, Farnell DJJ. Detection of periodontal bone loss and periodontitis from 2D dental radiographs via machine learning and deep learning: systematic review employing APPRAISE-AI and meta-analysis. Dentomaxillofac Radiol 2025;54(2):89-108.
10. de Oliveira PHJ, Li T, Li H, Gonçalves JR, Santos-Pinto A, Gandini Junior LG, et al. Artificial intelligence as a prediction tool for orthognathic surgery assessment. Orthod Craniofac Res 2024;27(5):785-794.
11. Xu M, Liu B, Luo Z, Ma H, Sun M, Wang Y, et al. Using a new deep learning method for 3D cephalometry in patients with cleft lip and palate. J Craniofac Surg 2023;34(5):1485-1488.
12. Jiang Y, Jiang C, Shi B, Wu Y, Xing S, Liang H, et al. Automatic identification of hard and soft tissue landmarks in cone-beam computed tomography via deep learning with diverse datasets: a methodological study. BMC Oral Health 2025;25(1):505.
13. Goey RS, Elenbaas L, Berkhout E, Moin DA, van der Kleij R, Forouzanfar T, et al. AI acceptability in dentistry: insights from dental professionals and students in the Netherlands: a pilot study. Int Dent J 2025;75(6):103933.

14. Yadav P, Asdullah M, Gupta J, Khan MH. Enhancing dental care through artificial intelligence: a comprehensive overview. Int J Oral Health Dent 2023;9(4):247-250.
15. Fomete B, Adebayo ET. Review of dentistry in West Africa: challenges and prospects. J West Afr Coll Surg 2018;8(4):93–113.
16. Kouketsu A, Doi C, Tanaka H, Araki T, Nakayama R, Toyooka T, et al. Detection of oral cancer and oral potentially malignant disorders using artificial intelligence–based image analysis. Head Neck 2024;46(9):2253-2260.
17. Khanagar S, Alkadi L, Alghilan MA, Kalagi SA, Awawdeh M, Bijai LK, et al. Application and performance of artificial intelligence (AI) in oral cancer diagnosis and prediction using histopathological images: a systematic review. Biomedicines 2023;11(6):1612.
18. Oluokun EO, Adedoyin FF, Dogan H, Jiang N. Digital interventions for managing medication and health care service delivery in West Africa: systematic review. J Med Internet Res 2024;26:e44294.

Original Article

Maternal "near miss" and maternal mortality at a tertiary health facility in Delta State, South-South Nigeria

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Abstract

Background: Maternal mortality and morbidity statistics serve as important indicators of the quality of healthcare delivery in a country or health facility.

Aims: To determine the institutional maternal mortality ratio (MMR), maternal near miss incidence ratio (MNMR), maternal near miss to maternal mortality ratio, mortality index, and factors that contributed to maternal outcome, at the Delta State University Teaching Hospital (DELSUTH), Oghara, Delta State.

Methods: This was a retrospective study, conducted at the Department of Obstetrics and Gynaecology, DELSUTH, Oghara. The medical records of maternal deaths and maternal "near miss", from June 1, 2019, to June 30, 2024, were retrieved. The data analysis was with SPSS version 25. Statistical level of significance was set at $P< 0.05$.

Results: The study recorded 1,037 live births, 54 maternal deaths, and 129 maternal near miss events. The maternal mortality ratio was 5,200 / 100,000 live births, during the study period. The maternal near miss incidence ratio was 124.3 /1000, while the maternal near miss to mortality ratio was 2.4, and the mortality index was 29.5%. The leading cause of mortality and morbidity was hypertensive disorders of pregnancy, which accounted for 59.3% and 73.6%, respectively.

Conclusion: The findings indicate that the maternal health indices are consistent with those of an over-strained healthcare facility, reflecting the consequences of delayed presentation of complicated obstetric cases. These highlight systemic challenges in timely access to obstetric care and emphasize the importance of strengthening antenatal care and referral services.

Keywords: Near miss, maternal mortality, maternal mortality ratio, mortality index, maternal near miss incidence ratio

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INTRODUCTION

The quality of health services offered to pregnant women by a country, or a health institution is not only defined by maternal mortality statistics, but to a greater extent, by the morbidities suffered in the course of pregnancy and during the puerperium. Thus, the concept of severe acute maternal morbidity (SAMM), or near miss, is considered more apt for the health care system.[1,2]

While the United Nations Development Fund for population reported a maternal mortality ratio of 243/100,000 livebirths for Nigeria in 2014,[3] the Nigeria Demographic and Health Survey (NDHS) estimated the mortality ratio to be 576/100,000 livebirths during the same period.[4] The World population review,[5] estimated Nigeria's maternal mortality ratio to be 1,047/100,000 livebirths, in 2025. However, the challenge inherent in collecting vital statistics in developing countries makes the

above figures mere estimates, as the actual figures may be much higher. Mortality figures are a negative closure, irrespective of the number of interventions and this is why the concept of maternal near miss is a better assessment of health system performance.

The World Health Organization (WHO) defines a maternal near miss as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy."[6] The near miss indices and tools provide a useful assessment of the quality of obstetric care and reveal the sequence of events that could have led to maternal death. It assists in the development of preventive and educational programmes with improved resource - allocation for the reduction of maternal morbidity and mortality.[7] By leveraging on this information, the health system can be strengthened.

Until a decade and half ago there were no set criteria for identification of near miss cases, in order to facilitate the routine implementation, and wider application of this concept.[8] Epidemiological parameters, such as incidence ratios, mortality index, maternal near miss-mortality ratio, vary from country to country, and within the same country, vary from region to region. In 2017, Mbachu et al,[9] in a cross-sectional study examined, maternal near miss at a rural private tertiary health facility in the southern part of Nigeria, using the adapted WHO Near Miss protocol.[6,10] Their study showed a maternal mortality ratio of 1908/100,000 livebirths, and a maternal near miss mortality ratio of 11.4:1. [9]

This study aimed to determine institutional maternal mortality ratio (MMR), maternal near miss incidence ratio (MNMR), maternal near miss to maternal mortality ratio; mortality index, the aetiological, and other factors that contributed to maternal outcome, at the Delta State University Teaching Hospital (DELSUTH), Oghara, Delta State. There has been no recent study on obstetric "near miss" parameters at the study facility. The findings from the study may assist in revealing weakness in service delivery, improve resource allocation and deployment, with resultant improvement in the overall quality of maternal health service at the facility and public health facilities in Delta State, in general.

METHODOLOGY

This was a retrospective study, conducted at the DELSUTH, Oghara, Delta State. It involved the retrieval and analysis of data from the medical records of patients who died and those who satisfied the adapted inclusion criteria of WHO for maternal near-miss [5,9] at the study facility, from June 1, 2019 to June 30, 2024.

Exclusion Criteria: All pregnant women who were managed at the facility and did not satisfy the selection criteria for near-miss and maternal mortality were excluded from the study.

Operational Definitions:[11]

Maternal mortality ratio (MMR): The number of maternal deaths per 100,000 live births during a defined period.

Maternal near miss incidence ratio (MNMIR): (Number of Maternal Near cases/ Number of live births) x 1,000.

Maternal near miss to mortality ratio (MNM:MD) : It is the ratio of maternal near miss cases to maternal deaths

Mortality index (MI) = {Maternal Deaths (MD)/(Maternal Near Miss (MNM) + Maternal Deaths} X100

Study Setting: The Delta State University Teaching Hospital was established in 2010, in the Suburban community of Oghara, Delta State. The facility has a central ICU with 8 beds, and full complements of specialists in the different departments. The Department of Obstetrics and Gynaecology has a bed capacity of 24, with 15 Consultant Obstetrician and Gynecologist. It is a training centre for resident doctors, for which it maintains a memorandum of understanding with two other public health facilities in the State, Central

Hospital Warri (CHW) and Central Hospital Sapele (CHS). While CHW and CHS offer free maternity services, through the contributory Health Insurance of the State Government, the study facility offers out-of-pocket treatment for patients. Majority of the obstetric complications managed at the study facility are referrals from other public, private, missionary hospitals, maternity homes and traditional birth attendants.

WHO's inclusion criteria for maternal near miss [5,9]

CRITERIA	COMPONENTS
Severe maternal complications	Severe postpartum haemorrhage, Severe Preeclampsia, Eclampsia Sepsis or severe systemic infection, Ruptured uterus, Obstructed labour, Severe complications of abortion.
Critical interventions or Intensive care unit	Admission into ICU, Interventional radiology, Laparotomy for severe obstetric conditions, Use of blood products (FFP, etc)
Life-threatening conditions.	Cardiovascular dysfunction (Shock, Cardiac arrest: absence of pulse/heartbeat, and loss of consciousness). Use of continuous vasoactive drugs. Cardiopulmonary resuscitation. Severe hypoperfusion (lactate >5mmol/L or >45mg/dl), Severe acidosis(pH<7.1).
Respiratory dysfunction	Acute cyanosis, Gasping, Severe tachypnoea (respiratory rate > 40 bpm) Severe bradypnoea (RR < 6 Bpm), Intubation and ventilation are not related to anaesthesia, Severe hypoxaemia (O_2 saturation < 90% for 60 min or PAO_2 /FiO_2 < 200)
Renal dysfunction	Oliguria non-responsive to fluids or diuretics, Dialysis for acute renal failure (AKI), Severe acute azotaemia (creatinine ≥ 300 µmol/ml or ≥3.5 mg/ dl)
Coagulation/haematological dysfunction	Failure to form clots, Massive transfusion of blood or red cells (≥ 5 units), Severe acute thrombocytopaenia (< 50,000 platelets/ml).
Hepatic dysfunction	Jaundice in the presence of preeclampsia, Severe hyperbilirubinaemia (bilirubin >100 µmol/l or > 6.0mg/dl)

Neurological dysfunction	Prolonged unconsciousness (lasting ≥ 12h) /Coma (including metabolic coma), Stroke, Uncontrollable fits/ status epilepticus, Total paralysis
Uterine dysfunction	Uterine haemorrhage or infection leading to hysterectomy

Study tools and procedure: The names and hospital number of the patients who satisfied the inclusion criteria were copied by the researchers from the admission records in the Labour ward, Departmental triage, high dependency unit (HDU), and the intensive care unit (ICU).

The medical records of the patients were retrieved from the records department by staff of the department. Only file-content that satisfied the selection criteria for the study were transferred to the study proforma, after subjecting them to content validity. The information on the proforma was subsequently transferred to a computer-based data sheet for analysis.

Data processing and analysis: The data set was cleaned up before analysis with the Statistical Package for the Social Sciences, version 25.0 (IBM Inc, Chicago, IL, USA). The data set is presented in frequencies and percentages. Statistical associations between categorical variables were analyzed with Chi-square. The statistical level of significance was set at a p-value of < 0.05.

Ethical considerations: Ethical approval was obtained from the Research and Ethics Committee of Delta State University Teaching Hospital, with approval number: HREC/PAN/2024/053/0667.

RESULTS

During the study period of five years, there were a total of 1,101 deliveries, including 64 stillbirths and 1,037 livebirths. Out of the 194 patients who presented at the study facility with obstetric complications, 183(94.3%) patients had adequate data for analysis: of which 129/183 (70.5%) were obstetric "near miss," and 54/183 (29.5%) maternal death.

The MNMIR was 124.3/1000, MNM:MD Ratio was 2.4, and MI was 29.5 %.

Shown in Table 1 are the socio-demographic and clinical characteristics of the patients. There were no significant differences between near miss and women who died, in their age, educational level, occupation, parity, booking status and referral status. However, 72.2% of maternal deaths occurred among patients that presented postpartum, compared to 26.4% near miss ($p < 00.1$).

Table 2 shows the admission diagnosis and the maternal outcome of the patients. Hypertensive disorders of pregnancy were by far, the most common diagnosis at admission for both near miss and maternal death (73.6% versus 59.3% respectively). Obstetric haemorrhage was the next most common diagnosis at presentation, accounting for 12.4 % of patients with near miss and 25.9% of maternal death. One patient (0.8%) with near miss had anaesthetic complication, due to laryngeal oedema and difficult intubation.

Table 3 shows the administrative, financial and clinical difficulties in patients' care. Of the administrative, financial and clinical difficulties encountered in the course of patients' care, late presentation occurred more frequently constituting 48.8% for near miss and 53.7% for maternal death, followed by delay to make payment which constituted 11.6% and 20.4% for near miss and maternal death, respectively.

Table 4 shows that patients who died had relatively more special interventions compared to the near miss. Patients who had serial haemodialysis constituted 29.6% and 13.2%, for maternal death and near miss respectively. More (51.9%) patients who died were mechanically ventilated. These outcomes reflected the severity of organ dysfunctions at presentation.

Table 1: Socio-demographic and clinical characteristics of patients

		Near misses n = 129 N (%)	Mortality n = 54 N (%)	Chi-square	p-value
Age in years	<35	86(66.7)	39(72.2)	0.54	0.46
	≥35	43(33.3)	15(27.8)		
Educational level	None	2(1.6)	0(0.00)	7.31	0.06
	Primary	18(14.0)	2(3.7)		
	Secondary	59(45.7)	33(61.1)		
	Post-secondary	50(38.7)	19(35.2)		
Occupation	Unemployed	28(21.7)	10(18.5)	4.71	0.45
	Unskilled	10(7.8)	5(9.3)		
	Artisan	24(18.6)	13(24.1)		
	Trader	52(40.3)	19(35.2)		
	Farmer	5(3.9)	0(0.00)		
	Professional **	10(7.8)	7(13.0)		
Parity	<2	58(45.0)	25(46.3)	0.93	0.62
	2-4	52(40.3)	24(44.4)		
	≥5	19(14.7)	5(9.3)		
Booking status	Booked at DELSUTH	11(8.5)	0(0.00)	7.41	0.06
	Booked at other facilities	76(58.9)	28(51.9)		
	Unbooked	42(32.5)	26(48.1)		
Referral status	Referred from central hospital Sapele	18(14.0)	10(18.5)	2.84	0.24
	Referred from other facilities	105(81.4)	42(77.8)		
	Self-referral from home/TBA	6(4.7)	2(3.7)		
Pregnancy status at presentation	First trimester	3(2.3)	4(7.4)	39.96	0.00*
	Second trimester	7(5.4)	1(1.9)		
	Third trimester	69(53.5)	8(14.8)		
	Intra-partum	16(12.4)	2(3.7)		
	Post-partum	34(26.4)	39(72.2)		

*Significant; p<0.05.
**Teachers, Lawyers, health professionals, bankers.

Table 2: Admission diagnosis and maternal outcome of the patients

Primary diagnosis*	Near Miss n = 129		Maternal Death n = 54	
	Frequency	%	Frequency	%
*Hypertensive disorders in preg.	95	73.6	32	59.3
Obstetric haemorrhage	16	12.4	14	25.9
Puerperal sepsis	10	7.8	6	11.1
Obstructed labour	4	3.1	1	1.9
Surgical complication	1	0.8	1	1.9
Ruptured uterus	1	0.8	0	0.0
Abortion complications	1	0.8	0	0.0
Anaesthetic complication	1	0.8	0	0.0

***Hypertensive disorders in pregnancy (95):** Severe pre-eclampsia=**56**, Eclampsia=**29**, HELLP (Haemolysis, Elevated Liver enzymes and low Platelet count)=**10**

Table 3: Administrative , financial, and clinical difficulties in patients' care

Items	Near Miss (n= 129)		Maternal Death (n=54)	
	Frequency	%	Frequency	%
Problem with health personnel				
None	122	94.6	52	96.3
Delay in starting treatment	7	5.4	2	3.7
Patients' related problems				
Delay in presentation	63	48.8	29	53.7
Delay in making payment	15	11.6	11	20.4
Refusal of surgery	8	6.2	1	1.9
None	43	33.3	13	24.1
Logistical/ equipment problems				
Lack of bed space	6	4.7	2	3.7
Inadequate ventilators	2	1.6	6	11.1
Inadequate supply of blood from the blood bank.	1	0.8	3	5.6
None	120	93.0	43	79.6

Table 4: Interventions in patients' management

Interventions	Near misses n = 129 N(%)	Mortality n = 54 N(%)	Chi-square	p-value
None	43(33.3)	4(7.4)	38.13	0.00*
Serial haemodialysis	17(13.2)	16(29.6)		
Multiple surgeries	2(1.6)	1(1.9)		
Echocardiography	8(6.2)	1(1.9)		
Mechanical ventilation	20(15.5)	28(51.9)		
Hysterectomy	1(0.8)	1(1.9)		
Massive blood transfusion	1(0.8)	1(1.9)		
Other special intervention*	37(28.7)	2(3.7)		

*Other special interventions for the patients included: Cardioversion, Central venous pressure monitoring, High flow nasal oxygen, Enteral nutrition, management of intravascular coagulopathy

DISCUSSION

This study examined the various indicators of the quality of obstetric services at the Delta State University Teaching Hospital, Oghara, Delta State. The need to synchronize global parameters for defining quality of obstetric care, resulted in the WHO introducing "near miss" criteria to replace maternal mortality ratio, in 2009.[12]

The metric of maternal health services at the DELSUTH, Oghara, as defined by the WHO, showed the following: MMR of 5,200 per 100,000; MNMIR of 124.3/1000; MNM:MD Ratio was 2.4 MI was 29.5 %.

The maternal mortality ratio in this study is much higher than the most recent estimate for Nigeria of 1,047 per 100,000 live births by the World Population Review.[5] A maternal mortality ratio (MMR) of 1,908 per 100,000 livebirths was quoted by Mbachu et al.[9] in the southern part of Nigeria. Studies in developing countries show MMR of 423/100,000 live births and 324/100,000 live births.[13,14] The wide variation in the MMR is due to heterogeneity in study setting, delivery

rates, quality of data, and cost of care. The Delta State University Teaching Hospital, Oghara, is the only well-equipped public tertiary health facility, serving the Delta South and Central senatorial zones. Because of its eccentricity in location, a substantial number of referrals travel long distances on dilapidated road infrastructure to access the facility, with consequential delays. Furthermore, in contrast to the other public hospitals in Delta State that operate on the policy of free maternity services, including free caesarean section,[15] the study facility has an out-of-pocket service which sometimes resulted in type 3 delay,[16] which is the delay in receiving adequate care at a health facility. The delay factors highlighted in this study is consistent with the Nigeria near miss study.[17,18]

The near miss to mortality ratio of 2.4 in this study, means there was one maternal death for every two to three complicated obstetric cases. Higher ratios are indicative of higher quality of care. A ratio of 2.14 was documented in a prospective study conducted in the Eastern part of Nigeria.[19] Other developing countries, such as Syria and Nepal have much better indices of quality of maternal care, such as MNM:MD ratios of 60:1 and 72:1, respectively.[13,14] The factors responsible for the variation in MNM:MD are similar to those responsible for MMR,[20] which include inequitable distribution of health facilities, poor staffing of facilities, poor utilization of antenatal services, poor health seeking behaviour, socio-cultural and religious beliefs, cost of maternity services and transportation. Most of these factors were encountered in the setting for the present study.

Hypertensive disorders in pregnancy were the most common admission diagnosis in both near miss and maternal death in this study. This was followed by a fewer proportion of women, who presented with obstetric haemorrhage and puerperal sepsis. The leading contribution of pre-eclampsia in maternal morbidity and mortality is similar to the findings of other studies.[9,21,22] However, the 73.6% and 59.5%, contribution of hypertensive disorders in pregnancy to near misses and maternal death in this study is disproportionately higher than that for most other studies.[9,18] Most public health facilities in Delta State routinely administer magnesium sulphate (MgSO4); however, the lack of clear treatment protocols, inadequate dosage of the drug, delayed administration, and the absence of ICUs in most referral facilities may explain the high mortality and near miss cases from hypertensive disorders of pregnancy.

The finding of various levels of delay in the present study is in keeping with the findings in other studies.[17,18] In particular, the delay associated with the large number of referrals from other facilities, may have contributed to the high proportion of maternal deaths that occurred among patients that presented postpartum. Strategic investment in health service delivery and road infrastructure in Delta State and Nigeria as a whole is urgently required to eliminate preventable delays associated with maternal morbidity and mortality.

There is an urgent need for a shift in government policy regarding the contributory health insurance of the state, which ostensibly excluded the only well-equipped tertiary health facility in Delta South and Central Senatorial zones from secondary and tertiary levels of care. Because services at DELSUTH, Oghara are out-of-pocket, the study centre often manages complicated obstetric cases from other hospitals across the state that are unable to provide such care. In addition, some of these patients, despite the delay in presentation, are also confronted with the difficulty in raising money for various services, including special interventions. The need to upscale the quality of services at the various primary and secondary health facilities in the state benefiting from free maternity services, cannot be overemphasized, as most of them lack ICUs. The study facility is the only health facility with a functional ICU within the Delta South and Central senatorial zones.

The present study had some limitations. This was a single hospital-based study, albeit, a teaching hospital, thus making generalization difficult. The retrospective design raised the question of data completeness, as authors only made use of information in patients' medical

records. All the limitations highlighted can be overcome by a follow-up prospective longitudinal multi-Centre study.

CONCLUSION

The findings indicate that the maternal health indices are consistent with those of an over-strained healthcare facility, reflecting the consequences of delayed presentation of complicated obstetric cases. These highlight systemic challenges in timely access to obstetric care and emphasize the importance of strengthening antenatal care and referral services.

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There are no conflicts of interest.

REFERENCES

1. Stones W, Lim W, Al-Azzawi F, Kelly M. An investigation of maternal morbidity with identification of life threatening “near miss” episodes. Health Trends 1991;23(1):13-15.
2. Sivalingam N, Looi KW. Clinical experience with management of “near - miss” cases in obstetrics. Med J Malaysia 1999; 54(4): 496-503.
3. Millennium Development Goals: End-Point Report 2015 Nigeria. Abuja, Nigeria: Office of the Senior Special Assistant to the President on Millennium Development Goals (MDGs), 2015. Available from: http//www.sparc-nigeria.com/RC/files/4.2.20.2_Nigeria_MDG_Report_2015_Full_Report. Pdf. Accessed June 3, 2024.
4. National Population Commission (NPC) [Nigeria] and ICF International. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International, 2014.
5. World Population Review. Maternal mortality rate by Country 2025. Available from: https://worldpopulationreview.com/country--rankings/maternal-mortality-rate-by-country. Accessed June 15, 2025.
6. World Health Organization. Evaluating the quality of care for severe pregnancy complications: The WHO near miss approach to maternal health. Geneva: WHO, 2011.
7. Ronsmans C, Filippi V. Reviewing severe maternal morbidity: learning from survivors of life-threatening complications. In: World Health Organization. Beyond the numbers: reviewing maternal deaths and complications to make pregnancy safer. Geneva: WHO, 2004; 103 - 124.
8. Say L, Pattinson RC, Gulmezoglu AM. WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). Reprod Health 2004;1(1):3.
9. Mbachu II, Ezeama C, Osuagwu K, Umeononihu OS, Obiannika C, Ezeama N. A cross-sectional study of maternal near miss and mortality at a rural tertiary centre in Southern Nigeria. BMC Pregnancy Childbirth 2017;17(1):251.
10. Oladapo OT, Adetoro OO, Fakeye O, Ekele BA, Fawole AO, Abasiattai A, et al. National data system on near and maternal death: shifting from maternal risk to public health impact in Nigeria. Reprod Health 2009; 6:8.
11. Roopa PS, Verma S, Rai L, Kumar P, Pai MV, Shetty J. “Near miss” obstetric events and maternal deaths in a tertiary care hospital: an audit. J Pregnancy 2013; 2013: 393758.
12. Say I, Souza JP, Pattinson RC; WHO working group on Maternal Mortality and Morbidity classifications. Maternal near miss-towards a standard tool for monitoring quality of maternal health care. Best Pract Res Clin Obstet Gynecol 2009;23(3):287-296.
13. Shrestha NS, Saha R, Karki C. Near miss and maternal morbidity and mortality at Kathmandu Medical College Teaching Hospital. Kathmandu Univ Med J (KUMJ) 2010;8(30):222-226.

14. Almerie Y, Almerie MQ, Matar HE, Shahrour Y, Al Chamat AA, Abdulsalam A. Obstetric near miss and maternal mortality in maternity university hospital, Damascus, Syria :a retrospective study. BMC Pregnancy Childbirth 2010; 10: 65.
15. Odunvbun WO, Nwachi AA, Oyeye LO, Ojeogwu CI. Impact of free maternity service on caesarean acceptance and perception in Delta State. South South Nigeria. Afr J Trop Med Biomed Res 2019; 4(2): 44-50.
16. Barnes-Josiah D, Myntti C, Augustin A. The “three delays” as a framework for examining maternal mortality in Haiti. Soc Sci Med1998;46(8):981-993.
17. Oladapo OT, Adetoro OO, Ekele BA, Chama C, Etuk SJ, Aboyeji AP, et al. When getting there is not enough: a nationwide cross-sectional study of 998 maternal deaths and 1451 near misses in public tertiary hospitals in a low-income country. BJOG 2016; 123(6):928-938.
18. Souza JP, Gülmezoglu AM, Vogel J, Carroli G, Lumbiganon P, Qureshi Z, et al. Moving beyond essential interventions for reduction of maternal mortality (the WHO multicountry survey on maternal and newborn health): cross-sectional study. Lancet 2013;381(9879): 1747-1755.
19. Ugwu GO, Iyoke CA, Ezugwu EC, Ajah LO, Onah HE, Ozumba BC. A comparison of the characteristics of maternal near misses and maternal deaths in Enugu, Southeast Nigeria: a 3-year prospective study. Int J Women’s Health 2020; 12:207-211.
20. Fawole AO, Shah A, Fabamwo AO, Adegbola O, Adewunmi AA, Eniayewun AB, et al. Predictors of maternal mortality in institutional deliveries in Nigeria. Afr Health Sci 2012; 12(1): 32-40.
21. David E, Machungo F, Zanconato G, Cavaliere E. Fiosse S, Sululu C, et al. Maternal near miss and maternal death in Mozambique: a cross-sectional, region-wide study of 635 consecutive cases assisted in health facilities of Maputo province. BMC Pregnancy Childbirth 2014; 14:401.
22. Nelissen EJT, Mduma E, Ersdal HL, Evjen-Olsen B, van Roosmalen JJM, Stekelenburg J. Maternal near miss and mortality in a rural referral hospital in Northern Tanzania: cross-sectional study. BMC Pregnancy Childbirth 2013; 13:141.

Original Article

Comparing the effectiveness of tetracycline sclerotherapy versus placebo in the prevention of postmastectomy seroma among female patients in a tertiary hospital in Southern Nigeria

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Abstract

Background: Postmastectomy seroma is the commonest complication following mastectomy. It is a cause of significant morbidity for the patient and its management is challenging. Several attempts have been made to prevent or reduce the occurrence of postmastectomy seroma and the results have been inconclusive. Tetracycline is an effective sclerosant and has shown effectiveness in the management of seroma.

Aims: To evaluate the effectiveness of tetracycline sclerotherapy in the prevention of post-mastectomy seroma among women undergoing modified radical mastectomy for breast cancer.

Methods: Seventy-six (76) female patients with histological diagnosis of breast cancer were randomised into 2 groups. Following Auchincloss modified radical mastectomy, both groups had their wounds irrigated with distilled water. Group A in addition, had a suspension of tetracycline instilled. Daily measurements and recording of the drainage volume was done and drain was removed when drainage volume was less than 30mls per day on two consecutive days. The patients were assessed for post-operative pain and other wound complications.

Results: Most patients presented with advanced disease and the predominant histologic sub-type was invasive ductal carcinoma. Seroma was the most common complication followed by wound infection. The incidence of seroma was lower in the tetracycline group 1 (2.6%) than in the control group 5 (13.2%) though this difference did not reach statistical significant ($p = 0.089$). The application of topical tetracycline did not adversely affect healing of the wound.

Conclusion: Patients that had topical tetracycline applied to their wound following mastectomy had reduced incidence of seroma formation though not statistically significant.

Keywords: Postmastectomy, seroma, sclerosant, sclerotherapy, tetracycline, suspension

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INTRODUCTION

Breast cancer is the most commonly diagnosed malignancy affecting women worldwide and a leading cause of cancer-related deaths in women globally.[1] It is the commonest female malignancy in sub-Saharan Africa with an incidence of 20 - 25 per 100,000 women.[2] In Nigeria, it is also the commonest female malignancy.[3]

Optimal treatment outcome for breast cancer depends on early diagnosis and an individualized multimodal approach to management. Current therapies in treating breast cancer include one or a combination of surgery, chemotherapy and radiotherapy.[4]

Current surgical options of treatment include breast conserving surgery and mastectomy with or without axillary lymph node dissection depending on the stage of the disease.[5,6]

Seroma is the most common complication following mastectomy. It is the collection of serous fluid in the dissection bed following mastectomy and/or axillary dissection.[7] Although not a life threatening complication, it is a source of significant morbidity for the patient. Its sequelae include increased rate of surgical site infection, flap necrosis, wound dehiscence and the need for further surgical intervention. It also results in increased hospital stay and delay in commencement of adjuvant therapy.[8,9]

The pathogenesis of seroma has not been fully elucidated. One hypothesis for seroma formation and perhaps the most widely accepted is that impairment in lymphatic drainage results from surgical disruption of lymphatic channels during mastectomy. Consequently, there is accumulation of liquid that forms seroma. This hypothesis is supported by studies in which the analysis of the drained liquid was found to be comparable to lymph.[10] Other factors that have been proposed to be involved in the pathogenesis of seroma include fibrinolytic activity and accumulation of acute inflammatory exudates in response to surgical trauma and acute phase of wound healing.[7]

The management of seroma is challenging to the surgeon. It is ideally managed by repeated needle aspiration of the collection to seal the skin flaps against the chest wall. Seroma aspiration is not without risks as repeated aspirations potentially introduce infection. In reconstructive surgery, where implants are used, this could result in total implant failure.[9] Sometimes seroma can persist despite repeated aspirations and become longstanding. Some researchers have explored techniques in which agents such as talc and tetracycline are introduced into the seroma cavity to promote adhesion of flaps to the chest wall. When these methods fail surgical intervention with either scoring or capsular excision may be indicated.[11]

Several attempts have been made to prevent or reduce the occurrence of postmastectomy seroma including moderate use of electrocautery, suturing the skin flaps to underlying muscle, application of mechanical pressure garment, use of various types of drains and application of sclerosants and sealants, with all of these producing variable results.[12] Tetracycline is an antibiotic that is commonly used in several aspects of surgery as a sclerosant. This study was carried out therefore, to determine the effectiveness of tetracycline sclerotherapy in preventing postmastectomy seroma among female patients undergoing modified radical mastectomy for breast cancer at the University of Benin Teaching Hospital, Benin City, Nigeria.

MATERIALS AND METHODS

The study was a prospective randomized comparative study carried out at the department of surgery, University of Benin Teaching Hospital, Benin City, Nigeria between July 2022 and October 2023.

Ethical approval for the study was obtained from the Ethics Committee of the University of Benin Teaching Hospital.

Seventy-six consecutive adult female patients with histologic diagnosis of breast cancer scheduled for Auchincloss modified radical mastectomy in the General surgical unit of the University of Benin Teaching Hospital were randomly distributed into groups A and B using a computer-generated table of random numbers. Preoperatively the patients were evaluated in the out-patient clinic and socio-demographic data, anthropometric measurements, side of the lesion and histology were noted. At completion of the procedure, the wounds of all the patients were irrigated with distilled water and suctioned. In group A patients, a closed passive drain designed using a size 18FG feeding tube made of plastic was used. Multiple fenestrations were made in the segment of the tube to be placed within the wound. The tube was passed through a separate stab incision on the lateral aspect at the level of the 5th intercostal space and extended through the axilla to the medial side

of the wound. The drain was anchored to the skin using Nylon 1 sutures. The external end of the tube was capped. A suspension of 2g of tetracycline manufactured by Fidson Healthcare PLC in 100mls of normal saline was applied to the chest wall and the underside of the skin flaps using a wet gauze and the wound was closed with Prolene 0 interrupted stitches, and a sterile dressing applied. After 30minutes the drain was then opened and connected to a drainage bag manufactured by Huaian Angel Medical Instruments Co., Limited, Jiangsu, China. In group B patients, after the wound was irrigated with distilled water and suctioned a fenestrated size 18FG feeding tube was passed as in the group A patients and capped. 100mls of normal saline was applied to the chest wall and the underside of the skin flaps using a wet gauze. The wound was closed with Prolene 0 interrupted stitches and a sterile dressing applied. After 30 minutes the drain was then opened and connected to the drainage bag.

Analgesics were commenced post operatively based on the unit's routine pain management plan. Post-operative pain was assessed on post op day 1 using the visual analogue score (VAS). Daily measurement and recording of the drainage volume was done by a research assistant using a calibrated jar and drain was removed when drainage volume was less than 30mls per day on two consecutive days. The wound dressing was changed on days 3, 7, 10 and as indicated. The wound was inspected for infection as evidenced by clinical signs of cellulitis or purulent discharge. Seroma was defined as any clinically apparent fluid collection under the mastectomy flaps after removal of drain. Surgical site infection was defined by pain, erytherma, and seropurulent discharge from the wound.

Data analysis was done using SPSS (Statistical Package for Scientific Solution) Version 23, manufactured by IBM, Chicago, USA. Descriptive statistics was used for the demographic information in both study arms - frequencies, mean, percentages and standard deviation. We assume a normally distributed data and so a students' t-test was used to compare variables between the two groups while the primary outcome measure between the two groups were compared using Chi-square test. The Fishers exact test was also used to compare other outcome measures. A p-value of .05 or less was considered statistically significant.

RESULTS

Seventy-six female patients with a diagnosis of breast cancer were recruited for this study with 38 patients randomly allocated into two groups. Their age ranged from 31 to 85 years with a mean age of 47.0 ± 10.7 years. The mean body mass indices were comparable in both groups, 26.7±3.5 kg/m2 and 25.9±3.3 kg/m2 for the control and tetracycline groups respectively ($p>0.05$).

Fourteen (18.4%) of the patients had hypertension while 6 (7.9%) patients had diabetes mellitus. Most of the patients presented with locally advanced disease (73.7%) and metastatic disease (15.8%). Only 10.5% of patients presented with early disease. Seventy (92.1%) of the participants had histologic diagnosis of invasive ductal carcinoma, 3 (3.9%) invasive lobular carcinoma, 1 (1.3%) mucinous adenocarcinoma, 1 (1.3%) metaplastic adenocarcinoma and 1 (1.3%) carcinoma in-situ. Breast cancer more commonly involved the left breast 43 (56.6%) than the right.

The difference in mean weight of the mastectomy specimen in the study group (1417.9 grams ± 417.7) compared to the control group (1264.5 grams ± 437.6) was not statistically significant ($p>0.05$).

The patients that had topical tetracycline had a higher mean cumulative drainage volume compared to the control group. The difference was statistically significant (747.7mls vs 555.4mls; $p < 0.050$). Six (7.9%) of the participants had seroma, 5 (6.6%) had wound infection, 3 (3.9%) had wound dehiscence and 1 (1.3%) had flap necrosis. The incidence of seroma in the control group was higher than the treatment group (13.2% vs 2.6%; $p=0.089$).

Table 1: Comparison of demographic characteristics of patients in both groups

Variable	All participants N = 76 (%)	Control Group n = 38 (%)	Treatment Group n = 38 (%)	Test statistics	p value
Age (years)					
Mean (SD)	47.0 (10.7)	47.8 (11.4)	46.3 (10.0)	t = 0.598	p = 0.551
Co-morbidity					
DM	6 (7.9)	2 (5.3)	4 (10.5)		
Hypertension	14 (18.4)	9 (23.7)	5 (13.2)		
Nil	56 (73.7)	27 (71.1)	29 (76.3)	F = 1.845	p = 0.421
BMI (kg/m2)					
Mean (SD)	26.3 (3.4)	26.7 (3.5)	25.9 (3.3)	t = 0.916	p = 0.363
Bra Cup Size					
Mean (SD)	38.7 (2.9)	38.6 (3.1)	38.8 (2.8)	t = -0.306	p = 0.761

Table 2: Breast involved, histologic diagnosis and stage of the disease

Variable	All participants N = 76 (%)	Control Group n = 38 (%)	Treatment Group n = 38 (%)	Test statistics	p value
Breast involved					
Right	33 (43.4)	16 (42.1)	17 (44.7)	$\chi^2 = 0.054$	p = 0.817
Left	43 (56.6)	22 (57.9)	21 (55.3)	(df=1)	
Histologic diagnosis					
Carcinoma insitu	1 (1.3)	0 (0.0)	1 (2.6)		
Invasive ductal carcinoma	70 (92.1)	36 (94.7)	34 (89.5)		
Invasive lobular carcinoma	3 (3.9)	1 (2.6)	2 (5.3)		
Mucinous adenocarcinoma	1 (1.3)	1 (2.6)	0 (0.0)		
Metaplastic cancer	1 (1.3)	0 (0.0)	1 (2.6)	F = 3.273	p = 0.707
Stage of disease					
Early	8 (10.5)	5 (13.2)	3 (7.9)		
Locally advanced	56 (73.7)	29 (76.3)	27 (71.1)	$\chi^2 = 1.905$	p = 0.386
Metastatic	12 (15.8)	4 (10.5)	8 (21.0)	(df=2)	
Lymph Node Involvement					
No	8 (10.5)	5 (13.2)	3 (7.9)	$\chi^2 = 0.559$	p = 0.455
Yes	68 (89.5)	33 (86.8)	35 (92.1)	(df=1)	

Table 3: Peri-operative variables of patients in both groups

Variables	All participants N = 76 (%)	Control Group n = 38 (%)	Treatment Group n = 38 (%)	Test statistics	p value
Duration of surgery (mins)					
Mean (SD)	118.4 (10.6)	116.3 (11.1)	120.5 (9.8)	t = 1.748	p = 0.084
Weight of Specimen (g)					
Mean (SD)	1341.2 (431.9)	1264.5 (437.6)	1417.9 (417.7)	t = 1.563	p = 0.122

Table 4a: Pain and drainage outcomes

Variables	All participants N = 76 (%)	Control Group n = 38 (%)	Treatment Group n = 38 (%)	Test statistics	p value
Time of administration of first dose of analgesia (mins)					
< 30	3 (3.9)	0 (0.0)	3 (7.9)		
30 – 60	8 (10.5)	3 (7.9)	5 (13.2)		
61 – 120	25 (32.9)	13 (34.2)	12 (31.6)	$\chi^2 = 3.940$	p = 0.268
>120	40 (52.6)	22 (57.9)	18 (47.4)	(df = 3)	
VAS 1st day post-op					
4	11 (14.5)	5 (13.2)	6 (15.8)		
5	19 (25.0)	12 (31.6)	7 (18.4)		
6	35 (46.1)	19 (50.0)	16 (42.1)		
7	11 (14.5)	2 (5.3)	9 (23.7)		
Mean (SD)	5.6 (0.9)	5.5 (0.8)	5.5 (0.8)	t = -1.265	p = 0.210
Drainage volume (ml)					
Mean (SD)	651.6 (142.2)	555.4 (98.8)	747.7 (110.5)	t = -7.994	p = 0.000
Day of drain removal					
Mean (SD)	7.9 (1.3)	7.2 (1.3)	8.5 (1.1)	t = -4.733	p = 0.000

Table 4b: Complications and recovery

Variables	All participants N = 76 (%)	Control Group n = 38 (%)	Treatment Group n = 38 (%)	Test statistics	p value
Seroma formation					
No	70 (92.1)	33 (86.8)	37 (97.4)	$\chi^2 = 2.895$	p = 0.089
Yes	6 (7.9)	5 (13.2)	1 (2.6)	(df = 1)	
Number of times aspirated (n = 6)					
2	2 (33.3)	1 (20.0)	1 (100.0)		
3	1 (16.7)	1 (20.0)	0 (0.0)		
4	2 (33.3)	2 (40.0)	0 (0.0)		
5	1 (16.7)	1 (20.0)	0 (0.0)	F = 3.011	p = 1.000
Wound Infection					
No	71 (93.4)	36 (94.7)	35 (92.1)		
Yes	5 (6.6)	2 (5.3)	3 (7.9)	F = 0.214	p = 1.000
Flap Necrosis					
No	75 (98.7)	38 (100.0)	37 (97.0)		
Yes	1 (1.3)	0 (0.0)	1 (3.0)	F = 1.013	p = 1.000
Wound Dehiscence					
No	73 (96.1)	36 (94.7)	37 (97.0)		
Yes	3 (3.9)	2 (5.3)	1 (3.0)	F = 0.347	p = 1.000
No. of wound dressings					
1 – 5	69 (90.8)	35 (92.1)	34 (89.5)		
6 – 10	3 (3.9)	2 (5.3)	1 (2.6)		
> 10	4 (5.3)	1 (2.6)	3 (7.9)		
Mean (SD)	4.0 (3.1)	3.7 (2.3)	4.7 (3.7)	t = 1.415	p = 0.161
Day of stitch					

removal					
9	3 (3.9)	2 (5.3)	1 (2.6)		
10	38 (50.0)	20 (52.6)	18 (47.4)		
11	20 (26.3)	9 (23.7)	11 (28.9)		
12	9 (11.8)	5 (13.2)	4 (10.5)		
13	3 (3.9)	2 (5.3)	1 (2.6)		
14	3 (3.9)	0 (0.0)	3 (7.9)		
Mean (SD)	10.7 (1.1)	10.6 (0.9)	10.9 (1.2)	t = -1.032	p = 0.305
Duration of hospital stay					
≤ 7	5 (6.6)	4 (10.5)	1 (2.6)		
> 7 – 14	59 (77.6)	27 (71.1)	32 (84.2)		
> 14	12 (15.8)	7 (18.4)	5 (13.2)		
Mean (SD)	12.4 (2.7)	11.9 (2.8)	12.8 (2.4)	t = 1.504	p = 0.137

Test statistics: t = t test, χ^2 = Chi-square test F = Fisher's exact test

DISCUSSION

Assessment of pain on the first day post mastectomy revealed comparable pain levels in both arms of the study. In a study conducted by Rice et al.,[13] no significant difference in pain levels was observed between the control and tetracycline groups during the immediate postoperative period (p = 0.453). Similarly, Hokkam et al.[14] reported no substantial difference in the severity of pain (p > 0.05) between the control and treatment groups when tetracycline was employed in the management of post-mastectomy seroma.

Topical application of tetracycline has been shown to induce inflammatory response.[15] In addition, pain is one of the most commonly reported complications that occurs following tetracycline pleurodesis for pleural effusion.[16,17] This is contrary to the finding in this study. Injury to sensory nerves during mastectomy causes loss of sensation to the flap and adjoining chest wall and may account for the reason why topical administration of tetracycline did not cause increased sensation of pain in the treatment group.

The patients that had topical tetracycline had a higher mean cumulative drainage volume compared to the control group (p < 0.05). This is in keeping with findings by Rice DC et al[13] who reported a higher mean cumulative drainage volume in patients that had topical tetracycline compared to the control group (901mls vs 689mls). Tetracycline has been demonstrated to induce intense inflammation and causes early exudative effusion when applied topically into the pleural space which could have accounted for the higher mean cumulative drainage volume in the treatment group.[15] The mean day of drain removal in the control group was earlier compared to the study group and the difference was statistically significant (7.2 days ± 1.3 vs 8.5 ± 1.1; p < 0.050). This can be attributed to the increased exudative effusion caused by tetracycline application and consequent increase in post-operative fluid drainage from the wound.

Seroma was the commonest complication and occurred in 7.9% of the total participants. Seroma is the most frequent complication seen after mastectomy and axillary surgery with an incidence of 3 – 85%.[18] Ogundiran et al[19], Hashemi et al[9], Lumachi et al[20], and McCaul et

al[21] all reported seroma as the most common post-operative complication following mastectomy. Disruption of lymphatic channels during mastectomy is an important reason for this finding. The incidence of seroma was higher in the control group (13.2%) than in the tetracycline group (2.6%). This difference however did not reach statistical significance (p = 0.089). Tetracycline induces inflammation and fibrotic response that seals the dead space. The sclerotherapeutic effect of tetracycline may account for the reduced incidence of seroma in the treatment group. Conversely, Rice et al[13] reported a higher incidence of seroma in the tetracycline group compared to the control. The observation of a reduction in the rate of seroma formation in patients who received tetracycline in this study may be attributed to the use of increased dose of tetracycline. Two grams of tetracycline was used in this study as against 1g by the other researcher. While the only patient in the treatment group that developed seroma had the effluent aspirated on two occasions, the patients in the control group had 2 to 5 aspirations. This meant more clinic visits and the consequent financial burden on the patient.

Although the incidence of wound infection is comparable in both groups, more patients in the tetracycline group – 3 patients (7.9%) – developed wound infection postoperatively compared to 2 patients (5.3%) in the control group. The mean day of drain removal for patients in the tetracycline group was latter than for those in the control group. The presence of wound drain for a longer duration in the tetracycline group could have accounted for the increased number of participants with surgical site infection.

There was no statistically significant difference in the occurrence of other post-mastectomy complications in the control and tetracycline groups; wound dehiscence (p = 1.000), flap necrosis (0% vs 3.0% p = 1.000). The control and tetracycline groups had comparable mean days of suture removal (10.6 ± 0.9 vs 10.9 ± 1.2; p = 0.305). The mean duration of hospital stay in the control group was marginally shorter than that of the tetracycline group, although this difference did not reach statistical significance (11.9 ± 2.8 vs 12.8 ± 2.4; p = 0.137). Consequently, the administration of tetracycline neither adversely impacted the wound's healing process nor resulted in a delay in hospital discharge.

LIMITATIONS

Seroma was not objectively assessed using ultrasonography. This may have introduced bias.

Long term follow-up of the participants to detect those that may have had delayed seroma formation and other complications was not feasible due to the short duration of the study.

The relatively small sample size may affect the generalizability of the findings from this study.

CONCLUSION

The findings from this study showed a decreased incidence of seroma formation in patients who received tetracycline solution application to the mastectomy bed compared to the control group. Although this trend may have clinical relevance, it did not reach statistical significance. Conversely, patients who underwent tetracycline solution application experienced increased early exudative drainage from their wounds. Notably, the use of tetracycline solution did not result in a substantial difference in complication rates.

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There are no conflicts of interest.

REFERENCES

1. Stewart BW, Kleihues P (Eds). World cancer report 2003. Lyon: IARC Press, 2003; 156-159.
2. Ly M, Antoine M, Andre F, Callard P, Bernaudin JF, Diallo DA. [Breast cancer in sub-Saharan African women: review]. Bull Cancer 2011; 98(7):797–806.

3. Adebamowo CA, Ajayi OO. Breast cancer in Nigeria. West Afr J Med 2000; 19(3):179–191.
4. Mutebi M, Anderson BO, Duggan C, Adebamowo C, Agarwal G, Ali Z, et al. Breast cancer treatment: a phased approach to implementation. Cancer 2020; 126 Suppl 10:2365–2378.
5. Ali S, Buczek D, Jassem J. Changing paradigms in breast cancer treatment. Eur J Transl Clin Med 2020; 3(2):53–63.
6. Clegg-Lamptey JN, Baako BN, Badoe EA. The breast. In: Archampong EQ, Naaeder SB, Ugwu BT, eds. BAJA's Principles and practice of surgery including pathology in the tropics, 5th ed. Accra: Publishing Division of the Ghana Publishing Corporation, 2015; 505-537.
7. Sampathraju S, Rodrigues G. Seroma formation after mastectomy: pathogenesis and prevention. Indian J Surg Oncol 2010; 1(4):328–333.
8. Budd DC, Cochran RC, Sturtz DL, Fouty WJ Jr. Surgical morbidity after mastectomy operations. Am J Surg 1978; 135(2):218–220.
9. Hashemi E, Kaviani A, Najafi M, Ebrahimi M, Hooshmand H, Montazeri A. Seroma formation after surgery for breast cancer. World J Surg Oncol 2004; 2:44.
10. Kuroi K, Shimozuma K, Taguchi T, Imai H, Yamashiro H, Ohsumi S, et al. Pathophysiology of seroma in breast cancer. Breast Cancer 2005; 12(4):288–293.
11. Turner EJ, Benson JR, Winters ZE. Techniques in the prevention and management of seromas after breast surgery. Future Oncol 2014; 10(6):1049–1063.
12. Agrawal A, Ayantunde AA, Cheung KL. Concepts of seroma formation and prevention in breast cancer surgery. ANZ J Surg 2006; 76(12):1088–1095.
13. Rice DC, Morris SM, Sarr MG, Farnell MB, Van Heerden JA, Grant CS, et al. Intraoperative topical tetracycline sclerotherapy following mastectomy: a prospective, randomized trial. J Surg Oncol 2000; 73(4):224–227.
14. Hokkam E, Farrag S, El Kammash S. Tetracycline sclerotherapy in treating postmastectomy seroma: a simple solution for a frequently occurring problem. Egypt J Surg 2009; 28(3):99–104.
15. Alqhtani A. Tetracycline sclerotherapy for seroma: a systematic review. J Pharm Drug Deliv Res 2020; 9:1.
16. Shouman W, Elgazzar A, Hussien RM, El-Shaaray M, Light RW. Chemical pleurodesis for malignant pleural effusion. Egypt J Chest Dis Tuberc 2012; 61(3):115–120.
17. Gravelyn TR, Michelson MK, Gross BH, Sitrin RG. Tetracycline pleurodesis for malignant pleural effusions. A 10-year retrospective study. Cancer 1987; 59(11):1973-1977.
18. Garzali IU, El-Yakub AI. Factors affecting seroma formation after mastectomy among West African patients: a single center experience in North West Nigeria. PAMJ Clin Med 2020; 3:174.
19. Ogundiran TO, Ayandipo OO, Ademola AF, Adebamowo CA. Mastectomy for management of breast cancer in Ibadan, Nigeria. BMC Surg 2013; 13:59.
20. Lumachi F, Brandes AA, Burelli P, Basso SMM, Iacobone M, Ermani M. Seroma prevention following axillary dissection in patients with breast cancer by using ultrasound scissors: a prospective clinical study. Eur J Surg Oncol 2004; 30(5):526–530.
21. McCaul JA, Aslaam A, Spooner RJ, Louden I, Cavanagh T, Purushotham AD. Aetiology of seroma formation in patients undergoing surgery for breast cancer. Breast 2000; 9(3):144–148.

Original Article

Dental pain and oral health-related quality of life of patients attending a Nigerian tertiary hospital - a cross-sectional study

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Abstract

Background: Poor oral health significantly compromises quality of life. While the link between oral conditions and Oral Health-Related Quality of Life (OHRQoL) is established, specific data on the impact of dental pain from various oral conditions in Nigerian patient populations is scarce. This study addresses that gap.

Aim: To assess the impact of dental pain on OHRQoL among patients at the University of Port Harcourt Teaching Hospital, Rivers State, Nigeria.

Methods: A descriptive, cross-sectional study conducted among patients attending the University of Port Harcourt Teaching Hospital (UPTH). Semi-structured questionnaires were used for data collection. The questionnaire had three sections. Section A included information on socio-demography, Section B on diagnosis and duration of dental pain, and Section C on the short form of the Oral Health Impact Profile questionnaire (OHIP-14) to evaluate the QHRQoL of dental pain among patients. Data were analysed using SPSS version 27.0, with statistical significance set at $p < 0.05$.

Results: There were 212 participants [66 (31.1%) males and 146 (68.9%) females]. 'Physical pain' was the most severely affected domain. Maxillofacial fractures (mean OHIP-14: 31.3 ± 13.8), pericoronitis (28.6 ± 10.9), and dental caries (27.5 ± 11.5) had the highest negative impact. Most participants with these conditions reported negative OHRQoL impact ($p <0.001$). Gingivitis had the least impact.

Conclusion: Dental pain, particularly from maxillofacial fractures, pericoronitis, and caries, greatly impairs OHRQoL. Hence, the need for targeted, prompt management of painful dental conditions to improve patient well-being and highlights the value of OHRQoL measures in clinical assessment.

Keywords: Dental pain, oral health, quality of life, OHIP-14, Nigeria

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INTRODUCTION

Oral health is an essential aspect of general health. [1] It is multidimensional in nature, including physical, psychological, emotional, and social domains that are fundamental to overall health and well-being.[2] The impact of oral health on quality of life has been reported in the literature. [3] Poor oral health has a significant influence on the quality of life and can adversely affect people's daily lives and well-being. It causes discomfort, pain, difficulty with eating and chewing, speech and aesthetic problems as well as social embarrassment. [4, 5]

The World Health Organisation (WHO) defined quality of life as "perceptions of

people's position in life in the context of culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns." [6] While the United States Surgeon General's report defined OHRQOL as "A multidimensional construct that reflects (among other things) people's comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health." [7] There has been an increasing emphasis on OHRQoL as it measures ill-health in terms of its origins and impacts, due to the limitations of disease-based measures of oral health state. OHRQoL is associated with functional, psychological, and social factors and experience of pain or discomfort. It is assessed using multiple-item questionnaires such as the Geriatric Oral Health Assessment Index (GOHAI), Oral Impact on Daily Performance (ODIP), European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire—Oral Supplement (EORTC QOQ OH-17), Chewing Function Questionnaire and Oral Health Impact Profile-14 (OHIP-14). [4, 8, 9]

The OHIP-14 is an ideal measure of patients' perceptions concerning their oral health. [10] It is considered a short, valid, reliable questionnaire, with adequate cross-cultural consistency and is sensitive to changes. [11] It is considered to be one of the most internationally spread OHRQoL indicators, available in several languages. OHIP- 14 enquires into oral impacts in seven dimensions: functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. Participants respond on 5-point Likert scales according to the frequency of effects over a six-month reference period.[12]

Oral diseases such as caries, dental fluorosis, tooth loss, periodontal disease, dental injuries, oral cancer, dental anomalies, craniofacial disorders have a negative impact on oral health-related quality of life (OHRQoL). [13] In Nigeria, the association between sociodemographic factors, clinical dental conditions, oral health behaviors, and OHRQoL were investigated in children, [14] older adults, [15] and public workers. [16] However, there is a paucity in the literature of studies on the impact of dental pain caused by different dental conditions on oral health-related quality of life among Nigerian dental patients, especially in Port Harcourt, which represents a knowledge gap. Hence, this study aims to assess the effect of oral pain caused by different dental conditions on oral health-related quality of life among patients attending the dental clinic at the University of Port Harcourt Teaching Hospital.

METHODOLOGY

Study design and study setting

This was a descriptive, cross-sectional study conducted among patients who attended the Oral Diagnosis Clinic of the University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt, Rivers State. The hospital is located about 15km away from Port Harcourt city, along the East-West Road in Obio/Akpor Local Government Area of Rivers State.

Ethical approval

Ethical approval was obtained from the Health Research and Ethics Committee of the Institution (UPTH/ADM/90/S.II/VOL.XI/1219), followed by participants' consent before commencement of the study.

Study participants

Participants were recruited using a convenience sampling method. The participants were patients with dental pain who attended the Oral Diagnosis Clinic, UPTH. Inclusion criteria included patients with dental pain who were present at the time of data collection, had clear consciousness, were able to make independent judgments and gave consent to participate in the study. Exclusion criteria were patients without dental pain and patients with dental pain who did not give consent to participate in the study, mental disorders or other serious illnesses.

Study size determination

With reference to a previous study, [17] the prevalence of patients whose periodontitis had an impact on their quality of life was 86.7%.

The formula $N = Z^2pq/d^2$ was utilised, and the minimum sample size calculated was 182. However, in this study, 212 questionnaires were retrieved and accurately filled out.

Data sources

Data were collected over 6 months (November 2024 to May 2025), using semi-structured, self-administered questionnaires. A total of 230 questionnaires were retrieved; 18 questionnaires were discarded because they were not completed accurately, and only 212 were accurately completed, resulting in a response rate of 92.2%. The questionnaire had three sections. Section A included information on socio-demography (age, gender, and educational status). Section B included information on the diagnosis and duration of dental pain. Section C included information on the short form (English version) of the Oral Health Impact Profile questionnaire (OHIP-14) to evaluate Oral Health Quality of Life of dental pain among patients. The OHIP-14 is composed of 14 items that assess seven different dimensions, evaluating their impact as dental pain on the perception of the individuals regarding their own quality of life. Each of the 14 OHIP items or questions has a set of possible answers distributed on a Likert scale (4 = very often, 3 = fairly often, 2 = occasionally, 1 = hardly ever, 0 = never), which represents the frequency that the individual perceives the impact of oral health on seven dimensions: functional limitation (evaluated by items 1 and 2), physical pain (evaluated by items 3 and 4), psychological discomfort (evaluated by items 5 and 6), physical disability (evaluated by items 7 and 8), psychological disability (evaluated by items 9 and 10), social disability (evaluated by items 11 and 12) and handicap (evaluated by items 13 and 14) [11] To calculate OHIP-14, total scores range from 0 to 56 calculated by summing the ordinal values for the 14 items. The higher the OHIP-14 scores, the worse the OHRQoL and the lower the OHIP scores, the better the OHRQoL.[12] For cross tabulation, the OHIP score was dichotomised as "OHIP = 0 (i.e. no impact: Never, hardly ever (0–14)) and OHIP =1 (i.e. impact on daily performance: occasionally, fairly often, very often (15–56)".

The periodontal health was assessed using the community periodontal index (CPI) with the aid of standardized CPITN-C probe and mouth mirror. Dental caries was assessed using the decayed, missing, and filled teeth index (DMFT) as recommended by the World Health Organisation. [18] Pericoronitis was diagnosed by the presence of an inflamed operculum covering an unerupted third molar. [19] Dentine hypersensitivity was assessed using Schiff's scale of sensitivity to cold air. [20] Maxillofacial fracture was diagnosed by the presence of a midfacial or mandibular fracture, verified through orthopantomography. [21]

The reliability of the instrument was assessed using 10 patients other than those recruited for the study. The reliability of the instruments was determined using Cronbach's alpha, and an alpha coefficient of 0.82 was obtained. Examination of oral conditions was done by two examiners, and the Cohen's kappa coefficient for inter-examiner variation was 0.84.

Statistical analysis

Statistical analysis was done using the Statistical Product and Service Solution (SPSS) version 27.0 (IBM SPSS Inc., Chicago, Illinois). Continuous variables were expressed as mean ± standard deviation. Categorical variables were presented as frequencies and percentages. Differences between groups were compared using the chi-square test or Fisher's exact test for categorical variables, p-value < 0.05 was considered statistically significant. Fisher's exact test was used in this study because some cells had expected frequencies less than 5, which makes the chi-square test inaccurate.

RESULTS

Sociodemographic characteristics of participants

There were 212 participants with an age range of 17 – 98 years and a mean age of 37.0 ± 15.8 years. There were 66 (31.1%) males and 146 (68.9%) females with M: F of 1:2.1. Most of the participants, 70 (33.0%), were in the 20-29 age group, and 138 (65.1%) participants had tertiary education.

Distribution of diagnoses for dental pain among participants

Figure 1 shows that 68 (32.1%), 59 (27.8%), 29 (13.7%) and 19 (8.9%) participants respectively presented with periodontitis, dental caries, pericoronitis and dentine hypersensitivity.

Distribution of responses to Oral Health Impact Profile (OHIP-14) among participants

Table 1 shows that the OHIP-14 domain with the highest mean value was physical pain (pain aching = 2.74 ± 1.20 and uncomfortable eating = 2.66 ± 1.33). Psychological discomfort had the next mean OHIP-14 score (self-consciousness = 2.14 ± 1.42 and felt tense = 1.87 ± 1.45). Functional limitation (difficulty pronouncing words = 0.59 ± 1.15 and loss of taste = 0.79 ± 1.22) had the lowest mean OHIP-14 score.

Impact of different dental pain diagnoses on the domains of the OHIP-14 scale

Table 2 shows that periodontitis had an impact on physical pain, psychological discomfort and physical disability OHIP-14 domains, with a mean OHIP-14 score ≥ 3.50 +2.58. Dental caries had an impact on physical pain, psychological discomfort, physical disability, psychological disability and social disability domains with mean OHIP-14 scores of ≥ 3.53 ± 2.12, while maxillofacial fractures had an impact on all the domains of OHIP-14 with mean OHIP-14 scores of ≥ 3.24 ± 1.42.

Relationship between diagnosis of dental pain and Oral Health Impact Profile (OHIP-14) scores among participants

Table 3 shows that participants who had maxillofacial fractures had the highest mean OHIP-14 score of 31.3 ± 13.8. Participants with pericoronitis and dental caries, respectively, had mean OHIP-14 scores of 28.6 ± 10.9 and 27.5 ± 11.5, while participants with periodontitis had a mean OHIP-14 score of 20.9 ± 12.6. The overall mean OHIP-14 score was 22.9 ± 12.7.

Gingivitis had no impact on the OHRQoL of 14 (66.7%) participants but had a negative impact on the OHRQoL of 7 (33.3%) participants. Periodontitis had no impact on the OHRQoL of 25 (36.8%) participants, but it had an impact on the OHRQoL of 43 (63.2%) participants. Dental caries had an impact on the OHRQoL of 50 (84.7%) participants, while maxillofacial fractures had an impact on the OHRQoL of 7 (100.0%) participants. This finding is statistically significant. ($p < 0.001$).

Sociodemographic distribution of Oral Health Impact Profile (OHIP-14) scores among participants

Table 4 shows that the oral conditions had no impact on 20 (30.3%) males, while they had a negative impact on 46 (69.7%) males. Among females, the oral conditions had a negative impact on 102 (69.7%). This finding is not statistically significant ($p = 0.981$). Considering the age group, the oral conditions had a negative impact on 58 (82.9%) participants within the 20 - 29 years age group and 13 (65.0%) participants within the 50 - 59 years age group. This finding is statistically significant ($p = 0.003$).

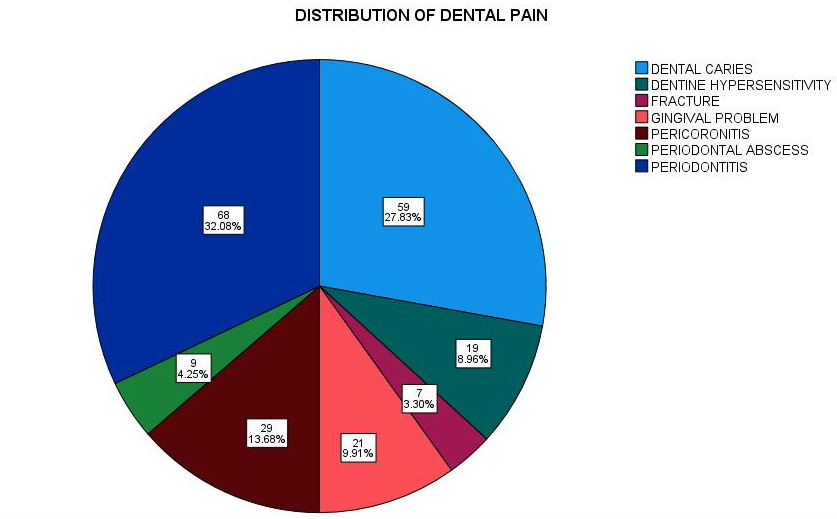

Figure 1: Distribution of diagnoses for dental pain among participants

Table 1: Distribution of responses to Oral Health Impact Profile (OHIP-14) among participants

	Responses N (%)					
	No Impact		Negative Impact			
OHIP-14 Domain and Questions	**Never**	**Hardly often**	**Occasionally**	**Fairly often**	**Very often**	**Mean ± SD**
Functional limitation:						
Difficulty pronouncing words	155 (73.1)	19 (9.0)	19 (9.0)	8 (3.8)	11 (5.2)	0.59 ± 1.15
Loss of taste	136 (64.2)	22 (10.4)	27 (12.7)	17 (8.0)	10 (4.7)	0.79 ± 1.22
Physical pain:						
Painful aching	17 (8.0)	5 (2.4)	70 (33.0)	44 (20.8)	76 (35.8)	2.74 ± 1.20
Uncomfortable eating	25 (11.8)	13 (6.1)	47 (22.2)	51 (24.1)	76 (35.8)	2.66 ± 1.33
Psychological discomfort:						
Self-consciousness	41 (19.3)	29 (13.7)	50 (23.6)	43 (20.3)	49 (23.1)	2.14 ± 1.42
Felt tense	56 (26.4)	30 (14.2)	51 (24.1)	35 (16.5)	40 (18.9)	1.87 ± 1.45
Physical disability:						
Unsatisfactory diet	49 (23.1)	24 (11.3)	53 (25.0)	45 (21.2)	41 (19.3)	2.02 ± 1.43
Interruption of meals	49 (23.1)	21 (9.9)	61 (28.8)	42 (19.8)	39 (18.4)	2.00 ± 1.40
Psychological disability:						
Lack of relaxation	48 (22.6)	28 (13.2)	58 (27.4)	31 (14.6)	47 (22.2)	2.00 ± 1.44
Embarrassed	89 (42.0)	40 (18.9)	43 (20.3)	22 (10.4)	18 (8.5)	1.25 ± 1.32
Social disability:						
Irritable with others	88 (41.5)	38 (17.9)	45 (21.2)	30 (14.2)	11 (5.2)	1.24 ± 1.27
Difficulty at work	80 (37.7)	31 (14.6)	50 (23.6)	28 (13.2)	23 (10.8)	1.45 ± 1.39
Handicap:						
Less satisfied with life	111 (52.4)	32 (15.1)	34 (16.0)	18 (8.5)	17 (8.0)	1.05 ± 1.32
Unable to function	105 (49.5)	33 (15.6)	39 (18.4)	18 (8.5)	17 (18.0)	1.10 ± 1.32

Table 2: Impact of different dental pain diagnoses on domains of the OHIP-14 scale

Diagnoses of dental pain	Domains of OHIP-14 Mean ±SD						
	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability	Handicap
Periodontitis	1.48 ± 2.22	4.85 ± 2.13	3.75 ± 2.41	3.50 ± 2.58	1.49 ± 2.22	2.46 ± 2.38	1.91 ± 2.27
Dental caries	1.58 ± 2.09	6.15 ± 1.76	4.59 ± 2.49	4.81 ± 2.51	3.86 ± 2.41	3.53 ± 2.12	2.98 ± 2.66
Dental hypersensitivity	0.26 ± 0.65	5.32 ± 2.06	3.37 ± 2.39	3.74 ± 2.56	2.42 ± 2.69	1.47 ± 1.95	1.21 ± 1.27
Maxillofacial fractures	3.24 ± 1.42	7.57 ± 0.79	4.86 ± 3.02	4.57 ± 2.44	3.86 ± 2.12	4.00 ± 2.72	3.28 ± 2.82
Gingivitis	0.86 ± 1.42	3.48 ± 2.20	1.95 ± 2.11	2.19 ± 2.42	1.33 ± 1.881	1.24 ± 1.89	0.76 ± 1.26
Pericoronitis	1.79 ± 1.98	6.03 ± 2.03	5.41 ± 2.58	5.24 ± 2.23	4.34 ± 2.18	3.24 ± 2.34	2.55 ± 2.61
Periodontal abscess	0.33 ± 0.71	5.56 ± 2.13	3.22 ± 1.99	3.44 ± 2.24	0.33 ± 0.71	2.33 ± 2.35	1.44 ± 1.94

Table 3: Relationship between the diagnoses of dental pain and Oral Health Impact Profile-14 scores among participants

Diagnosis of dental pain	Mean OHIP-14 score (mean ± SD)	OHIP-14 score N (%)		P value
		No impact: Never, hardly ever (0 - 14)	Negative impact: occasionally, fairly often, very often (15 - 56)	
Periodontitis	20.9 ± 12.6	25 (36.8)	43 (63.2)	< **0.001***
Dental caries	27.5 ± 11.5	9 (15.3)	50 (84.7)	
Dentine hypersensitivity	17.8 ± 11.4	10 (52.6)	9 (47.4)	
Maxillary/mandibular fracture	31.3 ± 13.8	0 (0.0)	7 (100.0)	
Gingivitis	11.8 ± 10.6	14 (66.7)	7 (33.3)	
Pericoronitis	28.6 ± 10.9	3 (10.3)	26 (89.7)	
Periodontal abscess	19.3 ± 8.5	3 (33.3)	6 (66.7)	

***Significant**

Table 4: Sociodemographic distribution of Oral Health Impact Profile (OHIP-14) scores among participants

Variables		OHIP-14 SCORE N (%)		P value
		No impact: Never, hardly ever (0 - 14)	Negative Impact: Occasionally, fairly often, very often (15 - 56)	
Gender	Male	20 (30.3)	46 (69.7)	0.981
	Female	44 (30.1)	102 (69.7)	
Age group (in years)	< 20	4 (20.0)	16 (80.0)	**0.003***#
	20 – 29	12 (17.1)	58 (82.9)	
	30 – 39	15 (36.6)	26 (63.4)	
	40 – 49	12 (35.3)	22 (64.7)	
	50 – 59	7 (35.0)	13 (65.0)	
	60 – 69	13 (59.1)	9 (40.9)	
	≥70	1 (20.0)	4 (80.0)	
Educational status	Informal	1(33.3)	2 (66.7)	0.255#
	Primary	1 (12.5)	7 (87.5)	
	Secondary	16 (25.4)	47 (74.6)	
	Tertiary	46 (33.3)	92 (66.7)	

***Significant #Fisher exact**

DISCUSSION

Oral diseases have a negative impact on oral health-related quality of life (OHRQoL).[13] In this study, the two most common dental diseases were periodontitis and dental caries, both caused by the accumulation of bacteria in dental plaque. [22] This finding is in tandem with reports in the literature. [23, 24]

The oral health-related quality of life (OHRQoL) was assessed using the OHIP-14, which is a reliable measure of individuals' perceptions regarding their own oral health and their expectations from treatments and services. [11] In this study, the domain with the highest mean OHIP-14 score was painful aching and uncomfortable eating. This finding is in concordance with results from previous studies conducted among dental patients.[17, 25] However, this finding is contrary to the findings from a previous study, where self-consciousness (psychological impact) was the highest impact.[16] The difference may be because the present study was conducted among participants with dental pain, and pain is a grave concern of patients with oral conditions and is the predominant reason for dental clinic visits, [26] while the study by Aikins et al [16] was conducted among healthy participants.

The mean OHIP-14 score of the participants was 22.9 ± 12.7, which indicates a high impact on the oral health-related quality of life of the participants. This finding is higher than the mean OHIP-14 from previous studies. [17, 25] The differences could be because of the type of oral conditions assessed and the OHIP scaling method used; the study by Lawal et al [17] assessed participants with dental caries and periodontitis only, while the present study assessed participants with dental caries, periodontitis and other oral conditions such as maxillofacial fracture and pericoronitis, etc. The study by An et al [25] used the OHIP-5 scale, while the present study used the OHIP-14 scale. Participants who presented with maxillofacial fractures had the highest mean OHIP-14 scores and had an impact on all the domains of the OHIP-14. This finding is in tandem with those from other studies, where maxillofacial fractures were reported to negatively impact all domains of the OHIP-14

scale, having both short and long-term impacts on the patients, also the patients needed psychological assessment for improvement of their OHRQoL.[27, 28] In this study, participants with pericoronitis had a higher mean OHIP-14 score after maxillofacial fracture. This may be because pericoronitis, which is often associated with partially erupted and impacted third molars, [29] can lead to pericoronal abscess, peritonsillar abscess, limited mouth opening and Ludwig's angina, which could result in airway compromise requiring emergency hospital treatment. These symptoms reduce the individual's quality of daily life. [30] This finding was validated in this study, as pericoronitis had an impact on all domains of the OHIP-14 scale except functional limitation and handicap.

Dental caries was reported to affect the physical limitation and psychological discomfort domains of the OHIP-14, hence decreasing the quality of life of patients. [25, 31, 32] This report aligns with the findings in this study, as dental caries had an impact on physical pain, psychological discomfort, physical disability, psychological disability and social disability. Regarding participants with periodontal disease, the mean OHIP-14 score was highest in those with periodontitis, then decreased in periodontal abscess, dentine hypersensitivity, with the lowest score in participants with gingivitis. Furthermore, periodontitis had an impact on psychological discomfort and physical pain. This finding follows the trend in previous studies, where periodontitis was reported to affect the functional, physical, and psychological domains.[33, 34] Gingivitis only had an impact on physical pain, which indicates that gingivitis had less impact on OHRQoL compared to other oral conditions.

Concerning the relationship between the diagnoses of dental pain and Oral Health Impact Profile-14 scores among participants, all the oral conditions except gingivitis had higher negative impact on the participants; this finding is statistically significant. This reiterates the importance of oral health as a vital component of general health and its consequences on public health.

Regarding the relationship between sociodemographic with the OHIP-14 score, there was a greater negative impact on females compared to males; however, this finding was not statistically significant. This finding follows the trends of previous studies. [16,17.25] However, there was a statistically significant association between the age groups and the OHIP-14 score. This finding is contrary to the findings from previous studies, [16, 25] where there were no statistically significant relationships between the age groups and the OHIP-14 score. This may be because of the difference in age grouping in the studies. There was no statistically significant association between educational status and OHIP-14 score; this finding aligns with previous studies. [16, 25]

This study is not without limitations; these include that it was a cross-sectional study, which prevents causal inferences. Convenience sampling was used, which limits generalizability. The data were self-reported, which has potential for recall and social desirability bias. Furthermore, the sample was limited to individuals attending a single tertiary hospital in Nigeria, which may have introduced selection bias and limited the generalizability of the findings to other populations. However, to the best of our knowledge, this is the first study to assess oral health-related quality of life among dental patients who presented in the dental clinic with pain from diverse oral conditions in the south-south region of Nigeria.

Recommendations

A longitudinal study is recommended to compare the pre- and post-treatment OHIP-14 scores for oral conditions. Also, a multicentre study is recommended to compare OHIP-14 scores among dental patients across various hospitals.

CONCLUSION

The overall-mean OHIP-14 score for the participants was 22.9 ± 12.7. Maxillofacial fractures, pericoronitis and dental caries, respectively, had higher negative impact on the

quality of life of the participants. There was a statistically significant association between the oral conditions and OHIP-14 scores (p = < 0.001).

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There are no conflicts of interest.

REFERENCES

1. Fiorillo L. Oral health: the first step to well-being. Medicina (Kaunas) 2019;55(10):676.
2. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. Lancet 2019;394(10194):249-260.
3. Koistinen S, Olai L, Ståhlnacke K, Fält A, Ehrenberg A. Oral health-related quality of life and associated factors among older people in short-term care. Int J Dent Hyg 2020;18(2):163-172.
4. Bennadi D, Reddy CV. J Oral health-related quality of life. J Int Soc Prev Community Dent 2013;3(1):1–6.
5. Lyons D, Zarzeczny A, Kahar P. Examining oral hygiene behaviours, oral health-related quality of life, and attitudes toward oral health among minority students. Cureus 2024;16(5):e60209.
6. The World Health Organisation Quality of Life Assessment (WHOQOL): Position paper from the World Health Organisation. Soc Sci Med 1995;41(10):1403-1409.
7. US Department of Health and Human Services. Oral health in America: A report of the Surgeon General. Rockville, Maryland: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institute of Health, 2000.
8. Mittal H, John MT Sekulić S, Theis-Mahon N, Rener-Sitar K. Patient-reported outcome measures for adult dental patients: a systematic review. J Evid Based Dent Pract 2019;19(1):53-70.
9. Riva F, Seoane M, Reichenheim, ME, Tsakos G, Celeste RK. Adult oral health-related quality of life instruments: a systematic review. Community Dent Oral Epidemiol 2022;50(5):333-338.
10. Oliveira BH, Nadanovsky P. Psychometric properties of the Brazilian version of the oral health impact profile-short form. Community Dent Oral Epidemiol 2005;33(4):307-314.
11. Saber F, Dawoud M, Hanafy SS, Omar OM. Evaluation of oral health-related quality of life in a group of dental students enrolled in Cairo University: a cross-sectional study**.** J Drug Deliv Ther 2023;13(9):8-14.
12. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. Community Dent Health 1994;11(1):3-11.
13. Mulla M. Impact of oral diseases and conditions on oral health-related quality of life: a narrative review of studies conducted in the Kingdom of Saudi Arabia. Cureus 2021;13(9):e18358.
14. Afolabi JB, Oziegbe EO, Adegoke SA, Adefehinti O, Oyetola EO, Folayan MO. Impact of dental caries on the quality of life of children with sickle cell anaemia in Nigeria. J Public Health Afr 2025;16(4):a1517.
15. Braimoh OB, Alade GO. Oral health-related quality of life and associated factors of elderly population in Port Harcourt, Nigeria. Saudi J Oral Sci 2019;6(1):18-24.
16. Aikins EA, Ordinioha B. Impact of oral diseases on the quality of life of public service workers in Port Harcourt, Nigeria. J Orofac Res 2015;5(2):46-50.
17. Lawal FB, Taiwo JO, Arowojolu MO. How valid are the psychometric properties of the oral health impact profile-14 measure in adult dental patients in Ibadan, Nigeria? Ethiop J Health Sci 2014;24(3):235-242.
18. World Health Organisation. Oral health surveys: basic methods, 5th edition. Geneva: World Health Organisation, 2013.
19. Schmidt J, Kunderova M, Pilbauerova N, Kapitan M. A review of evidence-based

recommendations for pericoronitis management and a systematic review of antibiotic prescribing for pericoronitis among dentists: inappropriate pericoronitis treatment is a critical factor of antibiotic overuse in dentistry. Int J Environ Res Public Health 2021;18(13):6796.
20. Dionysopoulos D, Gerasimidou O, Beltes C. Dentin hypersensitivity: etiology, diagnosis and contemporary therapeutic approaches - A review in literature. Appl Sci (Basel) 2023;13(21):11632.
21. van der Zaag PD, Rozema R, Reininga IHF, van Minnen B; REDUCTION study group members. Standardized clinical examination of maxillofacial injury: fracture diagnostic accuracy across experience levels. Eur J Trauma Emerg Surg 2025;51(1):251.
22. Larsen T, Fiehn NE. Dental biofilm infections - an update. APMIS 2017;125(4):376-384.
23. GBD 2017 Oral Disorders Collaborators; Bernabe E, Marcenes W, Hernandez CR, Bailey J, Abreu LG, Alipour V, et al. Global, regional, and national levels and trends in burden of oral conditions from 1990 to 2017: a systematic analysis for the global burden of disease 2017 study. J Dent Res 2020;99(4):362–373.
24. Morales A, Strauss FJ, Hämmerle CHF, Romandini M, Cavalla F, Baeza M, et al. Performance of the 2017 AAP/EFP case definition compared with the CDC/AAP definition in population-based studies. J Periodontol 2022;93(7):1003-1013.
25. An R, Li S, Li Q, Luo Y, Wu Z, Liu M, et al. Oral health behaviours and oral health-related quality of life among dental patients in China: a cross-sectional study. Patient Prefer Adherence 2022;16:3045–3058.
26. Devaraj CG, Eswar P. Reasons for use and non-use of dental services among people visiting a dental college hospital in India: a descriptive cross-sectional study. Eur J Dent 2012;6(4):422-427.
27. Mahat AK, Panta N, Shrewastwa MK, Puri R, Basnet LB. Short- and long-term impact on oral health-related quality of life after maxillofacial trauma. J Nepal Health Res Counc 2023;21(1):76-80.
28. de Carvalho Andrade AK, de Mendonca MPR, de Alcantara Pinto CM, de Jesus Rodrigues Mello M, Benevides BS, de Barros Silva PG, et al. Oral health status and dental care for hospitalised patients with facial fractures. Res Soc Dev 2021;10(8):e15810816637.
29. Pepper T, Konarzewski T, Grimshaw P, Combes J. Treatment of mandibular third molars and pericoronitis in British military personnel: Influence of guidelines from the National Institute for Health and Clinical Excellence. Br J Oral Maxillofac Surg 2016;54(10):1111–1115.
30. Magraw CB, Golden B, Phillips C, Tang DT, Munson J, Nelson BP, et al. Pain with pericoronitis affects quality of life. J Oral Maxillofac Surg 2015;73(1):7-12.
31. Bukhari OM. Dental caries experience and oral health-related quality of life in working adults. Saudi Dent J 2020;32(8):382-389.
32. de Albuquerque LS, de Queiroz RG, Abanto J, Strazzeri Bönecker MJ, Soares Forte FD, Sampaio FC. Dental caries, tooth loss and quality of life of individuals exposed to social risk factors in Northeast Brazil. Int J Environ Res Public Health 2023;20(17):6661.
33. Bhargava N, Jadhav A, Kumar P, Kapoor A, Mudrakola DP, Singh S. Oral health-related quality of life and severity of periodontal disease. J Pharm Bioallied Sci 2021;13(Suppl 1):S387-S390.
34. Slowik J, Panasiuk A, Kaczor M, Wnuk M. Oral health-related quality of life in patients with periodontitis: a systematic review and meta-analysis. Front Oral Health 2025;6:1503829.

Original Article

Pattern of lip competence and its association with malocclusion traits: a retrospective analysis of cases seen at a tertiary institution

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Abstract

Background: The lips are central to facial aesthetics, but it is their competence pattern that determines whether they meet aesthetic standards or not.

Aim: To assess the pattern of lip competence and its relationship to overjet and other malocclusion traits in patients seen at a tertiary hospital in South-South Nigeria and gender variations.

Methods: A retrospective study was conducted from June 2015 to June 2025. Case notes of 454 orthodontic patients who attended the hospital's orthodontic unit were reviewed. Case notes lacking complete information were excluded. Data on socio-demographics, overjet, molar relationship, and lip patterns were collected and analyzed using IBM SPSS version 26. Descriptive statistics (frequencies and percentages) and inferential statistics (Chi-square test) were used, with level of significance set at $p < 0.05$.

Results: Of the 454 patients, 179 (39.4%) were males, and 275 (60.6%) were females, with a mean age of 15.36 ± 8.05 years. The 10–19-year age group had the highest representation (261, 57.5%). Incompetent lip seal was most prevalent in Angle's Class II malocclusion (75.0%) and also common in Class I (65.3%) cases. Increased and normal overjet were significantly associated with incompetent lips (75.4% and 51.4%, respectively; $p = 0.001$). Incompetent lips were more common in females (61.8%).

Conclusion: Incompetent lip seal was associated with both increased and normal overjet and was more associated with Angle's class I malocclusion.

Keywords: Incompetent lip seal, increased overjet, normal overjet, facial aesthetics, malocclusion, molar relationship

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INTRODUCTION

The lips, nose, and eyes are prominent facial structures. Any abnormality in any of the component features will give rise to facial disfigurement. The lips tend to be the most important features of facial aesthetics due to their central position and the role they play in communication and relay of emotions.[1] The lips also play a very important role in feeding, along with teeth. Lip position has become one of the most important soft tissues analyzed because it influences the occlusion, tooth stability, and facial aesthetics.[2]

The lips can be classified into three types: competent, incompetent, or potentially competent. A competent lip means the lip seal can be maintained with relaxed facial muscles and the mandible in resting posture.[3] The lips naturally touch at rest. Potentially competent lips are usually capable but are prevented from coming together by protruding incisors. An

incompetent lip is when the lips remain parted during muscle relaxation with the mandible at rest. This is often caused by lips being abnormally short and unable to maintain a seal, or by an increased vertical distance between their attachments, even if the lips are of normal size.[3] In individuals with lip incompetence, muscular activity is required to achieve a lip seal, whereas in individuals with competent lips, no muscular activity is needed. [4] Lip competence is important, as it prevents some injuries that could result from incompetence. Several studies, [5-13] have shown a strong link between dental injuries, excessive overjet, and incompetent lips. A study[5] in Sweden identified malocclusion, lip incompetence, increased overjet, a short upper lip, and mouth-breathing as key risk factors for dental trauma. The main role of the lips, and therefore lip competence, is controlled by muscles, which tend to be weak in class II div 1 anomalies, due to persistent hyperactivity of the mentalis muscle. [14] A study[15] was carried out on the lip pattern of patients seen at University of Port Harcourt Teaching Hospital (UPTH) from 2008 to 2013, and this was over ten years ago. It is therefore necessary to conduct this study to look at the current trend in this subject. There may be related factors contributing to lip incompetence, such as increased overjet and Angle's Class II Div 1 malocclusion. This study aimed to assess the pattern of lip competence among patients attending a tertiary hospital in South-South Nigeria and to investigate its relationship with overjet and other malocclusion traits. Therefore, the null hypothesis for the study was that lip incompetence is not associated with a normal overjet or Angle's Class 1 malocclusion.

MATERIAL AND METHODS

The study was a retrospective study spanning ten years, from June 2015 to June 2025. Case notes of 454 orthodontic patients who attended the orthodontic units of the Department of Child Dental Health during this period were retrieved. Information regarding their socio-demographics, overjet, molar relationship, and lip patterns was recorded. Only case notes of individuals who had relevant information were included in the study. Overjet, Overbite, molar relationship, and lip competence were classified as follows:

Overjet, which is the horizontal distance between the incisal edge of permanent maxillary central incisors and the labial surface of the mandibular central incisors, was classified as normal overjet when the measurement was 2-4 mm, increased overjet when the value was greater than 4 mm, reduced when less than 2 mm, and reversed when less than 0 mm. Overbite, is a vertical relationship, where the upper central incisors overlap the labial surface of the lower central incisors with a 1/3 to ½ distance. When the overlap is > ½, it is termed deep overbite, if less than a 1/3, it is termed reduced.

Molar relationship: Class I is when the mesiobuccal cusp of the first permanent maxillary molar occludes on the buccal groove of the first permanent mandibular molar; Class II is when the mesiobuccal cusp of the first permanent maxillary molar occludes anterior to the buccal groove of the first permanent mandibular molar with at least half a unit. Class III is when the mesiobuccal cusp of the first permanent maxillary molar occludes posterior to the buccal groove of the first permanent mandibular molar with at least half a unit, where a unit is the width of the first premolar.[16] Lip competence occurs when the upper and lower lips come together effortlessly at the resting position, and incompetent lips are said to occur when the lips cannot come together at the resting position. The data were analyzed using the Statistical Package for the Social Sciences (SPSS version 26), IBM, Inc., Armonk, NY, USA. Descriptive statistics were used to summarize data, while the chi-square test was employed to examine the association between variables, with a significance level set at $p < 0.05$. The study protocol was approved by the Research and Ethics Committee of the tertiary hospital. (UPTH/ADM/90/S.11/VOL.XI/1986)

RESULTS

Sociodemographics

The sociodemographic characteristics of the patients are shown in Table 1. Four hundred and fifty-four case notes of patients were involved in the study. The mean age of patients was 15.36 ± 8.05 years. Regarding age distribution, there were four age groups of patients, with the 10-19 years age group being the one with the highest number of patients (261, 57.5%), followed by the 0-9 years age group (100, 22%). The age group with the least number of case notes was the 40-49 years age group (8, 1.8%). Most of the patients studied were found to be females (275, 60.6%). Records of students were mostly involved (396, 87.2%), followed by those of civil servants (32, 7.0%) (Table 1).

Table 1: Sociodemographics of Study Population

Demographic characteristics		N	(%)
Age group (yrs)	0-9	100	(22.0)
	10-19	261	(57.5)
	20-29	60	(13.2)
	30-39	25	(5.5)
	40-49	8	(1.8)
Gender	Male	179	(39.4)
	Female	275	(60.6)
Occupation of Patients	Business	26	(5.7)
	Civil Servant	32	(7.0)
	Student	396	(87.2)
	Total	**454**	**(100.0)**

Lip competence and its association with molar relationship and overjet

Three hundred and fifty-five patients had Angle's class I of which most were found to have an incompetent lip seal (233, 65.3%), followed by those with competent lip (122, 34.2%). Patients with class II Angle's malocclusion were more often found to have an incompetent lip (39, 75.0%). Angle's class III malocclusion was the second most common among patients with competent lip patterns and third among those with incompetent lip patterns. Angle's class I malocclusion patients had the most competent lip amongst the three classes of malocclusion. There was no statistically significant difference between lip patterns and malocclusion classes. Increased overjet was mostly associated with an incompetent lip pattern (205, 75.4%), followed by a competent lip pattern (65, 23.9%). Normal overjet was most commonly associated with incompetent lip pattern (57, 51.4%) followed by competent lip pattern (54, 48.6%). A statistically significant difference was found between overjet and lip pattern (P-value = 0.001) (Table 2).

Lip competence and its association with gender

Incompetent lip was the most common lip pattern and was found in 170(61.8%) females and 127(70.9%) males. This was followed by a competent lip pattern seen in 105(38.2%) females and 50(27.9%) males, as shown in Table 3. There was a statistically significant difference between lip competency and gender (P-value = 0.02) (Table 3).

Lip competency and its association with overbite

Competent lips were more associated with normal overbite (57, 36.8%), followed by reduced overbite (48, 37.8%), while an incompetent lip was seen to be more associated with deep overbite (110, 76.9%), followed by reduced overbite (79, 62.2%). There was a statistically significant difference between overbite and lip competence, with a p-value of 0.025 (Table 4).

Table 2: Lip competence and its association with molar relationship and overjet

		Lip Competence			Chi-square	p-value
		Competent Lip	Incompetent Lip	Potentially Competent		
		n (%)	n (%)	n (%)		
Angle's classification	Class I	122 (34.2)	233 (65.3)	2 (0.6)		
	Class II	13 (25.0)	39 (75.0)	0 (0.0)	4.61	0.329
	Class III	20 (44.4)	25 (55.6)	0 (0.0)		
Overjet	Increased	65 (23.9)	205 (75.4)	2 (0.7)		
	Normal	54 (48.6)	57 (51.4)	0 (0.0)	32.63	0.001
	Reduced	30 (50.0)	30 (50.0)	0 (0.0)		
	Reverse	6 (54.5)	5 (45.5)	0 (0.0)		
	Total	**155 (100.0)**	**297 (100.0)**	**2 (100.0)**		

Table 3: Gender lip type, and association with lip competence

		Gender						Chi-square	p-value
		Male		Female		Total			
		n	(%)	n	(%)	n	(%)		
Lip Competency	Competent	50	(27.9)	105	(38.2)	155	(34.1)		
	Incompetent	127	(70.9)	170	(61.8)	297	(65.4)	7.79	0.02
	Potentially Competent	2	(1.1)	0	(0.0)	2	(0.4)		

Table 4: Association between Lip Competence and Overbite

		Lip Competency		
		Competent Lip	Incompetent Lip	Potentially Competent
		n (%)	n (%)	n (%)
Overbite	Normal	57 (39.9)	85 (59.4)	1 (0.7)
	Deep	32 (22.4)	110 (76.9)	1 (0.7)
	Reduced	48 (37.8)	79 (62.2)	0 (0.0)
	NA	18 (43.9)	23 (56.1)	0 (0.0)

Chi-square 14.401, p= 0.025

DISCUSSION

This study aimed to assess the pattern of lip competence in patients who were seen at a tertiary hospital in South-South Nigeria and the relationship between it and the overjet of the patients and other malocclusion traits and gender influence. The results show that the ten-to-nineteen-year-old age group, which is an adolescent group, was the most prevalent in this study. This contrasted with a previous study[17] of patients who also presented for orthodontic treatment, where the 21-29 age group was the most prevalent. The reason for this difference could be that in our environment, parents seem to be more bothered about the appearance of the children in this age group. It could also be that the children themselves put more pressure on their parents because of their facial appearance. In this study, it was found that individuals with Angle's Class I malocclusion had more cases of incompetent lip seal (65.3%) than those with competent ones (34.2%), but the difference was not statistically significant. This result is inconsistent with previous international reports[17-19] and a previous Nigerian report,[10] though the reason for the

difference is yet to be ascertained. Regarding Angle's malocclusion, Class I was the most prevalent type, followed by Class II. This matches findings from earlier studies.[20-26] However, it contradicts the results from the studies by Ran et al,[27] which identified Class II as the most frequent malocclusions. Individuals with Angle's Class I malocclusion are more likely to have a competent lip seal compared to those with Class II. The report in this retrospective survey, with cases of Angle's Class I malocclusion having a higher association with an incompetent lip seal than with a competent lip seal, has shown inconsistency from normal expectations of individuals with Angle's Class I malocclusion having more of a competent lip seal than an incompetent lip seal. The different pattern found in this study could be because the studied population were orthodontic patients who presented for treatment. However, there was no statistically significant difference in this association. The present result is contrary to the previous reports by Muhialdeen et al[17] and Alyassary et al.[20] This study generally showed Angle's class II malocclusion to have the highest prevalence with lip incompetency. Angle's Class III malocclusion was also associated with an incompetent lip seal more than with a competent one, although this difference was statistically insignificant in this survey.

As regards overjet, this study revealed that increased overjet was found to be more associated with lip incompetence as compared to normal overjet, and this association had a statistically significant difference. ($p = 0.001$) Increased overjet was a more common presentation, followed by normal overjet. This is in contrast with reports from previous studies[17,28,29] where normal overjet was found to be a more common type of overjet presentation. The difference in this present study could be due to the variation in the study population. Our survey revealed that more participants with increased overjet (41.9%) had competent lips compared to normal overjet (34.8%). This finding is contrary to reports by Anirudh et al[30] and Muhialdeen et al,[17] who found that the majority of individuals with competent lips had normal overjet. Incompetent lip seal was found in this study to be more associated with females as compared to males, with a statistically significant difference. This finding contradicts that of Otuyemi et al,[6] where there was no significant sex difference in the presentation of increased overjet or incompetent lip pattern. This finding could be the reason why more females presented for treatment, since an incompetent lip is not aesthetically pleasing for a female. The lip incompetence prevalence in females is a contrasting report from a previous study.[17] The percentage of individuals with normal overbite obtained in this study, in relation to competent lip seal (39.9%) and incompetent lip (59.4%), is comparable to the findings from a previous Nigerian study.[31] A competent lip seal was found to be associated more with a normal overbite, while an incompetent lip seal was associated more with a deep overbite in this current study. The results of this current research have rejected the null hypothesis that incompetent lip is not associated with Angle's class I malocclusion or with normal overjet; rather, it has been revealed that incompetent lip pattern was associated with Angle's class II and class 1 malocclusions and also with individuals with increased overjet and normal overjet.

The limitation of the study is that data collected were from documentations found in the case notes of the patients.

Recommendation

An epidemiological study should be carried out among various age groups to assess lip competence and its relationship to overjet.

CONCLUSION

Incompetent lip seal was the most common lip competence type recorded and was more associated with individuals with Angle's Class I malocclusion. It was also more related to an increased overjet, which was more prevalent. A competent lip seal was associated more with a normal overbite than with a normal overjet.

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Conflict of Interest:

There are no conflicts of interest.

REFERENCES

1. Avelar LET, Haddad A, Horbilon J, Avelar LM, Realb J. Lip and perioral assessment scale- a tool that can improve your practice. J Dermat Cosmetol 2021; 5(4): 101-107.
2. Joshi M, Wu LP, Maharjan S, Regmi MR. Sagittal lip positions in different skeletal malocclusion: a cephalometric analysis. Prog Orthod 2015; 16(1): 8.
3. Partal I, Aksu M. Changes in lips, cheeks, and tongue pressures after upper incisor protrusion in class II Div 2 malocclusion: a prospective study. Prog Orthod 2017; 18(1): 29.
4. Elfseyie MTM, Abdullah NM, Hassan MIA. Occlusal features of 12 years old Malaysian Malay schoolchildren in Shah Alam. Compend Oral Sci 2014; 1(1): 6-12.
5. Forsberg CM, Tedestan G. Etiological and predisposing factors related to traumatic injuries to permanent teeth. Swed Dent J 1993; 17(5): 183-190.
6. Otuyemi OD. Traumatic anterior dental injuries related to incisor overjet and lip competence in 12-year-old Nigerian Children. Int J Paediatr Dent 1994; 4(2): 81-85.
7. Elsideeq SE, Abuaffan AH. Traumatic Dental injuries and associated risk factors among Sudanese school children. J Dent Oral Care 2015; 1(5): 1-4.
8. Arraj GP, Rossi-Fedele G, Dogamaci EJ. The association of overjet size and traumatic dental injuries- a systematic review and meta-analysis. Dent Traumatol 2019; 35(4-5): 217-232.
9. Elkarmi RF, Hamdan MA, Rajab LD, Abu-Ghazaleh SB, Sonbol HN. Prevalence of traumatic dental injuries and associated factors among pre-school children in Amman, Jordan. Dental Traumatol 2015; 31(6): 487-492.
10. Ogordi PU, Ize-Iyamu IN, Adeniyi EO. Prevalence of traumatic dental injury to the anterior teeth in children attending paramilitary and non-paramilitary schools in Nigeria. Ann Afr Med 2019; 18(2): 80-85.
11. Narayanan SP, Rath H, Panda A, Mahapatra S, Kader R. Prevalence, trends, and associated risk factors of traumatic dental injury among children and adolescents in India: a systematic review and meta-analysis. J Contemp Dent Pract 2021; 22(10): 1206-1224.
12. Vieira WDA, Pecorari VGA, Gabriel PH, Vargas- Neto J, Santos ECA, Gomes BPFA, et al. The association of inadequate lip coverage and malocclusion with dental trauma in Brazilian children and adolescents - a systematic review and meta-analysis. Dental Traumatol 2021; 38(1): 4-19.
13. Martins VM, Sousa RV, Rocha ES, Leite RB, Paiva SM, Granville- Garcia AF. Dental trauma among Brazilian school children: prevalence, treatment and associated factors. Eur Arch Paediatr Dent 2012; 13(5): 232-237.
14. Rajbhoj AA, Mathews H, Doucet K, Claes P, Begnoni G, Willems G, et al. Influence of age and diet consistency on the oral muscle pressure of orthodontically treated and untreated subjects with normal occlusion and comparison of their 3D facial shape. Clin Oral Invest 2023; 27(7): 3649- 3661.
15. Ukegheson GE, Onyeaso CO, Aikins EA. Lip pattern of orthodontic patients seen at the orthodontic patients seen at the orthodontic clinic of University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria. Port Harcourt Med J 2013; 7(1): 111-117.
16. Katz MI. Angle's classification revisited. Am J Orthod Dentofacial Orthop 2007; 132(6): 716-717.
17. Muhialdeen TI. Assessment of lip competence and its relation to (sagittal molar relationship and overjet): a retrospective Analysis. J. Neonatal Surg 2025; 14(32S): 6838-6843.

18. Yadav R, Yadav N, Basel P. Prevalence of lip competency among Nepalese adolescents with different ethnic groups of Kathmandu Valley. Orthod J Nepal 2019; 9(1): 45-49.
19. Marziya M, Inam J, Virda M, Munir B. Incidence of trauma to anteriors and its associated etiological risk factors. Pak Postgrad Med J 2015; 26(1): 6-10.
20. Alyessary AS, Alnajar HA, AL-Mayali AM, Naeemah RM. Association of the different lips competency with the molar relationship and anterior open bite malocclusion. Psychol Educ 2021; 58(2): 6735-6740.
21. Amin A, Arf AN, Rashid ZJ. Angle's classification of first molar occlusion among patients attending a private orthodontic clinic in Sulaimani city. Sulaimani Dent J 2014; 1(2):91- 93.
22. Mohammad BH, Abdul-Jabbar MF, Mohammed MH. Prevalence of Angle's classification of malocclusion among patients attending Orthodontic Department in the College of Dentistry-retrospective cross-sectional study. Erbil Dent J 2022; 4(2):111- 117.
23. Etim SS, Onyeaso CO. Angle's malocclusion among Nigerian adolescents - An epidemiological survey of the three major tribes. Odonto-stomatol Trop 2022; 45(2): 27-34.
24. Borzabadi-Farahani A, Borzabadi-Farahani A, Eslamipour F. Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11-to- 14-year-old children. Eur J Orthod 2009; 31(5): 477-484.
25. Josefsson E, Bjerklin K, Lindsten R. Malocclusion frequency in Swedish and immigrants adolescents- influence of origin on orthodontic treatment need. Eur J Orthod 2007; 29(1): 79-87.
26. Haynes S. The prevalence of malocclusion in English school children aged 11-12 years. Eur Orthod Soc Trans 1970; 48(1): 89-98.
27. Arron Lim YR, Kamaruddin AF, Ahmad Shafiai NA. Investigation of the prevalence of skeletal patterns in the Malay population using an angle and principal component analysis of cephalometric variables. J Health Transl Med 2023; 1(1): 226-234.
28. Shrestha S, Shrestha RM. An analysis of malocclusion and occlusal characteristics in Nepalese orthodontic patients. Orthod J Nepal 2013; 3(1): 19–25.
29. Nguee AA, Ongkosuwito EM, Jaddoe VWV, Wolvius EB, Kragt L. Impact of orthodontic treatment need and deviant occlusal traits on oral health–related quality of life in children: a cross-sectional study in the Generation R cohort. Am J Orthod Dentofacial Orthop 2020; 157(6): 764-772.
30. Anirudh BVM, Felicita AS, Prasanna Arvind TR. Correlation between upper lip morphology and proclination of anterior teeth in patients reporting for orthodontic treatment. J Pharm Negat Results 2022; 13(6): 2695- 2701.
31. Ajayi EO, Ize-Iyamu IN. Malocclusion and occlusal traits among orthodontic patients seen at the University of Benin Teaching Hospital, Nigeria. Nig Dent J 2010; 18(1): 12-16.

Original Article

Correlation between third molar impaction and mandibular anterior segment crowding

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Abstract

Background: Anterior crowding represents a discrepancy between mesiodistal tooth widths and available alveolar space. The role of third molar eruption in the development of lower incisor crowding remains controversial.

Aim: To evaluate the correlation between mandibular third molar impaction and lower anterior segment crowding.

Methods: A retrospective study was conducted at the Orthodontic Unit, Lagos University Teaching Hospital, over four years (Jan 2019 to Dec 2022). Patients aged 18 years and above with erupted permanent teeth and complete clinical records were recruited. Panoramic radiographs and study casts were assessed for third molar impaction status and tooth-bone ratio. Data were analyzed using SPSS version 23, employing descriptive (frequency and percentages) and inferential (Chi-square) analysis with significance set at $p < 0.05$.

Results: Of 794 panoramic radiographs assessed, 181 adult patients (122 females, 59 males) met inclusion criteria. Lower incisor crowding was present in 72 patients (39.8%), while 74 (40.1%) had unilateral or bilateral third molar impaction. A significant association was found between third molar impaction and crowding ($p = 0.032$), with over 50% of patients with impaction showing crowding. However, the association between impaction symmetry and crowding severity was not statistically significant ($p = 0.066$).

Conclusion: A significant correlation exists between third molar impaction and anterior segment crowding. Patients with impacted third molars are more likely to have mandibular anterior crowding.

Keywords: Third molar, impaction, crowding, mandibular anterior segment, malocclusion, orthodontics, tooth-bone ratio

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INTRODUCTION

Crowding is diagnosed when there is a negative arch length discrepancy, that is, when the available space in the dental arch is less than the space needed for proper teeth alignment.[1] According to its severity, crowding is classified as mild, moderate, or severe.[2] While crowding may occur in the anterior or posterior areas of either arch, it is most likely to occur in the anterior area, especially in the mandible.[3] Anterior crowding is identified as the discrepancy between the

mesiodistal tooth widths of the four permanent incisors and the available space in the alveolar process.[4] The cause of incisor crowding is multifactorial: tooth-bone discrepancies, discrepancies involving tooth number, premature loss of deciduous dentition, pressure from erupting molars, and variations in jaw growth.[2] The debate about the involvement of third molars in the development of incisor crowding remains a topic of interest.

It has been hypothesized that, while erupting, the third molar could transmit an anterior component of force down the dental arch, concentrating in the areas of canines and incisors, resulting in tooth rotation and misplacement.[5] Based on this theory, Niedzielska suggested that when sufficient space is available for the eruption of third molars, the tooth assumes a normal position in the dental arch and does not cause displacement of other teeth; conversely, when space is deficient, third molars may aggravate dental crowding.[6] Harradine and Richardson observed that the incidence of crowding increases in the dental arch during the period of third molar eruption.[7] A comparative longitudinal study by Vego demonstrated that the prevalence of late mandibular anterior crowding was greater in individuals with third molars compared to those with congenitally missing third molars, concluding that erupting third molars can exert a force on neighboring teeth.[8]

Conversely, other studies found no correlation between mandibular third molar presence and incisor crowding. Sidlauskas and Trakiniene studied a group of 91 subjects with a mean age of 21 years and concluded that there is no evidence to implicate third molars as aetiologic factors in late lower dental arch crowding.[9] Karasawa et al. evaluated 300 subjects with a mean age of 20.4 years on the presence or absence of wisdom teeth and mandibular incisor crowding, concluding that evidence on the role of third molars as an aetiologic factor in late lower arch crowding is lacking.[10] Lindqvist and Thilander found that third molar removal on one side did not relieve anterior crowding three years post-extraction.[11] Similarly, Pirttiniemi et al. did not find a significant change in anterior teeth crowding after extraction of mandibular third molars.[12] This study aimed to evaluate the relationship between the presence and absence of mandibular third molar impaction and lower anterior segment crowding.

MATERIALS AND METHODS

Ethical Considerations

Ethical approval for the study was obtained from the Health Research and Ethics Committee of the Lagos University Teaching Hospital before the commencement of the study. (ADM/DSCST/HREC/APP/5439)

This was a retrospective study, that was conducted over a four-year period at the Orthodontic Unit, Lagos University Teaching Hospital, Idi-Araba, Lagos State, Nigeria (from 1st January 2019 to 31st December 2022). Panoramic radiographs and study models of patients who presented for orthodontic treatment were used for this study. Subjects recruited for the study were at least 18 years of age and had all permanent teeth present, including third molars, either erupted or present on radiographic assessment. Patients with any form of craniofacial anomaly or special needs were excluded from the study. All patients below the age of 18 years, irrespective of whether all permanent teeth were present, were also excluded.

An initial census was carried out using all radiographs of orthodontic patients to obtain a sampling frame. Another assessment was carried out to screen subjects, and final recruits were those who met the inclusion criteria. Socio-demographic data of recruited subjects, including age and gender, were obtained from hospital records. Study casts of these subjects were also retrieved, and tooth-bone ratio was assessed.

The tooth-bone ratio was assessed by measuring the contact displacement between teeth or from one contact point to another. The measurement was from the mesial surface of one canine to the mesial surface of the contralateral canine. Scoring was either crowding or spacing, and the severity was noted. Assessment of third molar impaction

was done using Winter's classification[13] (horizontal, distal, mesial, and vertical) on panoramic radiographs.

Data analysis was performed using Statistical Package for Social Sciences (IBM SPSS) version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics and frequencies of variables were determined. Pearson's Chi-square test was used to determine the relationship between variables. Significance was set at $p < 0.05$.

RESULTS

A total of 794 panoramic radiographs of orthodontic patients were assessed. One hundred and eighty-one adult patients met the inclusion criteria and were recruited for the study, with their corresponding clinical records and study models. This comprised 122 females (67.4%) and 59 males (32.6%). The majority of participants were within the 18–25-year age bracket.

Lower incisor crowding was present in 72 patients (39.8%), while 74 patients (40.1%) were found to have either unilateral or bilateral third molar impaction. Our study revealed that the majority (58.9%) of patients without third molar impaction have spacing. Since the p-value ($p = 0.032$) is less than the chosen significance level of $\alpha = 0.05$, there is a statistically significant association between third molar impaction and tooth-bone ratio ($\chi^2(2) = 6.89$, $p = 0.032$). Patients with third molar impaction are more likely to have crowding in their anterior segment (Table 1).

The relationship between tooth-bone ratio and third molar impaction symmetry (unilateral or bilateral) was also assessed (Table 2). Half of the patients with unilateral impaction were noted to have crowding. Similarly, half of the patients with bilateral impaction had crowding. However, the association between molar impaction symmetry and tooth-bone ratio was not statistically significant ($p = 0.066$).

DISCUSSION

Inadequate space in the dental arch for erupting teeth (tooth size–arch size discrepancy) is the ultimate common cause of most anterior dental crowding.[14] The cause of reduced arch space in many contemporary populations has a multifactorial basis. In orthodontics, the most controversial role of third molars is whether they can contribute to the development of malocclusion or relapse after orthodontic treatment, particularly in the anterior segment of the dental arch. Several authors have observed that anterior crowding was found more frequently in patients with third molar impaction than in subjects with correctly positioned third molars.[15,16]

A study by Lindqvist et al. involving a group of 52 patients with bilateral third molar impactions used a "split mouth" design, with extraction of impacted molars on one side and use of the contralateral quadrant as a control side.[11] Their data indicated the existence of less crowding on the extraction side in 70% of patients. This finding is similar to what was obtained in our study, though the figures are higher; over 50% of subjects with crowding were found to have at least one impacted third molar. Genetic and environmental differences may account for the difference in severity seen in both results.

Another study by Forsberg was conducted to determine the relationship between the eruption status of third molars and the relative space in the dental arches.[17] Two groups of 75 adult, non-orthodontic patients were used: one group with patients who had all third molars erupted and another group with all third molars missing due to extraction. The degree of crowding was found to be higher in the first group, although only with a small difference. While this study did not involve patients who were to undergo third molar extraction, the observations are similar in that crowding was found to be more prevalent in patients who had not undergone third molar extraction.

Table 1: Relationship between third molar impaction and tooth-bone ratio

Third molar impaction	Normal n (%)	Crowding n (%)	Spacing n (%)	Total n (%)	p-value
Yes	8 (10.8)	37 (50.0)	29 (39.2)	74 (40.9)	**0.032***
No	9 (8.4)	35 (32.7)	63 (58.9)	107 (59.1)	

**Statistically significant ($p < 0.05$)*

Table 2: Relationship between tooth-bone ratio and third molar impaction symmetry

Third molar impaction	Normal n (%)	Crowding n (%)	Spacing n (%)	Total n (%)	p-value
Unilateral	2 (5.9)	17 (50.0)	15 (39.2)	34 (44.1)	0.066
Bilateral	6 (15.0)	20 (50.0)	14 (35.0)	40 (59.1)	

**Statistically significant ($p < 0.05$)*

The association between tooth-bone ratio and third molar impaction was also assessed in this study. It was found that the majority (58.9%) of patients without third molar impaction have spacing. Correlational analysis showed a significant association between the presence of third molar impaction and crowding. This is in contrast to a study by Hasegawa et al., who studied a group of 60 Mongolian subjects with a mean age of approximately 21 years to evaluate the influence of mandibular third molar space and angulation on lower anterior crowding.[18] The analysis of their data did not reveal any significant relationship between the presence and angulation of mandibular third molars and lower incisor crowding. Differences in parameters used in the assessment of tooth-bone discrepancies, as well as racial differences, may account for this.

The relationship between the presence of unilateral or bilateral third molar impaction in lower anterior crowding was also assessed in this study. We found no statistically significant difference in crowding between the presence of unilateral or bilateral third molar impaction ($p = 0.066$). This is consistent with the study by Hasegawa et al., which found no significant relationship between the angulation of third molars, the presence of unilateral or bilateral third molar impaction, and the Little's irregularity index.[18]

Based on our study findings and comparisons with previous research reports, extracting impacted third molars could benefit orthodontic patients with mild to moderate crowding who are undergoing or have completed orthodontic treatment. This method may help reduce the likelihood of relapse in these patients.

LIMITATION

The limitation of this study was its inability to take into consideration other factors that may play a role in third molar impactions.This was due to the fact that the study was a retrospective study.

CONCLUSION

The conflicting clinical literature on the relationship between third molars and anterior crowding may be due to a lack of data addressing not only the presence of third molars but also the presence or absence of impaction and its significance in population variation. Results from this study support a cause-and-effect relationship between third molar impaction and anterior segment

crowding. It is worthwhile to consider third molar extraction to avoid anterior tooth crowding or post-orthodontic relapse.

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Conflict of Interest:

There are no conflicts of interest.

REFERENCES

1. Little RM. The irregularity index: a quantitative score of mandibular anterior alignment. Am J Orthod 1975; 68(5):554–563.
2. Jain S, Sharma P, Shetty D. Comparison of two different initial archwires for tooth alignment during fixed orthodontic treatment: a randomized clinical trial. J Orthod Sci 2021; 10(1):13.
3. Husain S, Rengalakshmi S. Correlation between mandibular third molar and mandibular incisor crowding: a retrospective CBCT-based study. J Dent Res Dent Clin Dent Prospects 2021; 15(4):247 - 250.
4. Sanin C, Savara BS. Factors that affect the alignment of the mandibular incisors: a longitudinal study. Am J Orthod 1973; 64(3):248–257.
5. Zawawi KH, Melis M. The role of mandibular third molars on lower anterior teeth crowding and relapse after orthodontic treatment: a systematic review. Sci World J 2014; 2014; (6):6-12
6. Niedzielska I. Third molar influence on dental arch crowding. Eur J Orthod 2005; 27(5):518–523.
7. Harradine NW, Pearson MH, Toth B. The effect of extraction of third molars on late lower incisor crowding: a randomized controlled trial. Br J Orthod 1998;25(2):117–122.
8. Vego L. A longitudinal study of mandibular arch perimeter. Angle Orthod 1962; 32(3):187– 192.
9. Sidlauskas A, Trakiniene G. Effect of the lower third molars on the lower dental arch crowding. Stomatologija 2006; 8(3):80–84.
10. Karasawa LH, Rossi AC, Groppo FC, Prado FB, Caria PHF. Cross-sectional study of correlation between mandibular incisor crowding and third molars in young Brazilians. Med Oral Patol Oral Cir Bucal 2013; 18(3): 505–509.
11. Lindqvist B, Thilander B. Extraction of third molars in cases of anticipated crowding in the lower jaw. Am J Orthod 1982; 81(2):130–139.
12. Pirttiniemi PM, Oikarinen KS, Raustia AM. The effect of removal of all third molars on the dental arches in the third decade of life. Cranio 1994; 12(1):23–27.
13. Winter GB. Principles of exodontia as applied to the impacted mandibular third molar, 1st edition. St Louis: American Medical Book Co, 1926.
14. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics, 5th ed. St Louis: Mosby Elsevier, 2013.
15. Santiesteban-Ponciano FA, Gutiérrez-Rojo MF, Gutiérrez-Rojo JF. Severidad de apiñamiento relacionado con la masa dentaria [Severity of crowding related to tooth mass]. Rev Mex Ortod 2016;4(3):165–168.
16. Harris EF, Vaden JL, Williams RA. Lower incisor space analysis: a contrast of methods. Am J Orthod Dentofacial Orthop 1987; 92(5):375–380.
17. Forsberg CM. Tooth size, spacing, and crowding in relation to the eruption or impaction of third molars. Am J Orthod Dentofacial Orthop 1988; 94(1):57–62.
18. Hasegawa Y, Terada K, Kageyama I, Tsuchimochi T, Ishikawa F, Nakahara S. Influence of third molar space on angulation and dental arch crowding. Odontology 2013;101(1):22–28.

Original Article

Comparison of SIGN interlocking nailing and compression plating in the treatment of aseptic non-union of femoral shaft fractures

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Abstract

Background: Aseptic non-union of the shaft of femur presents a treatment challenge with the need for prolonged hospitalization, multiple procedures and economic burden. The choice of treatment is influenced by facilities available in a specified centre.

Aim: To compare the results of SIGN interlocking nailing and compression plating in the treatment of aseptic non-union of femoral shaft fractures.

Methods: Prospective cohort study conducted over a period of thirty-one (31) months (August 2015 to March 2018). Patients with aseptic non-union of femoral shaft fractures who presented to orthopaedic units of University of Port Harcourt Teaching Hospital, Port Harcourt over the study period were recruited into the study. They were randomly grouped into two- A and B. Group A had open reduction and internal fixation with SIGN interlocking nail, while group B had their fractures fixed by compressive plate osteosynthesis. The patients were followed up for at least six months and the results compared.

Results: Forty out of 42 patients completed the study. The SIGN interlocking nailing group had a union rate of 80% (n=16) in six months, while the compression plating group had 95% (n=19). The observed difference was not statistically significant (p=0.342). The two groups also had statistically comparable intra-operative blood loss, wound infection rates, duration for wound healing, post-operative limb shortening and duration of post-operative hospital stay.

Conclusion: SIGN interlocking nailing and compression plating are effective methods of treatment of aseptic non-union of femoral shaft fractures. They are comparable with respect to variables evaluated in this study

Keywords: Aseptic non-union, femoral shaft, SIGN interlocking nail, compression plating.

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INTRODUCTION

Fractures of the shaft of femur are commonly encountered in orthopaedic practice. The femur is one of the principal load-bearing bones in the lower extremity. Hence fracture involving it can cause prolonged morbidity and extensive disability unless appropriate treatment is given.[1]

Repair of fractures involves a sequence of dynamic events which ultimately restores the integrity of the bone and its biomechanical properties. Sometimes healing is compromised leading to a delayed union or non-union.[2]

Fracture non-union had been defined in various ways because of several factors that must be considered. Non-union had been

defined as a fractured bone that has not completely healed within 9 months of injury and that has not shown progression towards healing over 3 consecutive months on serial radiographs.[2,3] Hence, the absence of any clinical or radiographic evidence of progression of fracture healing for 3 months after the expected time period for healing constitutes non-union.[2,3] However, the exact time of union would differ depending on the fractured bone involved, the location of the fracture, the soft tissue condition as well as the fracture type.[2,3] Radiologically, non-union has been defined by the presence of the following criteria: absence of bone trabeculae crossing the fracture site, sclerotic fracture edges, persistent fracture lines and lack of progressive change towards union on serial radiographs.[2,3] Clinically, there should be persistent pain or motion at the fracture site which is best elicited by weight bearing.[2,3] Aseptic non-union is one in which there is no clinical or laboratory evidence of infection. In diaphyseal fractures of major long bones in adults, the diagnosis of non-union should not be made until 6 months have elapsed after the injury.[2-5]

The aetiological factors in non-union could be local or systemic. The local factors include excessive motion at fracture site, soft tissue interposition, severe soft tissue injury, infection, irradiated bone, injudicious intervention by traditional bonesetters and inherent blood supply characteristics of the involved bone. Malnutrition, chronic alcoholism, abuse of non-steroidal anti-inflammatory drugs (NSAIDs), tobacco smoking and prolonged use of steroids constitute systemic factors associated with non-union.[2, 5, 6]

Non-union can be classified as hypertrophic, oligotrophic or atrophic,[1,2,4,5,7] aseptic or septic (infected),[1,2,4,5,7,8] metaphyseal or diaphyseal.[1,2,4,5,7,8]

Treatment could be non- operative or operative.[2,5,9] Non-operative treatment includes cast- brace immobilization, electrical stimulation, bone marrow injection and shock wave therapy.[1-9] In the femur, operative treatment is favoured.[1-9] The operative procedures include plate fixation, intramedullary (IM) nailing and exchange nailing. These fixation methods may be accompanied by bone grafting (when indicated) to stimulate osteogenesis. Treatment is individualized and may involve two or more methods.[1-5,8,9]

Prior to the availability of Surgical Implant Generation Network (SIGN) interlocking nailing, compression plating was popular in Port Harcourt. Surgery with SIGN nail became attractive due to its low cost as the implants were donated free of charge by SIGN.[10] This is important in an environment, like Port Harcourt, Nigeria where the cost of health care is predominantly borne out-of-pocket by patients due to low health insurance coverage. The SIGN nail is a solid, stainless steel nail with slots to accommodate the interlocking screws.[10] The nail is straight but has two bends at the proximal and distal ends, which are 9 and 1.5 degree apex posterior bends respectively.[10] These two bends in the femur create an effective radius of curvature which closely approximates that of the normal human femur.[10] The nail is provided with a target arm along with instruments which allow the interlocking screws (including distal screws) to be inserted with or without an image intensifier. The SIGN nail in the medullary canal functions in load-sharing capacity [10] and may assuage the potential effects stress shielding may have on the bone when compared to compression plating. The locking screws proximally and distally prevent rotation. The aim of this study was to compare the results of SIGN interlocking nailing and dynamic compression plating (DCP) in the treatment of aseptic non-union of femoral shaft fractures at the University of Port Harcourt Teaching Hospital.

PATIENTS AND METHODS

It was a prospective cohort study conducted over a period of thirty-one (31) months (August 2015 to March 2018). This study was carried out in the University of Port Harcourt Teaching Hospital, Port Harcourt, Rivers State, Nigeria. It is a tertiary health institution and hence attends to the bulk of the patients with orthopaedic problems in the state and

neighbouring states like Bayelsa, Abia and Imo.

The study was conducted on adult patients who presented to orthopaedic units of University of Port Harcourt Teaching Hospital (UPTH), Port Harcourt with aseptic non-union of femoral shaft fractures and had SIGN interlocking nailing or compression plating. They were patients who met the eligibility criteria.

The sample size was calculated using this formula[11]:

$$n = \frac{4Z^2 x (PQ)^2}{(d)^2}$$

Where P is set at 50% and Z at 1.96

n= the desired total sample size

Z = the assumed standard deviation set at 1.96 which

Corresponds to 95% confidence level.

P = the population in the target population estimated to have a particular characteristic. 50% (0.50) was used since there is no reasonable estimate.

Q = 1.0-P

d = the degree of accuracy desired at 20% (0.20)

$$n = \frac{4(1.96)^2 x (0.50x\ 0.50)^2}{(0.20)^2}$$

$$n = \frac{4 x 3.842 x 0.0625}{0.04}$$

$$= 19$$

Adding 10% attrition rate: 1.9

n = 19 + 1.9 = 20.9 (approximately 21 patients)

The sample size was doubled to improve the statistical strength

This gave a sample size of 42. The sample size was therefore 42 patients.

The study included patients above 18 years old with clinically and bacteriologically proven aseptic non-union of femoral shaft who were treated by SIGN interlocking nailing or dynamic compression plating.

The exclusion criteria were: fractures with intra-articular component ; metaphyseal fracture non-union ; patients below the age of 18years; patients who did not give consent; infected non-union; pathologic fracture non-union; patients who opted out of the study even after giving consent; and patients with co-morbidities e.g. diabetes mellitus.

Systematic random sampling method was utilized in the study. The eligible patients were given numbers in order of presentation to the hospital. The odd number group (group A) had SIGN interlocking nailing, while the even number category (group B) was treated by compression plating. This randomization was carried out by the authors immediately a patient gave consent to be recruited into the study. The patients were followed up for at least six months and the results compared.

DETAILS OF THE STUDY

Patients who met the inclusion criteria and gave consent were included in the study. Pre-operative diagnosis was made by history taking, physical examination and plain radiographs. Baseline investigations such as full blood count, urinalysis, serum electrolytes, urea and creatinine, fasting blood sugar, grouping and cross-matching were done to ascertain patients' fitness for surgery. In addition, erythrocyte sedimentation rate (ESR) and C- reactive protein were requested to rule out infection (exclusion criteria). For patients above 40years, chest radiograph and electrocardiogram were carried out in addition to the above.

The surgeries were done under general anaesthesia or subarachnoid block. Prophylactic antibiotic (1g of ceftriaxone) was given at induction of anaesthesia. Skin preparation was carried out by washing with cetrimide (3%) and chlorhexidine gluconate (0.3%) mixture (twice) followed by drying with sterile gauze. Another round of cleaning was done with 70% alcohol. Finally, the skin was painted with povidone iodine (5%). Each patient was positioned and draped in such a way that the appropriate source of bone graft

could be accessed if required without repositioning.

With patient on supine position, a lateral longitudinal skin incision centred on the fracture non-union site was made and deepened through the subcutaneous tissue to fascia lata. The fascia lata was divided in line with skin incision and retracted to expose the vastus lateralis. The interval between the vastus lateralis and lateral intermuscular septum was identified and deepened to the femur by lifting the vastus lateralis muscle anteriorly with a retractor. Haemostasis was secured. Through subperiosteal dissection, the bone ends were exposed and freshened until healthy bleeding areas were visualised. Previous implant was removed if any. Tissue sample from the non-union site for each patient was collected and sent for microscopy, culture and sensitivity. Patients with positive cultures were excluded from the study. The marrow cavities were re-established; reduction done and bone stabilized either by Surgical Implant Generation Network (SIGN) locked intramedullary nailing or dynamic compression plating depending on which category the patient belonged. All the SIGN patients had hand reaming. The platings were done with 10-12 hole 4.5mm broad DCP. The wound was closed in layers over a suction drain.

Osteogenesis was stimulated by cancellous autogenous bone grafting harvested from the iliac crests for all cases of atrophic non-union in order to bring them to the status of their hypertrophic counterpart.

Intra-operative blood loss was assessed by reading the volume of blood in a graduated suction bottle. Where irrigation fluid was used, this was subtracted. Blood in surgical pad and floor were estimated by gravimetric method [12,13] and added to that in suction bottle to give the total blood loss. In gravimetric method, a known weight of dry surgical pad was subtracted from the weight of a wet one and the difference in grams noted. A difference of one gram is equivalent to 1millilitre of blood. [12,13]

Post-operatively, antibiotics (ceftriaxone and metronidazole) were continued for 5 days for all patients. Wound drain was removed as soon as it served its purpose. Physiotherapy was commenced as soon as pain allowed.

Patients were discharged as soon as they were stable on crutches and without any post-operative complication that required in-hospital care.

Post- operative shortening (limb-length discrepancy) was determined by measuring the length of each femur from the tip of the greater trochanter to ipsilateral fibular head using a measuring tape. The observed difference if any was documented. All the measurements were done by the same investigator using same measuring tape to avoid inter and intra-observer errors respectively.

The state of the wound with respect to healing status and presence/absence of infection were assessed prior to discharge as well as during follow-up visits. Wound infection here was defined as presence of sero-purulent or purulent discharge with or without positive microbial culture.

Before discharge, patients were counselled on the need for regular follow-up. In addition, the authors obtained their contact addresses, phone numbers and folder numbers. Each patient was followed up for a minimum of 6 months. Post-operative check radiographs were obtained during follow-up visits. The study protocol was discussed with the consultants and residents of all the orthopaedic units for uniformity.

Union was defined by clinical and radiological findings.[3,8,14] The clinical parameters were absence of tenderness at the fracture site, painless weight bearing and negative findings on varus-valgus and anterior-posterior stress tests with one hand above and the other below the fracture non-union site. The radiological parameter was presence of bridging callus across the non-union site in at least three cortices in two orthogonal radiographic views.

The authors participated in the pre-operative work-up and surgical planning of all the patients and played a minimum role of assistant surgeon. When this was not possible, other orthopaedic surgeons with similar level of competence stood in for them.

To ensure standard in both techniques (SIGN interlocking nailing and compression plating), all the surgeries were done in the presence of experienced Consultant Orthopaedic Surgeons who had been trained on SIGN interlocking nailing, either as the Lead Surgeon or Assistant Surgeon.

Data collated were analyzed using the Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp., Armonk, NY, USA). Tables and bar charts were used to present the results. They were expressed as proportion, mean and standard deviation. The observed differences were subjected to statistical test of significance with p-value set at 0.05.

Ethical approval was obtained from the Research and Ethics Committee of University of Port Harcourt Teaching Hospital, Port Harcourt, in line with Helsinki declaration with reference number - UPTH/ADM/90/S.II/VOL.X/823.

RESULTS

Forty out of the 42 patients recruited completed the study. Two patients, one from each treatment group were lost to follow-up leading to attrition rate of 4.7%. The forty patients (20 in each group) had comparable socio-demographic characteristics as shown in Table 1. The predominant age group was 30-39 years (8 patients for the interlocking group, and 9 for the plating category). The SIGN interlocking group had 14 males (70%) and 6 females (30%) while the compression plating group had 12 males (60%) and 8 females (40%) respectively.

The commonest cause of injury for interlocking nailing and plating groups was motor vehicle accident- 13 (65%) and 10 (50%) patients respectively. The interlocking group had no case of assault while the plating group had 1 (5%) as shown in Figure 1.

Table 1: Comparison of demographic characteristics of patients between SIGN interlocking nailing and compression plating groups

Socio-demographic characteristics	Groups in the study		Total N=40 n (%)
	Interlocking nailing N=20 n (%)	Compression plating N=20 n (%)	
Age category			
20 – 29 years	5 (25.0)	5 (25.0)	10 (25.0)
30 – 39 years	8 (40.0)	9 (45.0)	17 (42.5)
40 – 49 years	6 (30.0)	5 (25.0)	11 (27.5)
50 – 59 years	1 (5.0)	1 (5.0)	2 (5.0)
	Chi square=0.150; p-value=0.985		
Sex			
Male	14 (70.0)	12 (60.0)	26 (65.0)
Female	6 (30.0)	8 (40.0)	14 (35.0)
	Chi Square=0.440; p-value=0.507		

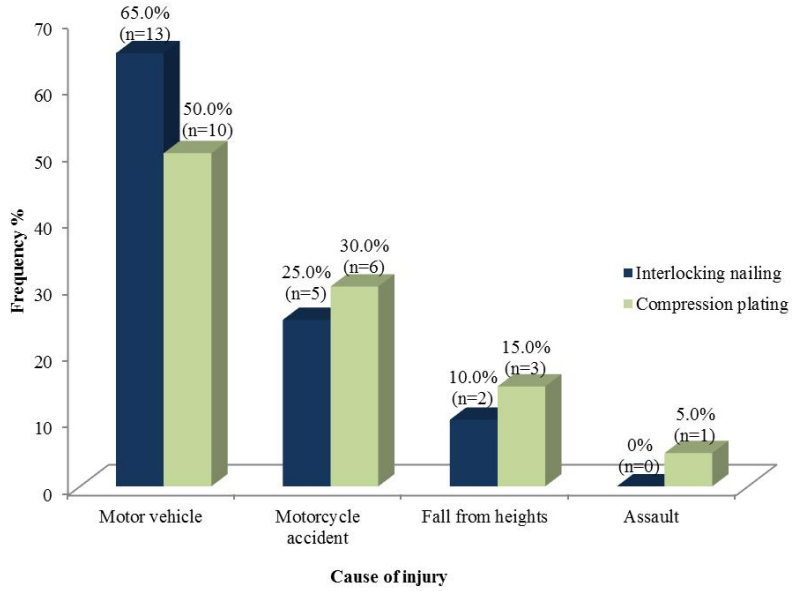

Figure 1: Distribution of cause of injury between patients in two groups in the study

Nineteen patients (95%) in the interlocking group had closed fractures while 1 (5%) had open fracture. The distribution of closed and open fractures in the compression plating group was 18 (90%) and 2 (10%) respectively. This is shown in Figure 2.

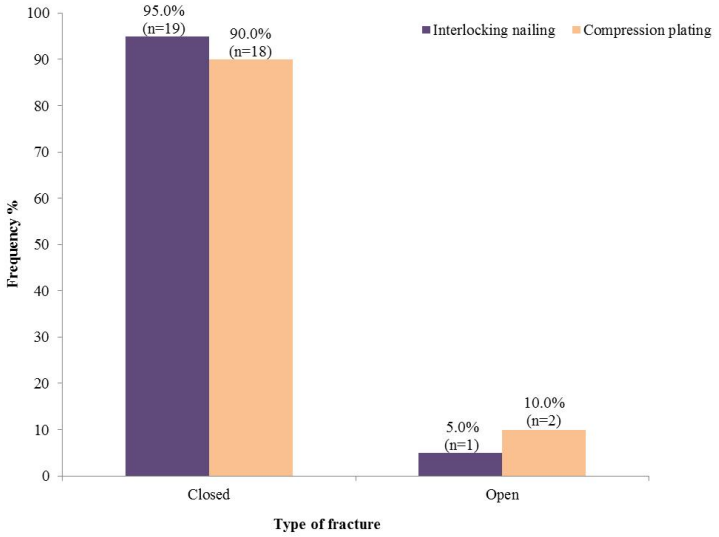

Figure 2: Distribution of type of incident fracture amongst group in the study

Table 2: Initial treatment given to patients among groups in the study

	Groups in the study		
Initial treatment given	**Interlocking nailing n (%)**	**Compression plating n (%)**	**Total n (%)**
Traditional bone setting	16 (80.0)	15 (75.0)	31 (77.5)
Hospital care	4 (20.0)	5 (25.0)	9 (22.5)
Total	**20 (100.0)**	**20 (100.0)**	**40 (100.0)**

Fisher's exact test p value=0.500

Table 3: Distribution of type of hospital care given to patients prior to presentation with non-union

	Groups in the study		
Type of surgical hospital care	**Interlocking nailing n (%)**	**Compression plating n (%)**	**Total n (%)**
Conservative (skeletal traction)	2 (50.0)	2 (40.0)	4 (44.4)
Surgical treatment	2 (50.0)	3 (60.0)	5 (55.6)
Total	**4 (100.0)**	**5 (100.0)**	**9 (100.0)**

Fisher's exact test p value=0.643

Table 4: Distribution of specific hospital treatment received by patients among groups in the study prior to presentation with non-union

	Groups in the study		
Specific hospital treatment received	**Interlocking nailing n (%)**	**Compression plating n (%)**	**Total n (%)**
Interlocking	2 (50.0)	0 (0.0)	2 (22.2)
Plate fixation	0 (0.0)	3 (60.0)	3 (33.3)
Skeletal traction	2 (50.0)	2 (40.0)	4 (44.4)
Total	**4 (100.0)**	**5 (100.0)**	**9 (100.0)**

Fisher's exact test=4.230

Table 5: Comparison of the mean time between original injury and presentation (in weeks) between groups in the study

	Groups in the study			
	SIGN Interlocking nailing Mean duration of hospital stay ±SD (weeks)	**Compression plating Mean duration of hospital stay ± SD (weeks)**	**t**	**p-value**
Time between original injury and presentation (in weeks)	69.62±44.54	66.50±22.731	0.280	0.177

SD- Standard deviation

Table 6: Comparison of the time and rate of union with serial x-rays during follow-up period among patients in the two groups

		Groups		
Follow-up	**Union**	**SIGN Interlocking nailing n (%)**	**Compression plaiting n (%)**	**Total n (%)**
3 weeks	Yes	0 (0.0)	0 (0.0)	0 (0.0)
	No	20 (100.0)	20 (100.0)	40 (100.0)
		Fisher's exact p-value =1.000		
6 weeks	Yes	0 (0.0)	0 (0.0)	0 (0.0)
	No	20 (100.0)	20 (100.0)	40 (100.0)
		Fisher's exact p-value =1.000		
12 weeks	Yes	4 (20.0)	3 (15.0)	7 (17.5)
	No	16 (80.0)	17 (85.0)	33 (82.5)
		Fisher's exact p-value =1.000		
18 weeks	Yes	12 (60.0)	18 (90.0)	30 (75.0)
	No	8 (40.0)	2 (10.0)	10 (25.0)

		Fisher's exact p-value =0.065		
6 months	Yes	16 (80.0)	19 (95.0)	35 (87.5)
	No	4 (20.0)	1 (5.0)	5 (12.5)
		Fisher's exact p-value =0.342		

Table 7: Comparison of the mean intra-operative blood loss between groups in the study

	Groups in the study		t	p-value
	SIGN Interlocking nailing Mean ± SD	**Compression plating Mean ± SD**		
Blood loss (mls)	505.00±276.20	500.00±264.57	0.058	0.144

S.D- Standard deviation

Table 8: Comparison of wound status prior to discharge between groups in the study

	Groups in the study		
Condition prior discharge	**SIGN Interlocking nailing n (%)**	**Compression plating n (%)**	**Total n (%)**
Wound healed	3 (15.0)	6 (30.0)	9 (22.5)
Wound not healed	16 (80.0)	13 (65.0)	29 (72.5)
Wound infected	1 (5.0)	1 (5.0)	2 (5.0)
Total	**20 (100.0)**	**20(100.0)**	**40 (100.0)**

Fishers exact=1.513; p value=0.519

Table 9: Comparison of wound status during follow-up period among patients in the two groups

		Groups		
Follow-up	**Wound status**	**SIGN Interlocking nail n (%)**	**Compression plating n (%)**	**Total n (%)**
3 weeks	Wound healed	19 (95.0)	17 (85.0)	36 (90.0)
	Wound not healed	0 (0.0)	2 (10.0)	2 (5.0)
	Wound infected	1 (5.0)	1 (5.0)	2 (5.0)
		Fisher's exact test =1.979; p-value =0.737		
6 weeks	Wound healed	20 (100.0)	20 (100.0)	0 (0.0)
	Wound not healed	0 (0.0)	0 (0.0)	0 (0.0)
	Wound infected	0 (0.0)	0 (0.0)	0 (0.0)
		Chi-square =0.000; p-value = 1.000		
12 weeks	Wound healed	20 (100.0)	20 (100.0)	0 (0.0)
	Wound not healed	0 (0.0)	0 (0.0)	0 (0.0)
	Wound infected	0 (0.0)	0 (0.0)	0 (0.0)
		Chi-square = 0.000; p-value = 1.000		
18 weeks	Wound healed	20 (100.0)	20 (100.0)	0 (0.0)
	Wound not healed	0 (0.0)	0 (0.0)	0 (0.0)
	Wound infected	0 (0.0)	0 (0.0)	0 (0.0)
		Chi-square = 0.000; p-value = 1.000		
6 months	Wound healed	20 (100.0)	20 (100.0)	0 (0.0)
	Wound not healed	0 (0.0)	0 (0.0)	0 (0.0)
	Wound infected	0 (0.0)	0 (0.0)	0 (0.0)
		Fisher's exact test =0.000; p-value = 1.000		

Table 10: Comparison of post-operative shortening between groups

Shortening	Groups in the study: SIGN Interlocking nailing n (%)	Groups in the study: Compression plating n (%)	Total n (%)
1 – 2 cm	4 (40.0)	5 (62.5)	9 (50.0)
3 – 4 cm	6 (60.0)	3 (37.5)	9 (50.0)
Total	**10(100.0)**	**8 (100.0)**	**18 (100.0)**

Fisher's exact p value=0.637

Table 11: Comparison of mean duration of post-operative hospital stay between groups in the study

Duration of hospital stay	Groups in the study: Interlocking nailing Mean duration of hospital stay ± SD	Groups in the study: Compression plating Mean duration of hospital stay± SD	t	p-value
Post-operative hospital stay (days)	10.35±3.61	14.85±3.45	-4.024	0.918

SD – Standard deviation

Thirty-one patients (77.5%) were initially treated by traditional bone setters, while 9 (22.5%) had hospital care elsewhere prior to presentation with non-union. Those that had initial hospital treatment were managed by skeletal traction (4 patients), plate fixation (3 patients) and locked intramedullary nailing (2 cases). These are illustrated in Tables 2 through 4.

The mean time between original injury and presentation was 69.62 weeks (17 months) for the SIGN interlocking group, and 66.5 weeks (16 months) for the compression plating patients. This is shown in Table 5.

Time of union corroborated with serial radiographs

During the follow-up visits (Table 6), it was observed that union was first noticed at 12 weeks in both groups. At this time, 4 patients (20%) in the SIGN interlocking group had their fractures united while 3 patients (15%) in the compression plating group had union.

At 18 weeks, SIGN interlocking group had a union rate of 60% (12 patients), while the compression plating group had 90% (18 patients). The observed difference was not statistically significant (p=0.065).

At 6 months, the SIGN interlocking group had 80% union (16 patients) while the compression plating group had 95% (19 patients). The observed difference was not statistically significant (p=0.342).

Table 6 also revealed that 4 patients (20%) in the SIGN interlocking group did not achieve union within the duration of follow-up. For the plating category, 1 patient (5%) failed to achieve union. The observed difference was not statistically significant (p=0.342).

Intra-operative blood loss

A comparison of intra-operative blood loss between the two groups (Table 7) revealed that the SIGN interlocking nailing group had a mean blood loss of 505.0±276.2mls while the compression plating group had 500.0±264.5mls. The difference was not statistically significant (p= 0.144).

Wound healing and wound infection

Prior to discharge, 3 patients (15%) in the interlocking group had their wounds healed, while 6 (30%) in the compression plating group achieved wound healing as shown in Table 8. The observed difference was not statistically significant (p= 0.519). Only 1 patient (5%) in each group had superficial wound infection.

During the 3 weeks follow- up visit (Table 9), 19 patients (95%) in the interlocking group had satisfactory wound healing, while 17 (85%) in

the plating group had their wounds completely healed. The observed difference was not statistically significant (p= 0.737). Superficial wound infection was still 1 patient (5%) for each group.

At 6 weeks follow-up visit, the 20 patients (100%) in each group had their wounds healed including the ones that had wound infection during earlier visits. These remained unchanged during 18 weeks through 6months follow-up visits (Table 9).

Post –operative shortening

Table 10 showed a post-operative shortening of 1-4cm in both groups. Six patients among the SIGN interlocking group had significant shortening of >2cm while 3 in the compression plating category had same. The observed difference was not statistically significant (p=0.637).

Duration of post-operative hospital stay

Table 11 showed that the SIGN group had a mean post-operative hospital stay of 10.3±3.6 days while the plating group had 14.8±3.4 days. The difference was not statistically significant (p= 0.918).

DISCUSSION

The management of non-union poses a challenge to the orthopaedic surgeon. Hence treatment options continue to evolve and existing ones continue to be compared.

This study revealed that both the SIGN interlocking nailing and compression plating groups have similar socio-demographic characteristics. The preponderant age bracket was 30-39 years for both study groups. This is active age group and hence prone to musculoskeletal injuries. This compares favourably with the finding of Ikpeme *et al* [8] in Calabar. This might be due to the fact that both studies took place in South-south Nigeria, hence similar demographics. Nwagbara[14] in Enugu (South-east Nigeria) reported a preponderance of 18- 29 years age bracket. This difference may be due to the fact that the study was carried out in a different geopolitical zone. Male to female ratio was 2.3:1 for the interlocking group and 1.5:1 for the plating group. The male preponderance seen is similar to the findings of other investigators. [8,15-17] Fractures are commoner in males within the first four decades of life in our environment. [8]

The patients in both groups are also comparable with respect to the cause of the injury. Majority of the injuries were caused by motor vehicle accident, 13 cases (65%) for the SIGN interlocking group and 10 cases (50%) for compression plating category. This agrees with the finding of Nwagbara [15] in Enugu.

The study revealed statistically comparable union rates of 80% (n=16) and 95% (n=19) for the SIGN interlocking and compression plating groups respectively in 6 months. Wu and Shih [17] in Taiwan reported a union rate of 86.5% in 3-7 months for 32/37 cases of femoral shaft non-union fixed with locked intramedullary nail (Grosse-Kempf). Wu and Shih finding is comparable with the result of this study probably due to the fact that infected cases were ruled out in both studies. Hierholzer *et al* [18] reported a union rate of 98% in 24 months for 71 patients out of 72 that had exchange nailing. The higher union rate achieved by Hierholzer *et al* in contrast to the finding for SIGN interlocking patients may be partly due to longer duration of follow- up of 24 months unlike the present study that limited the duration of follow-up to 6 months.[18] The difference may also be due to the fact that all the patients in Hierholzer *et al* [18] work had initial hospital treatment (interlocking nailing) unlike this study where majority of the SIGN interlocking patients (80%) were initially treated by traditional bone setters. The union rate (80%) observed in the SIGN group did not also compare favourably well with 100% union obtained by Kim *et al* [19] in 16-18.5 weeks in 19 patients with aseptic femoral non-union that had exchange nailing. This may be partly due to the reasons given earlier or partly due to difference in sample size.

The bone union rate of 95% in 6 months achieved for the compression plating group is better than 88.2% reported by Nwagbara.[14] It is also higher than 75% (for 11 out of 16 patients treated by plate fixation) reported by Wu and Shih[17] in 3-7 months. Whereas compression plating with broad DCP was used in this study,

Wu and Shih [17] did not specify their technique of plate fixation nor the type of plate used.

The comparable mean intra-operative blood loss seen in this study may be due to the fact that both fixations were done open. This also suggests that reaming associated with interlocking nailing did not contribute significantly to intra-operative blood loss. The mean intra-operative blood loss of 505mls for the SIGN interlocking nailing patients is more than mean blood loss of 400mls reported by Wu and Shih [17] for the 32/37 femoral shaft non-union fixed with locked IM nailing. Also, the mean intra-operative blood loss of 500mls for the compression plating group is much less than average of 1500mls reported by Wu and Shih.[17] Unlike the present study where majority of the patients were initially managed by traditional bone setters, all Wu and Shih patients that were treated by plate fixation had another implant prior to presentation with non-union.[17] These had to be removed intra-operatively before plate fixation of the femoral non-union. This additional procedure may have increased soft tissue dissection, prolong the duration of surgery and hence more bleeding. Furthermore, Wu and Shih[17] did not report their method of estimation of intra-operative blood loss. In addition, their study was retrospective; hence whatever method of intra-operative blood loss estimation used may not have been uniformly applied.

Both treatment groups had superficial wound infection rate of 5% (n=1) each at the time of discharge. These were incidental findings in patients with close fractures prior to presentation with non-union. The similar infection rate for the two study groups might be due to the fact that the surgeries were done in same environment. This compares fairly well with 1 case of deep wound infection out of 16 cases for plating group and 1 out of 11 cases for Huckstep nailing patients reported by Wu and Shih. [17] At 3 weeks follow-up visit, the SIGN interlocking group had delayed wound healing of 5% (1 patient) which was statistically comparable to 10% (2 patients) recorded in compression plating group. In the study of Hierholzer *et al* [18] where effectiveness of exchange nailing was evaluated in the treatment of non-union, delayed wound healing was responsible 0.08% of complications reported.

The groups compared have clinically comparable post-operative shortening. The post-operative shortening of 50% (10 out of 20 patients) observed in the SIGN group is higher than that of 36% (26 out of 72 patients) reported in a related study.[18] The difference may be related to initial treatment given. In the former, most of the patients (80%) were originally treated by traditional bone setters unlike the latter patients that had interlocking nailing before presenting with non-union. The post-operative shortening of 3-4cm seen in 3 out of 20 patients (15%) in the compression plating group differs from 4 out of 17 patients reported by Nwagbara.[14] Whether the difference is related to surgical technique, injury severity and or initial treatment given is unclear.

Both groups evaluated had comparable post-operative hospital stay. This may be due to comparable wound healing and wound infection rates observed in this study or similar local protocol with respect to fracture care in the centre where the study took place.
The present study was limited by the small sample size and this will limit its generalizability.

CONCLUSION AND RECOMMENDATION

SIGN interlocking nailing and compression plating are effective methods of treatment of aseptic non-union of femoral shaft fractures. Both methods are comparable with respect to rate of union, time of union, wound infection rate, duration of wound healing, intra-operative blood loss, post-operative limb shortening and duration of post-operative hospital stay.

Therefore, the authors recommend their continued use in treatment of aseptic non-union of femoral shaft fractures. However, multi-centre studies with larger sample size, longer duration of follow-up backed with meta-analyses are needed to have a widely accepted comparison of these two treatment options.

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There are no conflicts of interest.

REFERENCES

1. Whittle AP. Fractures of the lower extremity. In: Canale ST, Beaty JH, editors. Campbell's Operative Orthopaedics, 11th ed. Philadelphia: Mosby Elsevier, 2008; 3085-3236.
2. Chapman MW. Principles of treatment of nonunions and malunions. In: Chapman MW, editor. Chapman's Orthopaedic Surgery, 3rd ed. Philadelphia: Lippincott Williams and Wilkins, 2001; 848-867.
3. Somford MP, van de Bekerom MP, Kloen P. Operative treatment for femoral shaft nonunions, a systematic review of the literature. Strategies Trauma Limb Reconstr 2013; 8(2): 77-88.
4. Marsh JL, Buckwalter JA, Evarts CM. Delayed union, nonunion, malunion, and avascular necrosis. In: Epps CH, editor. Complications in orthopaedic surgery, 3rd ed. Philadelphia: JB Lippincott, 1994; 183-211.
5. Cleveland KB. Delayed union and nonunion of fractures. In: Canale ST, Beaty JH, editors. Campbell's operative orthopaedics, 11th ed. Philadelphia: Mosby Elsevier, 2008; 3529-3574.
6. Gille J, Wallstable S, Schulz AP, Perch A, Gerlach U. Is nonunion of tibial shaft fractures due to nonculturable bacterial pathogens? A clinical investigation using PCR and culture techniques. J Orthop Surg Res 2012; 7: 20.
7. Weber BG, Cech O. Pseudarthrosis: pathology, biomechanics, therapy, results. Bern: Hans Huber, 1976.
8. Ikpeme IA, Mkpanam NE, Abang IE, Ngim NE, Udosen AM. Long bone nonunions and malunions: risk factors and treatment outcomes in Calabar, Southern Nigeria. Open J Orthop 2013; 3(6): 253- 257.
9. Lambiris E, Panagopoulous A, Zouboulis P, Sourgiadaki E. Current concepts: aseptic nonunion of femoral shaft diaphysis. Eur J Trauma Emerg Surg 2007; 33(2): 120-134.
10. Chakraborty MK, Thapa P, Sathian B. Surgical Implant Generation Network (SIGN) solid intramedullary interlocking nail in the lower extremity: an observational study from Western Nepal. J Clin Diagn Res 2011;5(8):1614-1617.
11. Araoye MO. Research methodology with statistics for health and social sciences. Ilorin, Nigeria: Nathadex Publishers, 2003; 120.
12. Ajao OG. Measurement of intra-operative blood loss. Trop Doct 1982; 12(1): 29-31.
13. Thornton JA, Saynor R, Schroeder HG, Taylor DG, Verel D. Estimation of blood loss with particular reference to cardiac surgery. Description of a method. Br J Anaesth 1963; 35: 91-99.
14. Nwagbara IC. Treatment femoral shaft non-union. Orient J Med 2010; 22(1-4): 1-5.
15. Nwagbara IC. Osseous union in cases of nonunion in long bones treated by osteosynthesis. Niger J Clin Pract 2010; 13(4): 436-440.
16. Ogunlade SO, Omolulu AB, Alonge TO, Diete ST, Obawonyi JE. Predisposing factors and outcome of treatment of nonunion of long bone fractures in Ibadan, Nigeria. Niger Postgrad Med J 2011; 18(1): 56-60.
17. Wu CC, Shih CH. Treatment of 84 cases of femoral nonunion. Acta Orthop Scand 1992; 63 (1): 57-60.
18. Hierholzer C, Glowalla C, Herrler M, von Ruden C, Hungerer S, Buhren V, *et al*. Reamed intramedullary exchange nailing: treatment of choice of aseptic femoral shaft nonunion. J Orthop Surg Res 2014; 9: 88.
19. Kim SS, Sohn SK, Kim CH, Lee MJ, Wang L. Cause and treatment of the nonunion of femoral shaft fracture after interlocking intramedullary nailing. J Korean Fract Soc 2007; 20 (2): 141- 148.

Case Report

Assessment of readiness to wean an elderly patient from mechanical ventilation using clinical and diaphragmatic ultrasound predictors: a case report

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Abstract

Background: Weaning from mechanical ventilation is a critical and high-risk phase of intensive care management, particularly in elderly patients. One-fifth of mechanically ventilated patients experience difficulty during weaning and conventional clinical assessment may be unreliable, necessitating the use of objective physiological indices. Weaning predictors such as the rapid shallow breathing index and diaphragmatic ultrasonography have been shown to support decision-making when clinical evaluation is limited.

Aim: Report the use of combined clinical criteria and diaphragmatic ultrasound parameters in assessing readiness for weaning from mechanical ventilation in an elderly patient with cognitive impairment.

Case Report: A 70-year-old female with multiple ischaemic cerebrovascular accidents and vascular dementia was admitted following head trauma complicated by bilateral subdural haematomas. She underwent burr-hole evacuation and required postoperative mechanical ventilation with sedation. After 26 hours of ventilatory support, standard clinical criteria for weaning were fulfilled. Spontaneous breathing test was performed using low-level pressure support ventilation. Objective weaning predictors were assessed, including the rapid shallow breathing index and diaphragmatic ultrasound parameters. Rapid shallow breathing index was 38 breaths/min/L. Diaphragmatic ultrasonography demonstrated a diaphragm thickening fraction of 41.25% and a diaphragm excursion of 162 mm. Spontaneous breathing test was completed successfully without respiratory distress or haemodynamic instability.

Conclusion: This case highlights the clinical value of integrating conventional weaning criteria with diaphragmatic ultrasound assessment in elderly patients with neurological and cognitive impairment. Objective evaluation of diaphragmatic function enhances confidence in extubation decisions and may reduce the risk of weaning failure in complex clinical settings.

Keywords: Mechanical ventilation, weaning

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INTRODUCTION

Weaning patients from mechanical ventilation in the intensive care unit is a complex and high-risk process. Approximately 20% of patients receiving invasive mechanical ventilation experience difficulty during ventilator liberation. [1] Current clinical practice guidelines recommend the use of structured, objective clinical criteria to assess a patient's readiness for weaning before initiating a ventilator weaning trial. [2,3]

Early identification of patients who are suitable for weaning has been shown to reduce the duration of mechanical ventilation. It is associated with lower mortality and fewer ventilation-related complications, including barotrauma and ventilator-associated pneumonia. [1] Conversely, failure to recognise

inadequate readiness for weaning may result in premature extubation and adverse outcomes such as severe hypoxia, cardiovascular instability, respiratory muscle fatigue, and psychological distress. [4]

Elderly patients with neurological impairment present additional challenges, as clinical assessment of mental status and respiratory effort may be unreliable. In such circumstances, incorporating objective physiological indices may enhance the accuracy of weaning decisions. The aim of this paper is to report the use of combined clinical criteria and diaphragmatic ultrasound parameters in assessing readiness for weaning from mechanical ventilation in an elderly patient with cognitive impairment.

CASE REPORT

A 70-year-old female with a background history of multiple ischaemic cerebrovascular accidents and established vascular dementia was admitted to the neurosurgical unit of hospital No 17, Kiev affiliated to the medical university following head trauma. On presentation, Glasgow Coma Scale was 8, patient was intubated, commenced on mechanical ventilation, investigated. Cranial computed tomography done revealed bilateral subdural haematoma. She was further moved to the operating room where she subsequently underwent burr-hole evacuation of the haematomas. Postoperatively, the patient was admitted to the intensive care unit and invasive mechanical ventilation under sedation continued. Indications for ventilatory support included impaired consciousness and the need for airway protection. Ventilation was maintained for a total duration of 26 hours. Following neurological stabilisation and improvement in respiratory parameters, the patient underwent a structured daily assessment for readiness to wean from mechanical ventilation. Clinical readiness criteria were satisfied, including haemodynamic stability without vasopressor support, adequate oxygenation on low ventilatory settings with tidal volume of 6ml/kg in synchronized intermittent mechanical ventilation (SIMV) mode which allowed her the ability to initiate spontaneous respiratory effort. The patient had other parameters that were adequate for weaning such reduction in secretions, adequate cough, arterial blood gas values were at acceptable, other parameters were as follows PaO_2 > 60 mmHg, SaO_2 > 90% at FiO_2 up to 0.4.

A spontaneous breathing test was conducted using low-level pressure of less than 8 cm H_2O support ventilation. During the test, objective weaning predictors were assessed. The rapid shallow breathing index was calculated as the ratio of respiratory frequency to tidal volume and yielded a value of 38 breaths/min/L. Diaphragmatic ultrasonography was performed during the spontaneous breathing test to assess diaphragmatic function. Ultrasound examination demonstrated a diaphragm thickening fraction of 41.25% and a diaphragm excursion of 162 mm. These measurements were obtained without technical difficulty, and no signs of respiratory distress were observed during the procedure.

The spontaneous breathing test was completed successfully. Throughout the assessment period, the patient remained haemodynamically stable, with no evidence of tachypnoea, hypoxaemia, hypercapnia, or increased work of breathing. Based on the combined clinical assessment and objective weaning indices, the patient was considered suitable for ventilator liberation. Post weaning parameters were good, Non-invasive Blood Pressure (BP) was stable at 140/ 80mm Hg, afebrile temperature was 37.1°C, haemoglobin level was of 12g/dl, pH of 7.1, no acidosis or alkalosis, PaO_2/FiO_2 (P/F) ≥ 180 mmHg.

DISCUSSION

Liberation from mechanical ventilation represents a critical phase of intensive care management and is associated with significant morbidity when unsuccessful. Approximately 20% of mechanically ventilated patients experience difficulty during the weaning process, underscoring the importance of accurate and reliable assessment strategies. [1] This challenge is amplified in elderly patients with neurological impairment, in whom

clinical evaluation of respiratory effort and mental status may be unreliable.

The spontaneous breathing test remains the cornerstone of ventilator weaning and has consistently demonstrated safety and effectiveness when conducted using minimal ventilatory support. [1–3] In the present case, the patient fulfilled established clinical readiness criteria prior to initiation of the spontaneous breathing test, in accordance with current international recommendations. Daily assessment for weaning readiness after more than 24 hours of mechanical ventilation facilitated timely evaluation and avoided unnecessary prolongation of ventilatory support.

The rapid shallow breathing index is one of the most widely used predictor of weaning success due to its simplicity and high sensitivity. [4] We recorded in our patient, a markedly low rapid shallow breathing index of < 105 breaths/min/L which suggested a favourable probability of successful ventilator liberation. The rapid shallow breathing index is calculated as the ratio of respiratory rate (breaths per minute) to tidal volume (liters). A low value (<105 breaths/min/L) is generally indicative of a higher likelihood of successful extubation, as it suggests that the patient can maintain effective ventilation without mechanical support.[4,5]

However, despite its widespread use, the predictive accuracy of the rapid shallow breathing index is limited by modest specificity and its inability to detect isolated diaphragmatic dysfunction.[5,6] This limitation is particularly relevant in elderly or neurologically impaired patients, in whom accessory respiratory muscle recruitment may temporarily compensate for diaphragmatic weakness.

Mechanical ventilation has been shown to induce early and progressive diaphragmatic dysfunction, a phenomenon known as ventilator-induced diaphragmatic dysfunction, which may develop within the first 24 hours of ventilatory support.[7,8] In such circumstances, reliance solely on global respiratory indices may result in false reassurance and increase the risk of extubation failure. Accessory chest walls muscles, although capable of short-term compensation, fatigue more rapidly than the diaphragm and are unable to sustain adequate ventilation over time. [9]

Diaphragmatic ultrasonography [DU] provides a direct, non-invasive method for assessing diaphragmatic structure and function and has emerged as a valuable adjunct in ventilator weaning. The specificity and sensitivity of DU is in the array of advantages it offers, as it is a practical, accurate, and reproducible tool for evaluating diaphragm function, which is important for successful weaning. DU is capable of predicting how successful weaning of patient from the ventilator can be, as it shows both structural and functional status of diaphragm, allowing the physician to assess patient's respiratory capabilities. Other advantages include its portability, allowing quick assessments and it is safe for patients. [10] Diaphragm thickening fraction (DTF) reflects diaphragmatic contractile activity and has been shown to correlate with weaning success.[9, 11] DTF of the diaphragm unit is a percentage, and DTF ≥ 27.9% is used to predict successful weaning with a sensitivity of 98.3%, and a specificity of 62.1%.[10-16] In the present case, the diaphragm thickening fraction was DTF was 41.25%; this was above the reported cut-off values associated with successful extubation, indicating preserved diaphragmatic function. Diaphragm excursion further complements this assessment by quantifying diaphragmatic mobility during inspiration. Reduced excursion has been associated with an increased risk of weaning failure.[13,14]

According to studies, a diaphragmatic excursion of 8.45mm achieved 92.1% sensitivity and 88.2% specificity for predicting extubation failure.[13,14] This means that patients with diaphragmatic excursion of 8.45mm or more are less likely to experience extubation failure.[15] The substantial diaphragm excursion of 162mm observed in this patient provided additional objective confirmation of readiness for ventilator liberation and supported the clinical decision to proceed with extubation.

The combined application of conventional clinical criteria, rapid shallow breathing index, and diaphragmatic ultrasound parameters enhances predictive accuracy and mitigates the limitations of relying on a single index. [13-16] This integrated approach is particularly advantageous in patients with cognitive impairment, where assessment of neurological recovery and cooperation is limited. In such cases, objective evaluation of respiratory muscle function improves confidence in extubation decisions and may reduce the incidence of weaning failure.

CONCLUSION

Weaning from mechanical ventilation after more than 24 hours of ventilatory support is a structured and stepwise process that requires careful assessment to minimise the risk of failure. Standard clinical readiness criteria remain essential for identifying patients suitable for a spontaneous breathing test; however, these criteria alone may be insufficient in elderly patients with neurological or cognitive impairment. The rapid shallow breathing index is a useful and widely applied predictor of weaning success, but it reflects the combined activity of all inspiratory muscles and may fail to detect isolated diaphragmatic dysfunction. Diaphragmatic ultrasonography, through assessment of diaphragm thickening fraction and diaphragm excursion, provides a direct, non-invasive evaluation of diaphragmatic performance and offers valuable complementary information during the weaning process.[16,17] This case demonstrates that integrating conventional clinical assessment with objective diaphragmatic ultrasound parameters can enhance confidence in extubation decisions in complex clinical settings. Such an approach is particularly beneficial in elderly patients with impaired consciousness, where subjective clinical assessment may be unreliable, and may contribute to safer and more effective liberation from mechanical ventilation. Most patients who have required prolonged mechanical ventilation (PMV) can benefit from this technique but will require a more gradual approach. The gradual approach to weaning can comprise as much as 40%-60% of the total ventilator time. [18,19]

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REFERENCES

1. Esteban A, Frutos F, Tobin MJ, Alía I, Solsona JF, Valverdú I, et al. A comparison of four methods of weaning patients from mechanical ventilation. Spanish Lung Failure Collaborative Group. N England J Med 1995;332(6):345–350.
2. Schmidt GA, Girard TD, Kress JP, Morris PE, Ouellette DR, Alhazzani W, et al.; ATS/CHEST Ad Hoc Committee on Liberation from Mechanical Ventilation in Adults. Official executive summary of an American Thoracic Society/American College of Chest Physicians clinical practice guideline: liberation from mechanical ventilation in critically ill adults. Am J Respiratory Critical Care Med 2017;195(1):115–119.
3. MacIntyre NR, Cook DJ, Ely EW Jr, Epstein SK, Fink JB, Heffner JE, et al. Evidence-based guidelines for weaning and discontinuing ventilatory support. Chest 2001;120(6 Suppl):375S–395S.
4. Yang KL, Tobin MJ. A prospective study of indices predicting the outcome of trials of weaning from mechanical ventilation. N England J Med 1991;324(21):1445–1450.
5. Meade M, Guyatt G, Cook D, Griffith L, Sinuff T, Kergl C, et al. Predicting success in weaning from mechanical ventilation. Chest 2001;120(6 Suppl):400S–424S.
6. Sassoon CS, Mahutte CK. Airway occlusion pressure and breathing pattern as predictors of weaning outcome. Am Rev Respir Dis 1993;148(4 Pt 1):860–866.
7. Shi ZH, de Vries H, de Grooth HJ, Jonkman AH, Zhang Y, Haaksma M, et al.

Changes in respiratory muscle thickness during mechanical ventilation: focus on expiratory muscles. Anesthesiology 2021;134(5):748–759.
8. Jaber S, Petrof BJ, Jung B, Chanques G, Berthet JP, Rabuel C, et al. Rapidly progressive diaphragmatic weakness and injury during mechanical ventilation in humans. Am J Respiratory Critical Care Med 2011;183(3):364–371.
9. DiNino E, Gartman EJ, Sethi JM, McCool FD. Diaphragm ultrasound as a predictor of successful extubation from mechanical ventilation. Thorax 2014;69(5):423–427.
10. Emre G, Acosta D, Baston C. Diaphragm ultrasound for assessing diaphragmatic function and predicting ventilator weaning success: a review of the literature. Curr Pulmonol Rep 2025;14: 33.
11. Ueki J, de Bruin PF, Pride NB. In vivo assessment of diaphragm contraction by ultrasound in normal subjects. Thorax 1995;50(11):1157–1161.
12. Kim WY, Suh HJ, Hong SB, Koh Y, Lim CM. Diaphragm dysfunction assessed by ultrasonography: influence on weaning from mechanical ventilation. Critical Care Med 2011;39(12):2627–2630.
13. Pirompanich P, Romsaiyut S. Use of diaphragm thickening fraction combined with rapid shallow breathing index for predicting success of weaning from mechanical ventilator in medical patients. J Intensive Care 2018;6(1):6. Erratum in: J Intensive Care 2018;6:25.
14. Li S, Chen Z, Yan W. Application of bedside ultrasound in predicting the outcome of weaning from mechanical ventilation in elderly patients. BMC Pulm Med 2021;21(1):217.
15. Lin H, Yao M, Qin Z, Fu S, Wang H. Predictive values of ultrasonic diaphragm thickening fraction combined with integrative weaning index in weaning patients with mechanical ventilation: a retrospective study. J Cardiothorac Surg 2024;19(1):66.
16. Mahmoodpoor A, Fouladi S, Ramouz A, Shadvar K, Ostadi Z, Soleimanpour H. Diaphragm ultrasound to predict weaning outcome: systematic review and meta-analysis. Anaesthesiol Intensive Ther 2022;54(2):164-174.
17. Dubé BP, Dres M, Mayaux J, Demiri S, Similowski T, Demoule A. Ultrasound evaluation of diaphragm function in mechanically ventilated patients: comparison to phrenic stimulation and prognostic implications. Thorax 2017;72(9):811– 818.
18. Huang HY, Huang CY, Li LF. Prolonged mechanical ventilation: outcomes and management. J Clinical Med 2022;11(9):2451.
19. Epstein SK. Weaning from mechanical ventilation. Respir Care 2002;47(4):454-468.

Case Report

Home massage tool induced acute thoracic spinal epidural haematoma – a case report

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Abstract

Background: Spinal epidural haematoma is a rare but potentially devastating condition that may present as an acute neurosurgical emergency. Prompt recognition and intervention are critical to prevent permanent neurological deficits.

Aim: To report a rare case of spinal epidural haematoma following the use of a home massage tool and to highlight the importance of early diagnosis and urgent surgical management.

Case Report: We present a 72-year-old man who was admitted into the emergency room after developing weakness of both lower extremities following the use of a home massage tool. Definitive diagnosis was made after magnetic resonance imaging was done. He subsequently underwent an emergency decompressive laminectomy and evacuation of the haematoma.

Conclusion: Spinal epidural haematoma can present as a surgical emergency. Early diagnosis with magnetic resonance imaging and prompt surgical decompression are essential for favourable outcomes. With the increasing availability and use of commercial body massagers, greater public awareness and caution are warranted.

Keywords: Home massage tool, spinal epidural haematoma

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INTRODUCTION

Spinal epidural haematoma (SEH) is a rare condition that may present with acute onset of spinal pain or neurological deficits. It requires early diagnosis and prompt treatment, which can include surgical intervention. Aetiology may be spontaneous, traumatic, surgical, post-epidural catheterisation or idiopathic.[1] 'Spontaneous' herein refers to atraumatic aetiology. Several factors, such as anticoagulants, straining, lifting, sneezing, haemophilia, neoplasms, arteriovenous malformation, hypertension and others have been implicated.[2] This entity should be differentiated from 'idiopathic', in which there is no clear aetiology and represents about 40–60% of all spontaneous spinal epidural haematomas.[1]

Spontaneous spinal epidural haematoma was first described by Jackson in 1869.[3] Since its initial description, over 300 cases have been documented in the literature, with an even smaller number reported from the West African subregion.[4] It has an incidence of about 0.1 per 100,000 patients per year[5] with a male-to-female ratio of 2:1.[6] There is no race predilection, and it is most common between the ages of 40 and 80 years old.[7]

Clinical signs can rapidly develop with progressive and catastrophic neurologic sequelae.[8] Magnetic Resonance Imaging (MRI) is the diagnostic modality of choice.[9] When indicated, symptomatic spinal epidural haematoma requires urgent surgical decompression of the spinal canal with evacuation of the haematoma. Outcome is dependent on the location, degree of neurologic deficit, duration of symptoms and time to intervention.[10]

We present a case of an acute non-traumatic paraplegia due to a thoracic spinal epidural haematoma following the use of a commercial home massage tool.

CASE REPORT

A 72-year-old man presented with the inability to move both lower extremities and urinary retention of about 24 hours' duration. He developed sudden onset, electric shock-like pains in the mid back with radiation to both lower extremities while using a vibrating body massager (Figure 1). There was associated numbness and reduced power in both lower extremities. He was unable to pass urine and had faecal incontinence. He previously suffered from chronic, recurrent low back pain of about 4 years duration for which he had regularly used the device.

Figure 1: Home massage tool used by the patient

After initial care in a primary health care centre, where he was catheterized and was transferred to our facility, which is about 135 km from his domicile, for specialist care. He was a known hypertensive and diabetic, not on any anticoagulants or antiplatelet medication.

When examined, he was slightly agitated with Medical Research Council (MRC) power grade zero across the lower limbs and areflexia across the knees and ankles. He had a sensory level of T9 partially preserved to T11 with no sacral sparing. There was lax anal sphincter tone. Both the anal and bulbocavernosus reflexes were absent. He had point tenderness in the thoracolumbar junction, but there was no swelling or skin changes. A clinical assessment of T9 non-traumatic myelopathy American Spinal Injury Association (ASIA) grade A in spinal shock, was made. Blood investigations done, including complete blood count and clotting profile, were normal. The thoracic spine MRI showed an extra-axial mass lesion dorsal to the cord at T9, which had no enhancement on contrast administration (Figure 2). Differentials considered included a mitotic lesion and epidural haematoma. He had emergency T8-10 decompressive laminectomies. Intraoperatively, an acute haematoma with marked thecal compression was seen (Figure 3). The haematoma was evacuated, and rehabilitation commenced immediately. Pathological examination demonstrated a haematoma without malignant cells or abnormal blood vessels. Upon his last clinic visit, 3 years post op, he had power of MRC grade 2 in the lower extremities up to the right big toe with perianal sensation, but bi-sphincteric dysfunction persisted.

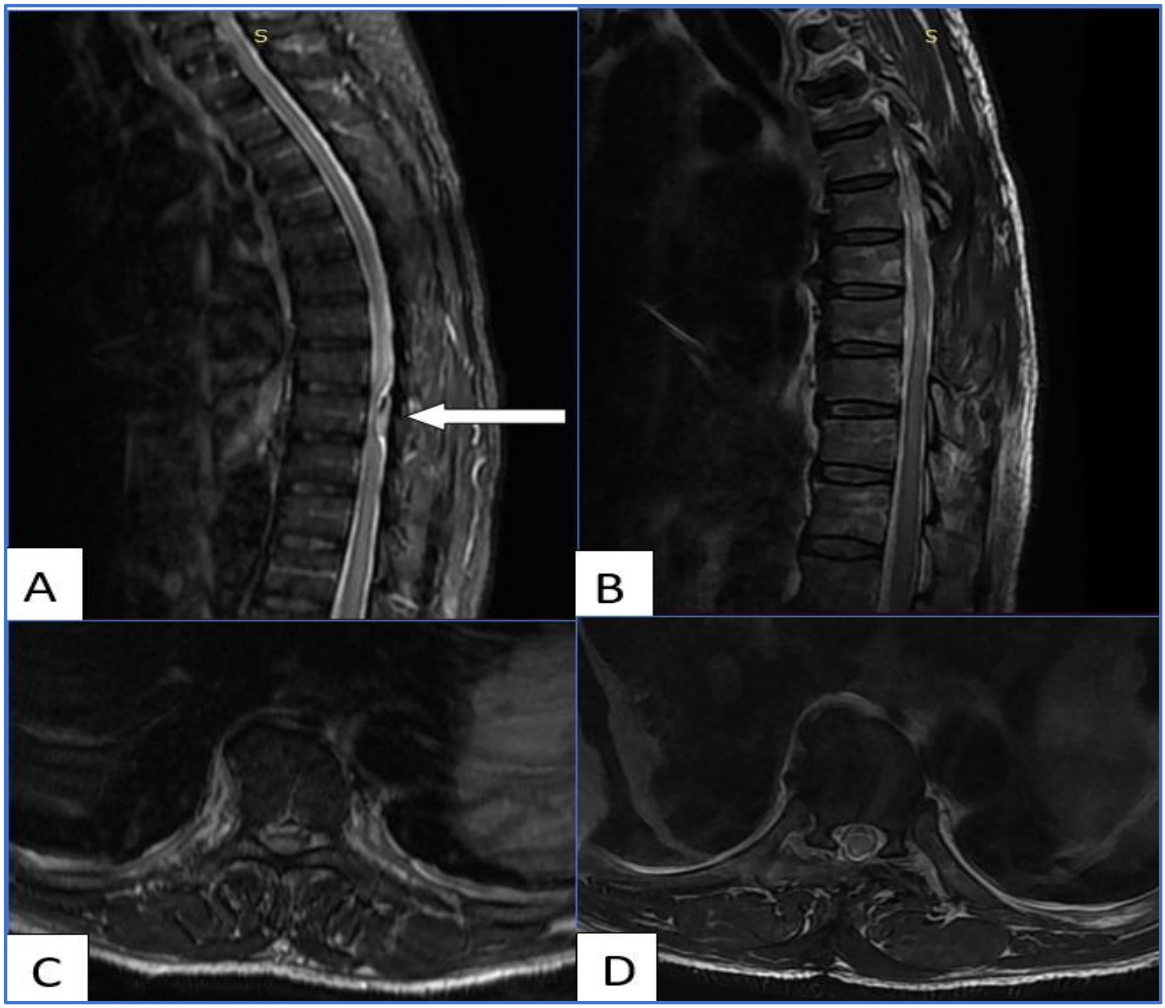

Figure 2: Magnetic Resonance Imaging (MRI) scan (T2-weighted) shows the dorsally located haematoma at the T9 vertebra level with cord compression, before (A and C) and three months after surgery (B and D).

DISCUSSION

The most common clinical presentation of SEH is the sudden onset of neck pain or back pain associated with features of spinal cord dysfunction or cauda equina compression. These symptoms and signs usually evolve rapidly after the onset of pain but may also present in a delayed fashion. It has been reported to occur at all anatomic levels in the spinal column, but it usually falls within two groups, C5-T2 and T12-L2.[11]The index case, with haematoma localisation at T9, therefore falls outside these commonly reported clusters. The spinal axial diameter across different anatomic levels is smallest at the thoracic vertebra level. The thoracic spinal cord is also known to have a tenuous blood supply with fewer radiculo-medullary branches compared to the thoracic and lumbar enlargements, which may affect neurological recovery after insult. Thoracic localisation may therefore contribute to more severe neurologic deficits and poorer recovery as seen in the index patient.

The diagnosis of acute epidural haematoma is usually based on clinical examination findings to determine the gross anatomic level and degree of neurologic compromise and radiological assessment to confirm the diagnosis and define the extent of the lesion. The combination of these usually determines if

surgical intervention is warranted. The definitive diagnosis is thus not based on history alone. This is due to the fact that aetiologic factors are heterogeneous and varied. Our patient had no clear risk factors, and it was initially difficult to link his symptoms with the body massager, as it was a device he had used for a long time. Also, this wasn't a common complication of its use, though recognised.[12] In cases where symptoms are more of mild weakness and radiculopathy, a strong differential would be a herniated disc. This is a more common clinical condition and must be considered when reviewing these patients.[5]

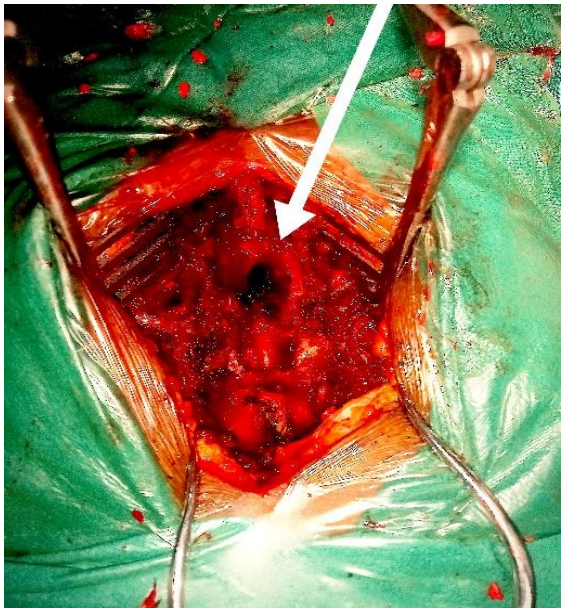

Figure 3: Intraoperative photograph after a decompressive laminectomy was done, with an arrow pointing to the lesion.

Magnetic Resonance Imaging (MRI) is the preferred diagnostic tool for SEH and can reveal the location and extent of the haematoma, the degree of spinal cord compression and the signal changes within the spinal cord. Signal characteristics vary according to the stage of haematoma evolution, aiding temporal characterisation.[2,5]Another major usefulness of the MRI is in differentiating other differentials of epidural cord lesions. In the index case, definitive diagnosis was established only after MRI evaluation, consistent with previous reports by other investigators.[6,11,13]

Where MRI is contraindicated or unavailable, spinal computerised tomography (CT) scans with or without myelography can also be useful, although with a slightly inferior sensitivity. Limited access to advanced neuroimaging remains a significant barrier in many low- and middle-income countries (LMICs) where high infrastructure costs and maintenance challenges continue to be a major impediment to its availability.[14] This contributes to significant delays in diagnosis and possible intervention, especially in sub-Saharan Africa, contributing to poorer outcomes.

Commercially marketed home massage tools are increasingly being used in the management of neck pain and back pain. These devices are perceived as affordable, convenient and easy to use. They are also being used as adjuncts to spinal manipulation therapy (SMT). Spinal manipulation therapy involves the application of high- velocity, low- amplitude forces to articulate the spinal column and is widely used to treat neck pain. SMT is rarely the cause of SEH, and the mechanism linking SMT and SEH is unclear.[15]Bleeding from the fragile epidural venous plexus is postulated to be the cause. A combination of these two methods of therapy may increase the risk of SEH, and further studies are warranted to clarify this potential association. In our patient, the commercial massage tool was the only aetiological factor we could identify. The vibrations of the tool could have been sufficient to rupture friable venous vessels in this elderly patient, as even relatively light external forces have been documented to result in traumatic SEH.[12]

Several factors influence postoperative recovery, including haematoma location, preoperative neurologic status, rapidity of symptom progression and timing of surgical decompression. The longer the duration of symptoms, the less likely full neurologic recovery. However, complete neurologic recovery has been reported up to 96 hours after symptom onset. Thus, even with delayed diagnosis, operative interventions can be offered.[4] In our patient, decompressive laminectomy was performed more than 48 hours after the onset of back pain. Although partial motor recovery was achieved, persistent lower

limb weakness and urinary dysfunction remain three years postoperatively, underscoring the prognostic significance of initial neurological severity and delayed intervention.

Delayed diagnosis in this case was multifactorial, reflecting both limited proximity to neurosurgical services and broader workforce shortages. Africa still has a very low neurosurgeon-to-population ratio, with most surgeons concentrated in the continent's urban centres.[16] This disparity exacerbates delays in definitive care for time-sensitive neurosurgical emergencies such as SEH and remains a major structural determinant of outcome.

CONCLUSION

SEH is a neurosurgical emergency that can rapidly lead to neurologic deficits, which can be permanent and life-altering. Its prognosis is usually dependent on its anatomic location, morphology of the lesion, duration of symptoms and timing of intervention. We present the case of an elderly patient who developed SEH following the use of a home massaging tool. Perhaps these vibrating tools may predispose elderly patients to developing this condition. However, due to its rarity, more research needs to be done. Treating physicians should be aware of the subtle signs of SEH in the setting of minimal or no clear antecedent trauma and should initiate prompt and appropriate imaging and treatment.

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REFERENCES

1. Duffill J, Sparrow OC, Millar J, Barker CS. Can spontaneous spinal epidural haematoma be managed safely without operation? A report of four cases. J Neurol Neurosurg Psychiatry 2000;69(6):816-819.
2. Zhong W, Chen H, You C, Li J, Liu Y, Huang S. Spontaneous spinal epidural haematoma. J Clin Neurosci 2011;18(11):1490-1494.
3. Jackson R. Case of spinal apoplexy. Lancet 1869;94(2392):5-6.
4. Dinsmore AJ, Leonard RB, Manthey D. Spontaneous spinal epidural haematoma: a case report. J Emerg Med 2005;28(4):423-426.
5. Holtas S, Heiling M, Lonntoft M. Spontaneous spinal epidural haematoma: findings at MR imaging and clinical correlation. Radiology 1996;199(2):409-413.
6. Kim T, Lee CH, Hyun SJ, Yoon SH, Kim KJ, Kim HJ. Clinical outcomes of spontaneous spinal epidural haematoma : a comparative study between conservative and surgical treatment. J Korean Neurosurg Soc 2012;52(6):523-527.
7. Meuga MW, Konan ML, Dongo S, Derou KL, Gbazi MS , Okamon DM, et al. Motor recovery after acute hemiparesis caused by spontaneous cervical spinal epidural haematoma: a case report. East Afr J Neurol Sci 2024;3(2):69-75.
8. Hammoud M, Mohammed HO, Chakour K, El Faiz Chaoui M. Spontaneous spinal epidural haematoma in infants: a case report and review of the literature. Surg Neurol Int 2024;15:320.
9. Labeodan OA. Spinal epidural haematoma mimicking spontaneous subarachnoid haemorrhage. Emerg Med J 2005;22(8):606-607.
10. Groen R, van Alphen H. Operative treatment of spontaneous spinal epidural haematomas: a study of the factors determining postoperative outcome. Neurosurgery 1996;39(3):494-509.
11. Raasck K, Habis AA, Aoude A, Simões L, Barros F, Reindl R, et al. Spontaneous spinal epidural haematoma management: a case series and literature review. Spinal Cord Ser Cases 2017;3(1):16043
12. Tominaga Y, Hirayama I, Nonaka M, Yano T, Ishii M. Commercial massage tool-induced spinal epidural haematoma. Acute Med Surg 2023;10(1):e886.
13. Hsieh CT, Chiang YH, Tang CT, Sun JM, Ju DT. Delayed traumatic thoracic spinal epidural haematoma: a case report and literature review. Am J Emerg Med 2007;25(1):69-71.
14. Ogbole GI, Adeyomoye AO, Badu-Peprah A, Mensah Y, Nzeh DA. Survey of magnetic resonance imaging availability in West Africa.

Pan Afr Med J 2018;30:240
15. Ryu JI, Han MH, Kim JM, Kim CH, Cheong JH. Cervical epidural haematoma that induced sudden paraparesis after cervical spine massage: case report and literature review. World Neurosurg 2018;112:217-220.
16. Ahmed H, Furqan M, Okon II, Oduoye MO, Mitchell UO, Akpan U, et al. The availability, access, challenges and advancements in neurosurgical care in Africa: a mini review. Ann Med Surg (Lond) 2024;86(4):2011-2015.

Case Report

Anaesthetic management of superior vena cava syndrome in a 14-year-old undergoing mediastinal mass excision: a case report

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Abstract

Background: Superior vena cava syndrome occurs when there is obstruction of blood flow through the superior vena cava to the right atrium and is mostly seen in patients with mediastinal masses. It can be a medical emergency associated with respiratory and cardiovascular collapse and requires immediate evaluation and treatment.

Aim: This is a case report of the approach to anaesthetic and intensive care of a 14-year-old scheduled for elective sternotomy for an obstructive mediastinal mass with typical presentations of superior vena cava syndrome.

Case Report: A 14-year-old male patient was diagnosed with features suggestive of superior vena cava syndrome following presentation at the children emergency ward of the University of Port Harcourt Teaching Hospital. Nigeria and after initial management of acute asthma on account of frequent respiratory distress. Following detailed preoperative assessment and preparation, meticulous anaesthetic care and monitoring contributed to a safe outcome despite challenging perioperative cardiorespiratory events typical of patients with such syndrome. The respiratory and cardiovascular variables later returned to normal values following sternotomy and debulking of the mediastinal mass and recovery was uneventful in the Intensive care unit from where he was finally discharged to the ward after 48hrs.

Conclusion: Diagnosis of superior vena cava syndrome can be masked by other common causes of airway obstruction. These patients pose a high anaesthetic risk perioperatively. Management includes surgical approach while specialised anaesthetic care is crucial to a safe outcome.

Keywords: Superior vena cava syndrome, sternotomy, specialised anaesthetic care

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INTRODUCTION

Superior vena cava syndrome (SVCS) is a condition that is associated with obstruction of blood flow through the superior vena cava (SVC) that drains blood from the upper part of the body into the right atrium. This results in oedema and distended veins in the upper part of the body, dyspnoea, orthopnoea etc. It occurs mostly in patients with mediastinal mass enlargement which may be malignant or non-malignant within the thorax, and can therefore be a medical emergency that requires immediate evaluation and treatment.[1-3]

William Hunter[4] first described the syndrome in 1757 in a patient who was diagnosed with syphilitic aortic aneurysm. SVCS is rare in all ages and incidence values in Nigeria are not known, but it is estimated at 1 in 650 to 1 in 3100 patients in the literature; and in the USA about 15,000 cases have been reported yearly.[5]

Tuberculous mediastinitis has also been implicated in the aetiology,[6] but most cases are

linked to malignancies or metastasis in the thorax[7] with incomplete SVC obstruction secondary to extrinsic pressure, unlike complete SVC obstruction which is the result of intravascular thrombosis in combination with extrinsic pressure. Such thrombosis may result from intravascular arterial devices and pacemaker wires.[8,9] The SVC being a thin-walled low pressure vessel in the mediastinum is vulnerable to both extrinsic and intrinsic pressure that leads to blockage of blood flow from the upper body parts and resultant upper extremity oedema, neck vein distension, etc

In adults, malignant causes of SVCS occur mostly in males because of the high incidence of lung cancer in them, but benign causes have no gender predilection.

In the paediatric age, causes may be Non-Hodgkins, or Hodgkins lymphoma, leukaemia, thymoma.or infections such as tuberculosis.[10]

Conservative treatment may bring some relief, but with decreased cardiac output and cerebral or upper airway oedema, emergency treatment with diuretics or corticosteroids is indicated. Other modalities of management include radio or chemotherapy for some tumors,[7] thrombolytics or anticoagulants and catheter removal (if possible) when thrombus forms around a central venous catheter, and endovascular treatment options.[8]

Surgical management poses a challenge to the Anaesthetist due to life threatening complications such as cardiovascular collapse; which results from reduced venous return as a result of obstructed flow into the SVC at induction when patient is placed in the supine position. Cerebral oedema with increased intracranial pressure constitute peculiar challenges to the neurological status. Venous access is preferrable at the lower limbs due to difficult flow via the upper extremities and presence of a thrombus creates a risk for pulmonary embolism. Complete airway obstruction, pulmonary and laryngeal oedema from venous congestion can be assaociated with severe hypoxia and difficult intubation during anaesthesia.[1,2] When all these complications are not well managed, the outcome can be very grave, especially in a low- and middle-income country where specialized anaesthesia workforce and equipment for monitoring and airway maintenance can be a challenge. Although, there may be need for individualised management, safe practices must be upheld.

We report the successful management of a 14-year-old male in a resource-constrained environment who had been undergoing treatment for repeated bouts of airway obstruction, but was eventually diagnosed with superior vena cava syndrome (SVCS) and booked for an elective mediastinal mass resection.

CASE REPORT

A 14-year-old male student who was 52kg in weight presented to the children's emergency ward of the University of Port Harcourt Teaching Hospital with 3 weeks history of cough and difficulty in breathing of one day duration. The cough was non-paroxysmal, associated with difficult and noisy breathing, productive of whitish sputum and was temporarily relieved by drugs such as antibiotics and bronchodilators. There was no voice change, but there was orthopnoea and daily activities were limited by the difficulty in breathing. There was no previous history of childhood asthma, allergy to drugs or particulate matter, or a positive family history of difficulty in breathing.

Examination of the patient revealed a facial swelling with distended veins on the forehead and over the upper chest. General examination showed him seated upright, dyspneoic with a respiratory rate of 32cycles/minute and on supplemental oxygen (3l/min) by nasal prongs. There was no fever, pallor, dehydration, central cyanosis, finger clubbing or peripheral oedema. Airway assessment revealed a supple neck with mobile temporo-mandibular joint and an inter incisor distance of >6cm, while the Mallampati assessment for ease of intubation was Grade I. Chest examination showed bilateral chest movement, no swelling or tenderness, percussion notes were resonant, there was markedly reduced air entry with rhonchi in all lung fields. Examination of the cardiovascular system showed a pulse rate of 110 beats/min (regular and of good volume),

blood pressure of 120/80 mmHg, slightly elevated JVP and normal heart sounds I and II.

A chest X-Ray finding that included widening of the madiastinum with a well marginated ovoid mass protruding unilaterally to the right side, and a CT scan that showed a superior mediastinal mass with some narrowing of the SVC at the level of the azygous vein suggested the mass was a thymoma. Other investigations including packed cell volume (34%), serum electrolytes, urea, creatinine and the electrocardiogram results were within normal limits, and an American Society of Anesthesiologists' (ASA) physical status score of IV was assigned.

General anaesthesia (GA) with muscle relaxation, tracheal intubation, and controlled ventilation was planned. Both written and informed consent were obtained and patient was placed on 6hrs preoperative fast for solids and 2hrs to clear fluids. Premedication was omitted, a request was made for 2 units of grouped and cross matched blood and patient was counseled for GA and the likely perioperative course including intensive care unit (ICU) admission for elective post operative ventilation. A multidisciplinary team session that included the Surgical, Anaesthetic, Nursing and Haematologic teams was held preoperatively to discuss envisaged perioperative problems and management plan.

On the day of surgery, following safety checks on the anaesthetic/suction machine, monitors, airway maintenance devices, and the difficult airway tray was placed on standby including plans for emergency tracheostomy, the patient was transported in a propped-up position into the theatre and subsequently positioned on the operating table with monitors (for noninvasive blood pressure, peripheral oxygen saturation, temperature and ECG) attached. Base line vital signs were BP - 125/75mmHg, SpO_2 - 97%, T^OC – 36.8 and ECG - sinus rhythm. Invasive monitoring could not be performed as transducers were not available. Intravenous access was secured on both arms with 16G canulae and warm fluid (0.9% normal saline) administered, but a reduction in flow was observed and an additional access was secured on the right lower limb. Preoxygenation was commenced with 100% oxygen at a flow of 4L/min for about 5 minutes and IV atropine 0.4mg was administered just prior to induction. Anaesthesia was induced with propofol (100mg) and intubation facilitated with suxamethonium (75mg) using a size 6mm I.D (internal diameter) cuffed endotracheal tube connected to a Mapleson A circuit and equality of air entry confirmed bilaterally. The end tidal capnography ($EtCO_2$) monitor was also attached and bladder catheterisation instituted to monitor the intraoperative urine output.

Following intubation and before administering the non-depolarising muscle relaxant, there was a sudden increase in intrathoracic pressure, with poor chest compliance and increased air way pressure from the poor breathing (reservoir) bag compliance. The peripheral oxygen saturation (SpO_2) dropped below 90%. Circuits and connections were quickly checked for kinking/disconnections; however auscultation of the chest revealed a marked decrease in air entry bilaterally. Oxygen flow rate was therefore increased to 8-9L/min, inspiratory-expiratory ratio of 3:1 was commenced and respiratory rate was maintained at 16cycles/minute. This improved the SpO_2 to about 95%. Fluid replacement and drug injection could only be achieved via the right lower extremity as there was reverse flow in the upper limb accesses due to increased intra thoracic and central venous pressure.. The BP was also markedly elevated to a range of 140/110 - 180/120mmHg. Anaesthesia was maintained with 100% of oxygen at 3-9l/min and isoflurane at 1-1.5%. Muscle relaxation and manual ventilation with a closed breathing circuit was achieved with 30mg atracurium and multimodal analgesia was employed with IV injections of 20mg pentazocine, 75µg fentanyl and 750mg paracetamol. During sternotomy, manual ventilation was temporarily stopped to prevent damage to inflated lungs from the sternotomy blade. Subsequently, there was an immediate decrease in intra thoracic pressure causing a noticeable reduction in airway pressure with better bag compliance, improved SpO_2 of >95% and lowered BP readings of 120/75 – 130/80mmHg. Also, following debulking of

the tumour, intravenous fluid flow was fully restored on the upper limb and all monitored parameters remained stable, there were no more rhonchi and air entry became adequate bilaterally. The estimated blood loss was 1.2L, patient was transfused with 1L of crossmatched blood and total urine output was about 300mls. At the end of surgery which lasted four and half hours, isoflurane was discontinued and residual neuromuscular block was reversed using 2mg neostigmine and 1mg atropine to obtund its muscarinic effects. Oxygen was continued for another 10min and pharyngolaryngeal suctioning ensured secretions were adequately cleared. The patient maintained strong respiratory efforts with adequate vital capacity breaths, was extubated awake with an oxygen saturation of 96-98% on 100% O_2, and was transferred to the ICU for close monitoring and continued post-operative care. In the ICU, he was nursed in a slight head-up position with supplemental oxygen at 3L/min via nasal prongs, and vital signs were closely monitored continuously, then every 15mins with recorded values within normal range. Pain management continued with IV administration of 20mg pentazocine 8hrly, 750mg paracetamol 6hrly and rectal diclofenac 50mg daily. Temperature maintenance was ensured with warm blankets and breathing exercises were commenced by the second post operative day. He was subsequently transferred to the paediatric ward for continued care after 48hours, and was discharged home on the 20th day post operatively, after an uneventful stay.

DISCUSSION

It is known that no gender predilection occurs with benign causes of SVCS.[10] This index report is on a male gender with thymoma who had a typical presentation of an easily missed early stage SVCS where partial obstruction may be asymptomatic or with minor symptoms and signs. However, with illness progression, the presentation was more classical with a worsening experience on bending forward or lying down.

Anaesthetic management of patients with SVCS must be preceded with a thorough preoperative evaluation which includes a careful airway assessment. Due to the likelihood of a difficult airway, sedative premedicants are to be avoided and antisialogues administered to dry up secretions. Patient should be transported in a propped-up position (30-45^0) to encourage good venous drainage from the upper half of the body. All these were observed in our patient as documented in previous studies.[10,11]

Venous access is better secured on the lower extremity to obviate problems related to complete SVC obstruction like pulmonary congestion, increased “one arm –brain circulation” time and a consequent prolonged induction time from reduced time to drug effector site, with the potential risk of over dose of induction agents (and all other drugs in general). Wide bore cannulae (18 or16G), to manage substantial haemorrhage associated with major intra thoracic surgery is appropriate.[10-12] In our patient however, venous access was initially secured on the upper limbs due to difficulty with alternate access. This could have contributed to the worsening of the SVC obstruction. Kamari et al[13] have noted a similar finding in their management of a large tumor in the superior mediastinum, where placement of venous access in the upper extremity was attributed as a likely cause of worsening intraoperative SVC obstruction. However, in the present report, the upper limb venous access subsequently became functional and the elevated BP normalised, following sternotomy and tumour resection.

General anaesthesia for SVCS can be associated with increased morbidity and mortality. This is partly caused by partial to total airway obstruction and inability to ventilate the patient. There is also increased risk of difficult intubation as a result of laryngeal edema and engorged veins. Severe haemodynamic compromise is worsened by IPPV leading to increased intra thoracic pressure and decreased venous return.[11-13] Therefore, GA with muscle relaxation should be avoided and maintenance of spontaneous ventilation favoured where feasible.[14] In the present case, GA was conducted being a paediatric, and in order to achieve good

muscle relaxation and airway control. A few studies have employed the use of local anaesthesia, but this was in adults who only had lymph node biopsies or interventional radiological studies.[11,12] Although difficult intubation was not encountered following induction and muscle relaxation, there was an increase in intra thoracic pressure with difficulty in manual ventilation as the airway pressure was markedly high. However, this was short-lived.

Blood loss may increase from increased venous pressure resulting into hypovolaemia and hypothermia. Blood was therefore replaced and adequate thermal care ensured by warming all fluids and observing a suitable ambient temperature. Renal compromise from hypovolaemia can also be a risk, but adequate fluid replacement and hourly urine output of not less than 0.5-1ml/kg/hr was ensured.

Thereafter, as with most non-complex SVCS's, the increased airway and blood pressures became normalized till discharge. Ideally, postoperative care should be in a paediatric intensive care unit (PICU) for this age category (or a high dependency unit),[14,15] the study centre however has no PICU and patient was monitored in a general ICU to ensure close monitoring. After an uneventful stay, he was safely discharged to the ward.

CONCLUSION

The anaesthetic management of a patient with SVCS can be very challenging as it is not commonly encountered in clinical practice, Heightened vigilance, careful interpretation of imaging and coordinated multi-disciplinary care are part of indices of favourable outcomes in settings with limited resources as demonstrated in this report.

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Conflict of Interest:

There are no conflicts of interest.

REFERENCES

1. Azizi AH, Shafi I, Shah N, Rosenfield K, Schainfeld R, Sista A, et al. Superior vena cava syndrome. JACC Cardiovasc Interv 2020;13(24):2896-2910.
2. Klein-Weigel PF, Elitok S, Ruttloff A, Reinhold S, Nielitz J, Steindl J, et al. Superior vena cava syndrome. Vasa 2020;49(6):437-448.
3. Armstrong BA, Perez CA, Simpson JR, Hederman MA. Role of irradiation in the management of superior vena cava syndrome. Int J Radiat Oncol Biol Phys 1987;13(4):531-539.
4. Hunter W. The history of an aneurysm of the aorta, with some remarks on aneurysms in general. Med Obs Enq 1757; 1: 323-357.
5. Nickloes TA,Kallab AM, Dunlap AB. Superior vena cava syndrome (SVCS). Rowe VL (Chief Editor) 2024. Available from: emedicine.medscape.com/article/460865. Accessed on 22/02/2025.
6. Schechter MM. The superior vena cava syndrome. Am J Med Sci 1954; 227(1): 46-56.
7. Flounders JA. Oncology emergency modules: superior vena cava syndrome. Oncol Nurs Forum 2003;30(4):E84-90.
8. Aung EY, Khan M, Williams N, Raja U, Hamady M. Endovascular Stenting in Superior Vena Cava Syndrome: A Systematic Review and Meta-analysis. Cardiovasc Intervent Radiol 2022; 45(9):1236-1254.
9. Ahmann FR. A reassessment of the clinical implications of the superior vena caval syndrome. J Clin Oncol 1984; 2 (8):961-969.
10. Seligson MT, Surowiec SM. Superior vena cava syndrome. [Updated 2022]. In: StatPearls. Treasure Island (FL): StatPearls Publishing, 2025.
11. Dishman D. Anesthetic implications of superior vena cava syndrome in interventional radiology: a case report. AANA J 2017;85(6):453-459.
12. Chaudhary K, Gupta A, Wadhawan S, Jain D, Bhadoria P. Anesthetic management of superior vena cava syndrome due to anterior mediastinal mass. J Anaesthesiol Clin Pharmacol 2012;28(2):242-246.

13. Kumari I, Gupta S, Singhal PP. Superior vena caval syndrome in children. A Case Report. Middle East J Anaesthesiol 2006;18(5):933-938.
14. Liu GL, Wang M, Zhang M, Dai Y, Zhang DW. Case Report: Unmasking a sporadic pediatric tumor emergency: superior vena cava syndrome. Front Pediatr 2025; 13:1517745.
15. Alagbe-Briggs OT, Agi B, Orji O, Otokwala J, Isokariari OMA, Mato CN. Clinical profile of children admitted in a general ICU and outcome at the University of Port Harcourt Teaching Hospital, Nigeria. Nigerian Journal of Anaesthesia 2025;2(2):100-105.

Graduating List

Graduating Medical Doctors for February 2026

ABEL, Gideon Nubakor
ADAGHEBALU, Justice Ehimen
AJOKU, Ebubechukwu Favour
AKPAN, Abigail Edet
ALABINTEI, Ndutimi Daniel
AMADI, Sharon Chisom
AMADI-IKPA, Obinichi Prince
APPAH, Didey Deshidey
ASOYEMIEARI, Prince Heavendows
AWUMADE, Progress Anthony
AZUBUIKE, Amarachi Eziaku
BAGSHAW, Ibingo Prince
BATUBO, Ibienesela-a Opirite
BOWEI, Ayibaebomotei Hope
CHIMA, Favour Smiles
CHINWENDU, Sharon Amaka
CHRIS-OBI, Crown Chibuoyim
CHUKWUEMEKA, James
DAASANG, Neeka Divine
DAVIES, Sokeipirim
DA-WARIBOKO, Soibifaa Chelsea
DON-PEDRO, Sobomate Melford
EFEDHOMA, Oghenemaga
EGENTI, Tochukwu Marvin
EGWUATU, Kenechi Elizabeth
EGWURUGWU, Treasure Nyekachi
EKE, Esther Mgbahara
EKWEBELEM, Kimberly Tochi
EMAGBETERE, Eseoghenevoka Rebecca
EMMANUEL, Ufuoma Onyinyechukwu
EMUGHEDI, Goodnews Young
ERILIBE, Daniel Ogagaoghene
EWOH, Miracle Udeade
EZEKIEL, Favour Iheoma
FABOPREGHA, Joseph Boloboye
GBEINBO, Tarilatei Bunakeama
GEORGE, Elizabeth Ibitroko
GEORGEWILL, Fitzgerald
GEO-UMEH, Sandra Chinelo
GUDI, Monue Stephen
IBE, Chiemeka Emmanuel
IBOYI, Okeroghene Rejoice
IDOGHO, Christian Oghenevware
IFI, Obasi Okoro
IGBEINKUTU, Emmanuel
IGOMA, FAVOUR
IGWE, Praise Chibuosor
ITINAGBEDIA, Winnifred Efetobore
IZUEHIE, Tochi ThankGod
JENEWARI, Deborah Bomakejenpirima
JENKINS, Chigozie Gift
JOSIAH, Ida-Emele
JUMBO, Josephine Ayebaebiekimiete
KPANI, Leeleebari Permanent
MADUKU, Aforkoghene Favour
MARTINS, Elsie Chika
MEGBOWON, Adetosimi Raymond
MGBAMGBA, Okechukwu Joseph
MOORE, Otavie
MOSES, Daniel Adibaalode
NCHEGE, Iheanyi Benebo
NDUKWE, Amarachukwu Ngwu
NSIRIM, Godwin Kinikachi
NTEKIM, Michael okon

NWABUNDO, Queensley Onyinyechukwu
NWADIALOR, Theresa Onyinyechukwu
NWANKWO, Chisom Mary-Joan
NWEKE, Chidera Colette
NWOKE, Favour Chidinma
OBAROLO, Onanome Blessing
OBIEZE, Precious Ezenwa
OBONG, Favour Hilary
ODIKE, Chinaecherem Michael
OHAEGBU, Regina Chinwendu
OHANUKA, Dominic Ifunanyachukwu
OKECHUKWU, Shalom Anwulichukwu
OKODUDU, Imaegia Kamsiyiochukwu
OKOROBA, Benita Reginald
OLANREWAJU-BUORO, Efome Emmanuella
OMODU, Favour Ada
ONWUKA, Emmanuel Oliver
ONYEMAIZU, Victory Chukwuezugolum
OPARAUGO, Smart Chidi
ORANU, Ebube Emmanuel
OSIAGO, David Chukwuladi
OYADONGHAN, Tamarapreye Peace
SAMPLE, Divine Ibinabo
SANABANI, Mebarie Esther
SAYAH, Moseph Umoroye
SELEMI, John Mubulajah
SIGALO, Francis Baridule
SUNDAY, Ndubuizu Ronald
SUNDAY-CHITTE, Oneensi Sanctuary
TASIE, Desire Christian
TUNGBULU, Preye Gideon
UDEGBUNAM, Chiamaka
UDENYI, Richard Onjefu
UDI, Esther Oghenevwaire
UMUHEHE, Ejaita
VAL-UGBOMA, Demi Somtoolisa
WICHE, PraiseGod Chimenum
WORIKA, Belema Queen
WORLU, Ovunda
ORANU, Annunciato Chinedu
UMEHAA, Chisom Chukwuma

Graduating List

Graduating Nurses for March 2026

ABENGOWE, Ugochinyere Precious
AGUMA, Dorathy Uchechi
AKANDE, Adesola Oluwabukunmi
ALAYA, Catherine Motunrayo
AMARANJO, Michael Uba
AMADI, Deborah Temple
ALAJIEKWU, Susan
BABATUNDE, Oluwatosin Victoria
BEKEE, Lilian Onyenekwe
CHIJIOKE, Lydia Cynthia
CHINEDU-OKOROAFOR, Christiana Chibunma
DIORU, Ogheneruno Destiny
ECHEFU, Blessing
EDOSIO-RICH, Iwomano Victoria
ELEM-OKORE, Daniella Udo
EMMANUEL, Aniefon Emmanuella
ESIEKPOR, Happy
EZE, Wisdom Chiemela
EZEOGBELE, Grace Anatom
EZEJI, Wisdom Oluchi
EZE, Chukwunonso
GODWIN, Daniel Ibuchim
IDIKA, Joy Nkechinyerem
IGWENWA, Jessica Ifeyinwa
IKEGBUNAM, Chiamaka Theresa
IWUJI, Ugochukwu Favour
JEROME, Ekemini Fyneface
JOHN, Samuel Tamuno
JUMBO, Joan
KAINE, Ogorchukwu
KEKE, Portia Oghenenyerhovwo
MBABA, Medlyn Gilliot
NDUNAKA Precious Nzubechi
NLETEM, Esther Ikechi
NWENWE, Glory Chinyere
NWIYORBARI, Tedum Pius
OBIAZIKWOR, Favour Chinedu
OGBE, Favour Ozakieoniso
OKURE, Blessing Enobong
OKECHUKWU, Prosper Dim
OKPONIPRE, Doubra Gift
OKUBUIKE, Mmesoma Evangeline
OLANIYI, Alimot Temitope
ONYEANUSI, Ruth Ifunanya
ONYEUKWU, Precious Uchenna
ONYEZONWU, Prudence Amarachi
OSSAI, Chukwuyenum
OSSAI, Jemima
SALAKO, Mary
SOMIARI, Emmanuella Nene
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TIMAH, Gogorobari Daniella
UDO, Laura Agezi
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