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THE ROLES OF ORTHOPAEDIC PROFESSIONALS IN THE KENYA ORTHOPAEDIC ASSOCIATION: PERSONAL PERSPECTIVE

Every year, the Kenya Orthopaedic Association (KOA) holds its annual general meeting and scientific conference where students, clinicians, academicians, researchers and other professionals meet and disseminate their work and receive feedback from other professionals who are drawn locally, regionally, and internationally. The annual conference involves both academic and social events that are attended by hundreds of members and associate members.

The theme for the just concluded KOA (16th-20th June, 2025) event dubbed - the 19th Annual Scientific Conference and the 20th Annual General Meeting: *Enhancing specialized orthopaedic services to advance orthopaedic care in Kenya*. Subspecialties included: trauma, pelvis, foot and ankle; arthroplasty and sports medicine; spine; tumour, sepsis and paediatrics; hand and ortho- plastics. The essentials in the program: medical camps, preconference workshops and conferences. The event was quite a success.

The event has been important in several ways in relation to enhancing specialized orthopaedic services to advance the orthopaedic care. Foremost the event enables the exploration of ways to ensure everyone has accessible, equitable, acceptable and affordable specialized orthopaedic care. The event also enables displays of technological advancements- showcasing how technology can revolutionize the delivery of orthopaedic services. On global health- discussion of the broader challenges and opportunities in global orthopaedics, including sustainability and collaboration. These are just few of the benefits achieved by the event this year. But there is need to plan for further improvements despite the great and admirable achievements gained since the inception of KOA about two decades ago. There is need therefore for those who come to disseminate their work define even better approaches of receiving innovative ideas and feedbacks, and make use of them to even further better their work.

Since inception of the KOA, the activities have ever been expanding; events program look congested, and every participant feels the inadequacy of time. There is need for every participant to make contribution- either directly or indirectly. The lowest moment experienced by the KOA was during the Corona Virus Disease (COVID) – 19 (1), which was quite devastating for 3 years. However, the KOA observed the ensuing protocol and has made significant strides since then and is back to the right track.

Orthopaedic profession stands out prominently in these yearly events. But successes of events are a contribution from various parties as already stated- the attendants (clinicians, academicians, students, researchers and other professionals). The orthopaedic professionals therefore have an uphill task of ensuring an upward trend and success for the future events. Orthopaedic professionals are therefore multi-faceted since they play several roles including- clinical, academics, and research.

So who actually is an orthopaedic professional? This individual cannot be simply and easily defined. However, the origin of this individual can be traced as that person who has a complex educational track record involving several stages, and the total process can take over a decade, and variability in training countries exist (2). In Kenya, the defining moment can be traced in the undergraduate curriculum, where the individual graduates with Bachelor of Medicine and Bachelor of Surgery (MBChB) degrees. Internship period of one year gives an individual an opportunity to develop interest in the orthopaedic profession, and in the next one year as a medical officer, further interest should enable one to enroll for Master of Medicine (Orthopaedic Surgery) which takes a minimum of four years. Alternatively after internship, one can enroll into the College of Surgeons of East, Central and South Africa (COSECSA) for Membership followed by Fellowship Program. With enthusiasm, one can proceed to do Fellowship in subspecialty of choice. A period of supervised practice is mandatory. The entire process is regulated by the Kenya Medical Practitioners and Dentists Council (KMPDC), which eventually, licenses and formally recognizes one as an orthopaedic surgeon, with or without subspecialty (3).

The training has undergone evolution since the time Mulimba (4) made a presentation at KOA. The curriculum should be relevant for the profession, serving the present and even future needs of the nation. Recently in Kenya, the Commission for University Education (5) has encouraged and advised the universities to align their curricula to be competence based. These competencies

include: communication and collaboration, critical thinking and problem-solving, creativity and imagination, citizenship, digital literacy, self-efficacy, and learning to learn. The expectation is that this will enable the churning out of graduates with adequate knowledge, skills for practice, positive attitudes, and professionalism and even to be innovative enough to offer high quality effective specialized orthopaedic care to the communities in this nation. Professionalism and professional values in orthopaedics are valued highly (6,7). Observing professionalism helps in checking medical liability lawsuits involving orthopaedic surgeons (8*)*. Attitude is another concept difficult to assess but has been documented by Reichman, *et al.* (9) and is important component in orthopaedic profession. Competency based curriculum concerns have been echoed by some authors (10,11)**,** so it is not a new concept at all.

As an orthopaedic professional, of much concern is giving back to the community, in terms of clinical, academics, and research work. This brings in the concept of interdisciplinary or a relationship being multifactorial (12). The orthopaedic professionals being also multi- faceted therefore have several batons to pass over to the next generation of practitioners, without leaving gaps or vacuum in these categories of work.

In terms of clinical work, the just concluded event listed the subspecialties of interest in orthopaedic profession. An orthopaedic professional has a lot of responsibilities regarding the clinical work, including: diagnosis and treatment planning; operative and non-operative care, preventive, promotive, rehabilitation, and even patient education. Multidisciplinary team approach and sharing of goals lead to improved outcomes in patient care. This concept of an orthopaedic professional in relation to clinical work has been documented by some authors and a lot of dynamics of orthopedist involvement is required in the management of clinical activities (12,13). The other concern is of subspecialty of interest to the orthopaedic professional. This calls for considerable efforts to have them established in this region so as to have health sector be self-sufficient and reliable as well as to save patients from misery involved in referrals outside the country. Collaborative approach is important and this can be cultivated during such KOA event when congregants of global, regional and local origins participate. Okumu, (14) in a study published in this issue conducted an audit and has given highlight on the perceptions of surgical training before and after the introduction of subspecialty units at Kenyatta National Hospital. An interesting research work to read and give comments. Orthopaedic professionals in academic field can make use of the idea to establish subspecialty units in other medical schools elsewhere.

Subspecialty undertaking is not just that simple. According to Jeyaraman, *et al.* (15), structured research training during orthopaedic residency and fellowship enhances research productivity and grant acquisition prospects. While its direct effect on academic promotions is influenced by various external factors, incorporating research education into the orthopaedic curriculum fosters scholarly output and cultivates research-oriented clinical scientists. It is also important that the orthopaedic professional with subspecialty of interest be conversant with sites where information can be obtained as documented by Kapil Sugand and colleagues (16). The sites provide compilation of landmark studies from all subspecialties within emergency and elective trauma and orthopaedic practice. It is written in an accessible way, appropriate for an array of practicing experts, allied healthcare professionals and students with the goal of disseminating findings from high-quality studies that have led to standardized clinical guidelines for front-line clinicians and real-world gains for patients. Chapters focus on key findings, implications for practice, study funding sources, conflicts of interest, criticisms and limitations, and results from associated studies. Each chapter also concludes with a case study, offering readers the opportunity to conceptualize the key findings in practice. The objective selection criterion was conducted by an international consensus to identify the most influential landmark publications, taking into account the citations per year, high levels of evidence, clinical studies and trials as well as available references and guidelines. This approach will simplify, consolidate and reinforce the current literature of the most important research published into in a digestible, manageable, and reader-friendly content for trauma and orthopaedic surgeons, practicing clinicians, trainees, students and those led by data-driven evidence-based clinical care.

In academics, the orthopaedic professional as a teacher and a mentor has to lay the necessary basic education for undergraduates, advanced education for the Master of Medicine (Orthopaedic Surgery), membership and fellowship, and even more

advanced education for the orthopaedic surgeons undertaking fellowship for some subspecialty of interest. The orthopaedic professional therefore has a herculean task as an academician. Koo, *et al.* (17) have documented a review highlighting the strategies that educators may find useful in improving their teaching skills for the modern orthopaedic surgery learners. As orthopaedic surgeons and as educators, there will continue to be innovations that challenge and improve the traditional models. Rising to these challenges calls on the orthopaedic surgeon to adopt a growth mindset in adapting to the changing needs and expectations of not only for the patients but also the trainees.The structured research training programs during orthopaedic residency and fellowship play a crucial role in career development (15).

The yearly KOA events give opportunities for participants to present their research works. However, a lot of unpublished work seems to be existing in this country. How come several presentations at the KOA, and even a lot of research works by Master of Medicine (Orthopaedic Surgery) residents, and even those in COSECSA Fellowship Program and respective tutors supervising them in the various medical schools go unpublished in this country yet the *East African Orthopaedic Journal* (EAOJ) exists? A lot needs be done to have more publications bearing in mind that the just concluded event was quite colourful. The biannual EAOJ publications need be up scaled to three per year, then to quarterly or four per year. This needs financial support but introduction of a small publication fee will be of more benefit than harm to the future of KOA.

At the University of Rochester (UoR), both the Orthopaedic Research Society (ORS) and Orthopaedic Trauma Association (OTA) have invested a lot of effort in research (18). The purposes of this ORS is to promote, support, develop and encourage research in surgery and musculoskeletal disease, while that of OTA is to promote excellence in care for the injured patient, through provision of scientific forums and support of musculoskeletal research and education of orthopaedic surgeons and the public. KOA can similarly emulate the UoR and do likewise as for OTA and ORS.

Technology plays a significant role in modern orthopaedic research. Technological integration has included the following approaches: robotics- being used to enhance surgical precision, potentially leading to more accurate outcomes; artificial intelligence- applied in various aspects of orthopaedics, including data analysis and treatment planning; and electronic databases and mobile apps- for streamlining data collection, tracking patient progress remotely, and monitoring recovery. The use of artificial intelligence in research has also been quite evident as the number of presenters this year at KOA, touched on this and such trend should be encouraged. Research remains important in orthopaedics field and to the professionals (15-17), though it should be noted that the research landscape is ever evolving, hence there is need to investigate the current most cited orthopaedic surgery articles and compare these to previously cited (19), and therefore constantly reviewing the patterns of changes taking place. The most referenced papers may have resulted in additional research on that topic due to the unique results or conclusion of that particular study. It was found that half of the top 100 most cited articles in orthopaedic surgery changed in the last decade. This may speak to the changing shift in topical interests, availability of the articles or increased accessibility of the paper by the internet. It will be interesting to discover which articles remain in the next decade.

Several authors (12,15,19) have documented the importance of research in orthopaedics field, and it is evident that there is relationship between the academic involvement and research productivity of orthopaedic team physicians. The field of orthopaedic research will therefore continue to grow in order to address the increasing global burden of musculoskeletal injury and disease (20). The research work can be on various types and covers virtually all parts of the body (21). McMillan and Wijenayake (22) have documented the top 100 cited publications related to orthopaedic profession produced by Australian authors, and this should excite orthopaedic professionals to visit them and also make contribution in terms of publications.

Several authors (23-28) have documented on importance of the research work by orthopaedic professionals and the link between it and industry. Members from both exist as partners. This has played a great role towards implants and even drugs manufacturing for use in the orthopaedics care. This relation is well stipulated, and includes key aspects such as: collaboration for innovation- where the surgeons and industry partner to create innovative medical devices and techniques

that enhance patient outcomes; surgeon's role- where they offer valuable input on product development, participate in research, and share their knowledge of new technologies through teaching and advisement; industry's role- where there is development and manufacturing of the tools and devices that orthopaedic surgeons use in their practice, contributing to the advancement of the field. The other aspect being the importance of management and oversight, such as: patient care as the priority- where the primary goal of this relationship must be the betterment of patient care; avoiding conflicts of interest- where the potential for conflicts of interest must be carefully managed to protect the integrity of the orthopaedic profession; ethical considerations- where the past incidents of misconduct by orthopaedics manufacturing companies have led to increased scrutiny and oversight by federal authorities, reinforcing the need for transparency and ethical practices; patient care, professionalism, and relations with industry; patient care is the primary focus of the orthopaedic profession. The enhancement of patient care has required and will continue needing the collaboration. According to Poehling, *et al*. (24), the relationship between orthopaedic surgeons and industry is of critical importance to the shared ultimate goal of improving patient care. The article outlines principles that orthopaedic surgeons should adhere to in order to prioritize patient interests and uphold professional integrity.

The KOA event this year as usual gave various firm opportunities for display of various implants orthopaedic professionals in this country use in orthopaedic care. It is important to note that the orthopaedic surgeons in this region continue to use imported implants, and often get challenge of mismatch, for example when performing arthroplasty. It is high time these firms establish partnership with orthopaedic surgeons in this region, and then conduct research on implants specific for the population in this region in order to minimize chances of mismatch.

Tippabhatla, *et al*. (25) conducted a study seeking to understand trends in *industry* payments for research awarded to orthopaedic *surgeons*. These results can be used as a primer for orthopaedic surgeons seeking to leverage industry relationships to fund translational research. According to Miltenberg and colleagues (26), there is a positive correlation between academic productivity and industry payments at both the individual and institutional levels in orthopaedic sports medicine departments, although this relationship was greater at the fellowship level. Furthermore, the majority of non-research industry funding goes to a minority of physicians. One-half of the *orthopaedic surgeons* in the United States have reported to have *industry* financial *relationship* in the open payment database. According to Michelberger and colleagues (27), *orthopaedic surgery* has had long close financial *ties* with the medical device *industry in United States,* southeast region notably receiving significantly more *industry* funding than anticipated. According to Silvestre and colleagues (28), academic career outcomes of orthopaedic research is quite promising and that there is benefit of resident research grant and pursuit of a future career in academic orthopaedic field. Callaghan and Liu (23) documented that the *orthopaedic surgeon* and *industry* who value proposition in regard to design partnerships must follow many of the principles utilized for decades by the legal colleagues.

So as orthopaedic professionals being multi-faceted, they have several batons to hand over to the next generation of practitioners. This calls for concerted effort by everyone and all of us in order to achieve quality, effective and efficient delivery of high quality orthopaedic care in the various categories of subspecialties advocated for in the just concluded 19th annual scientific conference.

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COMPARISON BETWEEN CLINICO-RADIOLOGICAL DIAGNOSIS AND ARTHROSCOPIC FINDINGS IN PATIENTS PRESENTING WITH KNEE INJURIES AT MAJOR HOSPITALS IN ELDORET, KENYA

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ABSTRACT

Background: Traumatic knee joint injuries are among the leading causes of disability in the world. The diagnosis of these injuries, however, varies across different modalities, with clinical assessments by experienced professionals occasionally yielding superior findings compared to radiology. Establishing a definitive diagnosis is imperative for timely and effective management of knee injuries, which is essential for optimizing patient outcomes.

Objective: The aim of this study was to compare the diagnostic accuracy of clinical and radiological tests, in reference to arthroscopic findings, in diagnosing knee joint injuries.

Design: This was a multi-center prospective cross-sectional study conducted at four selected hospitals in Eldoret, Kenya, over a one-year period.

Methods: Seventy-nine patients presenting for knee arthroscopic surgeries were evaluated preoperatively using MRI and eight clinical tests. The results from the clinic-radiological tests were compared with arthroscopic findings, which were considered the "gold standard". Categorical and continuous variables were summarized using frequency tables, and measures of central tendency and dispersion, respectively. The diagnostic tests' accuracy, sensitivity, specificity, and positive and negative predictive values were also computed for comparison purposes.

Results: The patients' average age was 32.4 years, with a male to female ratio of 1.5:1. Most of the injuries involved the right knee (53.2%). It was also observed that Anterior Cruciate Ligament (ACL) tears (44.3%) were the most prevalent type of knee injuries, followed by medial meniscus (30.4%), lateral meniscus (24.1%), and Posterior Cruciate Ligament (PCL) (12.7%). The study also found that MRI was more accurate than clinical tests in diagnosing medial meniscus (92.41% vs. 50.63%); lateral meniscus (96.2% vs. 72.15%) and PCL (100% vs. 98.73%) injuries. MRI, however, was as accurate (98.7%), sensitive (100%), and specific (97.7%) as clinical examination in diagnosing ACL injuries.

Conclusion: Due to its superiority, MRI should be used as a first-line tool in investigating patients with suspected meniscal and PCL injuries. Clinical examination performed by experienced orthopaedic surgeons, however, can be as accurate as MRI in detecting ACL injuries.

Key words: Arthroscopy, Arthroscopic diagnosis, Clinical examination, MRI, Knee injuries

INTRODUCTION

Traumatic knee injuries are not only common, but they are also among the leading causes of disability in the world (1). The rising rates of disability can be attributed to poor management, missed diagnosis, and misdiagnosis of knee injuries. Missed diagnosis and misdiagnosis of knee injuries, in particular, have been widely reported in literature. A number of studies have found, for example, that a significant number of intra-operative arthroscopic findings do not correlate with prior clinical and radiological diagnoses of knee injuries (2,3). Investigations about the accuracies of individual diagnostic modalities have also yielded mixed results. While some studies have found that MRI is superior to clinical examination in diagnosing traumatic knee joint injuries (4 - 6), others have found that clinical

examination is either as accurate as MRI (7,8) or more accurate than MRI in diagnosing most knee joint injuries (2,9). The existence of inconclusive results and the limited knowledge on the validity, accuracy, and reliability of clinical diagnosis and radiology in Kenya and in Eldoret, in particular, warranted the present study.

MATERIALS AND METHODS

Study design and study area: This was a multi-centre, prospective cross-sectional study conducted at four selected hospitals in Eldoret, Kenya, over a one-year period. The facilities were selected due to their capacities to perform arthroscopic surgeries.

Study population: The study included all the patients who had positive clinical and 1.5-Tesla-MRI diagnosis of knee joint injuries, who were also scheduled to undergo arthroscopic surgeries within the study period. Patients with missing MRI reports or a history of prior arthroscopic surgeries were excluded from the study.

Sampling of participants: Consecutive sampling was used when recruiting participants for the study. All accessible patients who met the inclusion criteria were recruited. A total of 79 patients were recruited and consented for the study.

Data collection procedures: Eligible patients were approached and invited to participate upon providing an informed consent. Then, a structured questionnaire to gather the socio-demographic data, medical history, and clinical information such as site, cause, and duration of injury was administered.

Qualified orthopaedic surgeons, who were blinded from the MRI results, performed clinical examinations and tests on the patients and recorded their diagnoses. The tests included McMurray and lateral and medial joint line tenderness tests, Lachman and anterior drawer tests, posterior drawer test, varus stress test, and valgus stress tests. These tests were conducted to evaluate the presence of meniscal tears, Anterior Cruciate Ligament (ACL), Posterior Cruciate Ligament (PCL), Medial Collateral Ligament (MCL), and Lateral Collateral Ligament (LCL) injuries, respectively. None of the tests were performed under anaesthesia. Afterwards, the patients underwent arthroscopic surgeries and the findings were recorded. The arthroscopy surgeons, however, were not blinded to the clinical and radiological findings.

Statistical analysis of data: The data that was gathered from the study was coded into SPSS for analysis. Categorical and continuous variables were summarized using frequency tables and measures of central tendency and dispersion, respectively.

Clinical and MRI results were compared with arthroscopy findings and placed into one of four categories: true positive, true negative, false positive, and false negative. True positives and true negatives were outcomes where clinical or MRI diagnoses were confirmed by arthroscopy findings. False positives and false negatives, on the other hand, included the outcomes where clinical or MRI diagnoses contradicted arthroscopy findings.

The four categories were utilized in computing the accuracy, sensitivity, specificity, negative predictive value, and positive predictive values of individual clinical tests and radiological diagnoses for comparison purposes. Accuracy demonstrated a diagnostic modality's capacity to correctly identify the presence or absence of an injury. Sensitivity and specificity, on the other hand, demonstrated a test's capacity to detect a positive and negative diagnosis, respectively. Further, positive predictive value and negative predictive value demonstrated the probability that patients with a positive screening test truly had a knee joint injury and individuals with a negative screening test did not have a knee joint injury, respectively.

The following formulae were used.

Accuracy = ((True Positive + True Negative) / Total examined patients)) * 100

Sensitivity = ((True Positive / (True Positive + False Negative)) * 100

Specificity = (True Negative / (True Negative + False Positive)) * 100

Positive Predictive Value (PPV) = (True Positive/ (True Positive + False Positive)) * 100 Negative Predictive Value = (True Negative / (True Negative + False Negative)) * 100

RESULTS

Sample characteristics: Seventy-nine patients were recruited for the study. The participants' average age was 32.4 years. There were more males (59.5%) than females (40.5%). In regard to occupation, most

of the patients either held salaried (41.8%) jobs or were students (41.8%), while a few were self-employed (12.7%), retired (2.5%), or unemployed (1.3%). Additionally, a majority had attained tertiary (78.5%) education, while only 20.3% and 1.3% had completed secondary and primary school education, respectively (Table 1).

Table 1

Demographics

Mean age	32.43 (SD = 12.84)	No. (%)
Gender	Male	47 (59.5%)
	Female	32 (40.5%)
Occupation	Students	33 (41.8%)
	Salaried	33 (41.8%)
	Self employed	10 (12.7%)
	Retired	2 (2.5%)
	Unemployed	1 (1.3%)
Education level	Primary	1 (1.3%
	Secondary	16 (20.3%)
	Tertiary	62 (78.5%)

Injury characteristics: It was observed that as compared to the left knee (46.8%), a higher proportion of injuries involved the right (53.2%) knee. Most of these injuries were caused by sports accidents (45.6%), while 39.2% and 15.2% were caused by traumatic and non-traumatic incidents, respectively (Table 2).

Table 2

Injury characteristics

		No. (%)
Knee injured	Left	37 (46.8%)
	Right	42 (53.2%)
Cause	Non trauma	12 (15.2%)
	Sport injury	36 (45.6%)
	Trauma	31 (39.2%)

Clinical results: The results revealed that 30.4%, 44.3%, and 49.4% of McMurray, lateral joint-line tenderness, and medial joint-line tenderness tests were positive, respectively. It was also observed that 44.3% of Lachman tests and 45.6% of anterior drawer tests, which were performed to investigate the presence of ACL injuries, were positive. Lastly, only 11.4% of posterior drawer tests and none of the varus and valgus stress tests were positive (Table 3).

Table 3

Frequency of positive clinical tests

Injury type		Clinical test	No. (%)
Meniscal tears		McMurray	24 (30.4%)
	Lateral meniscus injuries	Lateral joint-line tenderness	35 (44.3%)
	Medial meniscus injuries	Medial joint-line tenderness test	39 (49.4%)
ACL		Lachman	35 (44.3%)
		Anterior drawer test	36 (45.6%)
PCL		Posterior drawer test	9 (11.4%)
MCL		Varus stress test	0
LCL		Valgus stress test	0

MRI findings: According to the MRI scans, ACL (45.6%) injuries were the most common type of knee injuries, followed by medial meniscus (22.8%) and lateral meniscus (20.3%) tears. PCL (12.7%) injuries, in contrast, were the least common. No MCL and LCL injuries were detected in the MRI scans (Table 4).

Table 4

Frequency of positive MRI results

	No. (%)
Medial meniscus	18 (22.8%)
Lateral meniscus	16 (20.3%)
ACL	36 (45.6%)
PCL	10 (12.7%)
MCL	0
LCL	0

Arthroscopy findings: Arthroscopy was considered the "gold standard" and was used to validate the results from clinical tests and MRI. Like MRI, arthroscopy findings established that ACL was the most common knee injury among the study's patients. MRI (45.60%), however, reported more ACL cases as compared to arthroscopy (44.30%). Arthroscopy also reported a higher number of medial meniscus (30.4%) and lateral meniscus (24.1%) tears as compared to MRI (22.8% versus 20.3%). The two diagnostic modalities, however, found an equal number of positive PCL (12.7%) injuries. The negative MRI scans and varus and valgus stress tests were corroborated by arthroscopy, which did not detect any MCL and LCL injuries. Other knee anomalies that were detected during arthroscopy include chondromalacia, synovitis, joint effusion, lateral condyle osteoarthritis, and septic arthritis that were observed in 17.72%, 15.19%, 3.8%, 1.27%, and 1.27% of the patients, respectively (Table 5).

Table 5

Frequency of positive arthroscopy results

	No. (%)
Medial meniscus	24 (30.4%)
Lateral meniscus	19 (24.1%)
ACL	35 (44.3%)
PCL	10 (12.7%)
MCL	0
LCL	0
Other anomalies	
Chondromalacia	14 (17.72)
Synovitis	12 (15.19%
Joint effusion	3 (3.8%)
Lateral condyle osteoarthritis	1 (1.27%)
Septic arthritis	1 (1.27%)

Sensitivity analysis for clinical examination: The results from each clinical test were compared to arthroscopy findings in order to compute the true positives, true negatives, false positives, and false negatives. Cross tabulations were then performed on SPSS to determine diverse tests' sensitivities and specificities. Appropriate formulas, which were highlighted in the methodology section, were applied to compute the tests' accuracy, NPV, and PPV.

It was observed that medial joint-line tenderness had the least accuracy (50.63%), sensitivity (50%), and specificity (50.9%). When compared to medial joint-line tenderness, lateral joint-line tenderness test was more accurate (72.15%), sensitive (84.2%), and specific (68.3%). The results also found that the anterior Drawer's test was more accurate (98.73% versus 97.7%) and sensitive (100% versus 97.1%) than Lachman in diagnosing ACL injuries. The two tests, however, had equal specificities (97.7%). Like the anterior Drawer's test, the posterior Drawer's test had relatively high accuracy (98.6%), sensitivity (90%), and specificity (100%).

In regard to predictive values, medial joint-line tenderness had the least PPV (30.8%) and NPV (70%). Lateral joint-line tenderness also had a relatively low PPV (45.7%). Anterior Drawer's test (97.2%), Lachman (97.1%), and posterior Drawer's test (100%), in contrast, had relatively high PPVs (Table 6).

Table 6

Sensitivity analysis for clinical tests

Clinical test	True positive	True negative	False positive	False negative	Sensitivity	Specificity	PPV	NPV	Accuracy
Medial joint line tenderness	12	28	27	12	50.0%	50.9%	30.8%	70%	50.63%
Lateral joint-line tenderness	16	41	19	3	84.2%	68.3%	45.7%	93.2%	72.15%
Anterior Drawer's test	35	43	1	0	100%	97.7%	97.2%	100%	98.73%
Lachman test	34	43	1	1	97.1%	97.7%	97.1%	97.7%	97.47%
Posterior Drawer's test	9	69	0	1	90.0%	100%	100%	98.6%	98.73%

Sensitivity analysis for MRI: MRI results were also validated using arthroscopy findings. The true positives, false negatives, true negatives, and false negatives were generated using SPSS and used in computing MRI finding's sensitivity, specificity, PPV, NPV, and accuracy. The analysis found that MRI had higher accuracy (92.41% versus 50.63%), sensitivity (75% versus 50%), specificity (100% versus 50.9%), PPV (100% versus 30.8%) and NPV (90.2% versus 70%) than clinical diagnosis in diagnosing medial meniscus tears. Similarly, MRI had higher accuracy (96.2% versus 72.15%), specificity (100% versus 68.3%), PPV (100% versus 45.7%) and NPV (95.2% versus 93.2%) than clinical diagnosis in diagnosing lateral meniscus tears. In regard to ACL injuries, the diagnostic accuracy (98.73%), sensitivity (100%), specificity (97.7%), PPV (97.2%), and NPV (100%) for clinical examination and MRI were equal. Lastly, in regard to PCL injuries, MRI had a higher diagnostic accuracy (100% versus 98.73%), sensitivity (10% versus 90%), and NPV (100% versus 98.6%) than clinical diagnosis (Table 7).

Table 7

Sensitivity analysis for MRI findings

	True positive	True negative	False positive	False negative	Sensitivity	Specificity	PPV	NPV	Accuracy
Medial meniscus	18	55	0	6	75.0%	100%	100%	90.2%	92.41%
Lateral meniscus	16	60	0	3	84.2%	100%	100%	95.2%	96.20%
ACL	35	43	1	0	100%	97.7%	97.2%	100%	98.73%
PCL	10	69	0	0	100%	100%	100%	100%	100.00%

Statistical significance of the differences in clinic-radiological diagnostic accuracies: Independent sample t-tests were performed to test whether the differences between the diagnostic accuracy and sensitivity of clinical examination and MRI were statistically significant. The tests revealed that the differences were not statistically significant, t (6) = -1.427, p = 0.204; t (6) = -0.701, p = 0.516 (Table 8).

Table 8

Significance of differences in diagnostic accuracies

	Mean	T	Sig.
Accuracy	CE: 80.06 (SD = 23.28) MRI: 96.84 (SD = 3.35)	1.427	0.204
Sensitivity	CE: 81.05 (SD = 21.70) MRI: 89.80 (SD = 12.36)	-0.701	0.516

Relationships between variables: Diverse statistical tests were also performed to investigate the nature of relationships between variables. It was observed that gender and mechanism of injury were related (c^2 (2) = 16.102, p = 0.000), with more males than females sustaining sport-related and traumatic knee injuries. A significant relationship between occupation and mechanism of injury was also observed (c^2 (8) = 37.336, p = 0.000), with more students than salaried and self-employed patients sustaining sports-related knee injuries and more salaried patients than students, self-employed, and unemployed patients sustaining trauma-related knee injuries (Table 9).

The age differences between the three injury groups were also compared. The results revealed that the differences were statistically significant, F (2, 76) = 27.954, p = 0.00. It showed that on average, individuals who suffered from non-traumatic (M = 48.25, SD = 10.07) knee injuries were older as compared to participants who suffered from sports-related (M = 24.64, SD = 8.49) and traumatic (M = 35.35, SD = 11.22) knee injuries (Table 9).

Table 9

Significance of relationship between variables

Test	Variables			Test statistic	df	Significance
Chi-square	Gender Mechanism of injury			c^2 = 16.102	2	0.000
Chi-square	Occupation Mechanism of injury			c^2 = 37.336	8	0.000
ANOVA	Age	Sports	M = 24.64, SD = 8.49	F = 27.954	2, 76	0.000
	Mechanism of injury	Trauma	M = 35.35, SD = 11.22			
		Non- trauma	M = 48.25, SD = 10.07			

DISCUSSION

This study sought to measure the accuracy of clinical examination and MRI reporting, in relation to arthroscopic findings, in diagnosing knee injuries. The participants' average age was 32.4 years. Additionally, most of the patients were male. The participants' age and gender composition were comparable to previous studies that have investigated the patterns of knee joint injuries. In the study that was conducted by Navali *et al.* (2), for example, the average age of patients with knee injuries was 29.12 years (SD = 7.37). In regard to gender, other studies also documented that between 62% and 90% of patients with knee injuries were male (2,5,10,11). The higher susceptibility of young adult males to knee injuries was attributed to males' increased involvement in high-impact sports and activities; and increased use of bicycles, motorbikes and tricycle, which offer relatively lower body protection as compared with vehicles.

The present study also found that a majority of the injuries involved the right knee (53.2%). The findings were consistent with previous studies that reported that 56.1% (6), 54.4% (8), and 61.1% (11) of injuries involve the right knee. The present study's researchers justified the pattern to the fact that the right foot is the dominant foot for most individuals. It is often deployed during activities and defenses and, as such, is more vulnerable to injuries.

In regard to the type of knee injury, the present study found that ACL (44.3%) was the most common injury, followed by medial meniscus (30.4%), lateral meniscus (24.1%), and PCL (12.7%) injuries. Previous studies that have examined the types of knee injuries have reported mixed results. In the study conducted by Nickinson *et al*. (10), for example, the authors found that medial meniscal (34%) tears were the most common type of injuries, followed by osteoarthritis (26%), ACL (11%), and lateral meniscal (8%) tears.

The accuracy and sensitivity of different diagnostic tools was also investigated. The current study found that the anterior Drawer's test was more accurate (98.7% versus 97.5%) and sensitive (100% versus 97.1%) than the Lachman test in diagnosing ACL tears. The study's findings contradicted previous studies (12,13) that found that the Lachman test was superior to the anterior Drawer's test in diagnosing ACL tears.

This study also found that medial and lateral joint line tenderness tests were more accurate and sensitive than the McMurray test in detecting meniscal lesions. The findings, however, contrasted the studies that were conducted by Galli and Marzetti (14) and Gupta, *et al*. (15) that found that McMurray had a higher diagnostic accuracy than joint-line tenderness test in detecting meniscal tears. This study's researchers attributed the differences between McMurray's and joint line tenderness test's accuracy to local differences in practitioners' expertise. A standardized approach for performing and interpreting the tests was recommended.

The accuracy of clinical examination and MRI in diagnosing different knee injuries was also compared. It was observed that MRI was superior to clinical examination in diagnosing medial meniscus (92.41% versus 50.63%), lateral meniscus (96.20% versus 72.15%), and PCL (100% versus 98.73%) injuries. The findings aligned to those reported by Orlando *et al*. (11). However, it contradicted those reported by Ercin, *et al*. (9). In their study, Ercin, *et al*. (9) established that if performed by experienced orthopaedic surgeons, physical examination was as accurate as MRI in diagnosing meniscal and ligament injuries.

This study also found that MRI (98.73%) was as accurate as anterior drawer's test (98.73%) in diagnosing ACL injuries. The findings were consistent with those reported by Kocabey, *et al.* (7), but contrasted those reported by Orlando, *et al*. (11). In the latter study (11), the authors found that physical examination (90.27%) was more accurate than MRI (83.33%) in detecting ACL tears.

This study also reported that mechanism of injury was associated with gender and occupation. It was observed, for example, that as compared to females and non-students, students and male patients were more likely to sustain traumatic and sport-related injuries. The trend was attributed not only to traditional gender roles that assign light chores to women, but also to the incorporation of sports in schools and colleges.

A significant association between age and mechanism of injury was also observed in this study. The study found that a majority of patients who suffered sport-related, traumatic, and non-traumatic injuries were young, middle-aged, and older, respectively.

CONCLUSION

This study found that ACL injuries were more common than meniscal tears and PCL injuries in patients presenting with knee joint injuries in Eldoret, Kenya. A majority of these injuries were caused by sports-related and traumatic accidents. The accuracy of diagnostic modalities was analyzed and compared. It was observed that MRI was superior to clinical examination in diagnosing meniscal tears and PCL injuries. MRI, however, was as accurate as anterior drawer's test in diagnosing ACL injuries, leading to the conclusion that accurately performed clinical examination by experienced surgeons is sufficient in diagnosing ACL injuries.

RECOMMENDATIONS

(a) Due to its superiority, MRI should be used as a definitive diagnostic tool in patients suspected with meniscal tears and PCL injuries.

(b) Using qualified orthopaedic surgeons in evaluating patients could be effective in attaining accurate ACL diagnoses.

(c) Larger double blind control studies should be carried out in future to improve the quality of data and eliminate potential bias.

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INCIDENCE AND PATTERNS OF MUSCULOSKELETAL INJURIES AMONG YOUTH FOOTBALL PLAYERS IN NAIROBI: A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Football poses a significant risk of musculoskeletal injuries. Despite its prominence among the Kenyan youth, there is limited data on the incidence and anatomical patterns of injuries in these young footballers.

Objective: This study aimed to determine the incidence and anatomical patterns of musculoskeletal injuries among players in a Kenyan youth football academy during a single football season.

Methods: A prospective cohort study was conducted at Express Soccer Academy in Nairobi, Kenya, involving 182 players aged 5–20 years. Participants were systematically recruited and followed for three months during the 2023 season. Data on injuries, including frequency, type, and anatomical site, were collected. Injury incidence rates were calculated per 1000 playing hours.

Results: The overall injury incidence was 17.22 per 1000 hours of playing time, with injuries occurring more frequently during matches (62%) compared to training sessions (38%). The ankle (20.21%) and knee (16.50%) were the most affected anatomical sites, with ligament sprains (40.96%) and muscle injuries (36.17%) being the most common types of injuries. Collisions with opponents were the leading mechanism of injury, accounting for 46% of reported cases.

Conclusion: This study highlights a high incidence of lower extremity football-related injuries among Kenyan youth players.

Key words: Musculoskeletal injuries, Youth football, Nairobi, Injury incidence, Injury patterns, Trauma, Football

INTRODUCTION

Football, globally recognized as the "beautiful game," holds the distinction of being the most popular sport in the world. It is estimated that over 250 million players actively engage in organized football across more than 200 countries, with youth forming a significant portion of this population. The sport offers numerous physical, psychological, and social benefits, including improved cardiovascular fitness, team-building skills, and enhanced mental well-being (1,2). However, football is also associated with a substantial risk of musculoskeletal injuries, which can significantly impact players' health and performance.

The dynamic and physical nature of football, characterized by rapid changes in direction, high-speed running, and frequent physical contact, predisposes players to a high injury burden. The risk is particularly pronounced among youth players who are undergoing rapid physical and neuromuscular development, which can compromise their biomechanical stability (3,4). Globally, injury incidence rates in youth football range from 2.0 to 19.4 per 1000 hours of play, with match play carrying a substantially higher risk compared to training sessions (5).

Injuries predominantly affect the lower extremities, with the ankle and knee being the most frequently injured anatomical sites (6). Ligament sprains, muscle strains, and contusions are common injury types, and contact with opponents is a leading mechanism of injury (7).

While extensive research has been conducted in Western and professional football settings (8), there is limited data from sub-Saharan Africa, particularly in amateur and youth contexts, where socioeconomic and environmental factors can influence injury patterns.

In Kenya, football is a widely played and celebrated sport among youth, yet there is a paucity of data on the epidemiology of football-related injuries in this demographic region (9). This knowledge gap hinders the development of effective prevention strategies tailored to the unique challenges faced by Kenyan youth players, such as inadequate access to protective equipment and suboptimal playing surfaces. Understanding the incidence, anatomical patterns, and mechanisms of injuries is essential for informing evidence-based interventions that can enhance player safety and promote sustainable athletic development.

This study aims to bridge this knowledge gap by investigating the incidence and patterns of musculoskeletal injuries among youth football players at a Kenyan football academy during a single season. In providing a comprehensive analysis of injury data, this research seeks to contribute to the global understanding of football injuries and support the implementation of targeted preventive measures in youth football.

MATERIALS AND METHODS

This study employed a prospective cohort design to investigate the incidence and patterns of musculoskeletal injuries among youth football players at the Express Soccer Academy in Nairobi, Kenya. Participants were followed over a three-month football season in 2023, during which exposure data and injury occurrences were systematically recorded.

The research was conducted at the Express Soccer Academy, located at GEMS Cambridge International School, Karen, Nairobi. The academy, established in 2013, offers professional football training to boys and girls aged 5–20 years, focusing on skill development and competitive participation. The academy's structured environment provided a suitable setting for capturing detailed injury and training data. The study included active players registered with the Express Soccer Academy during the 2023 football season. The sample size was determined using Fisher's formula which, with an estimated prevalence of 50% (assumed, since there was no prior regional data) and a margin of error of 5%, yielded a sample size of 182 participants after adjusting for the finite population of 349 players. Players whose parents or guardians declined to provide consent or with pre-existing injuries that limited participation at the start of the season were excluded.

Stratified random sampling was employed based on age categories. Proportional allocation ensured representation across all age groups, with participants randomly selected within each stratum. A structured interviewer-administered questionnaire was used to collect data on demographics (age, sex, and football experience), training practices—hours, type of exercises, and use of protective gear, injury data: Anatomical site, type, mechanism, and timing of injuries (match vs. training).

Injury data were verified through clinical assessments. The operational definition of injury was any musculoskeletal trauma sustained during football activities that resulted in reduced participation or medical intervention. Two research assistants, a sports medicine nurse and a certified physiotherapist, were trained to administer the tool and assess injuries.

Data were analyzed using SPSS version 25. Descriptive statistics summarized participant characteristics and injury patterns. Injury incidence was calculated as:

Injury incidence = Number of injuries/Total exposure hours $\times 1000$

Bivariate analyses, including Chi-square tests and independent t-tests, assessed associations between categorical and continuous variables, respectively. Descriptive data on the other hand was expressed as frequencies and proportions or means with standard deviations. Statistical significance was set at $p<0.05$.

Ethical approval was obtained from the Kenyatta National Hospital-University of Nairobi Ethics and Research Committee. Parental or guardian consent and participant assent (for minors) were mandatory before enrollment. Confidentiality was maintained through anonymized data storage and secure handling of hard copies and digital files.

RESULTS

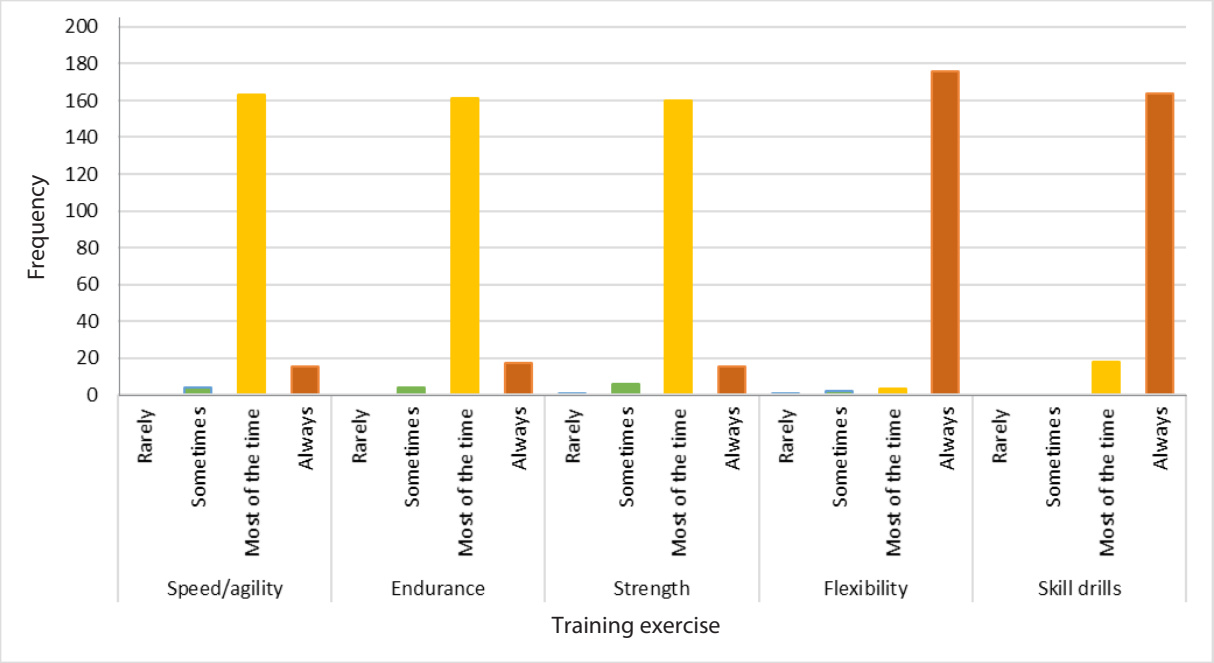
A total of 182 youth football players were enrolled in the study. Male participants dominated the cohort, accounting for 169 (92.9%), while female

participants comprised only 13 (7.1%) of the sample. The mean age of the players was 10.76 years (SD = 3.6), with a median of 10.50 years and a range of 5–20 years. The distribution of participants across age groups revealed the majority belonged to the Under-11 category, representing 39 (21.4%) of the sample.

Training practices: The majority of participants trained twice weekly (97.8%), with 4 hours per week being the most common training duration (96.2%). Skill drills and flexibility exercises were the most consistently performed activities, with 90.1% and 96.7% of players, respectively, engaging in these practices during training (Figure 1).

Figure 1

Training exercises among participants



Incidence of injuries: The study documented 188 injuries over a total exposure time of 10,920 hours, resulting in an incidence rate of 17.22 injuries per 1000 playing hours.

Anatomical patterns of injuries: Lower extremity injuries were the most prevalent, with the ankle (20.21%, n = 38) and knee (16.50%, n = 31) being the most affected sites (Table 1). The head and neck accounted for 13.82% (n = 26) of injuries, highlighting the significance of collision-related trauma.

Table 1

Anatomical distribution of injuries

Body part	Frequency (%)
Ankle	38 (20.21)
Knee	31 (16.50)
Head/Neck	26 (13.82)
Thigh	25 (13.30)
Leg	21 (11.17)

Types of injuries: Ligament sprains (40.96%) were the most common injury type, followed by muscle injuries (36.17%). Concussions accounted for 14.36%, underscoring the risks of head trauma in youth football (Table 2).

Table 2

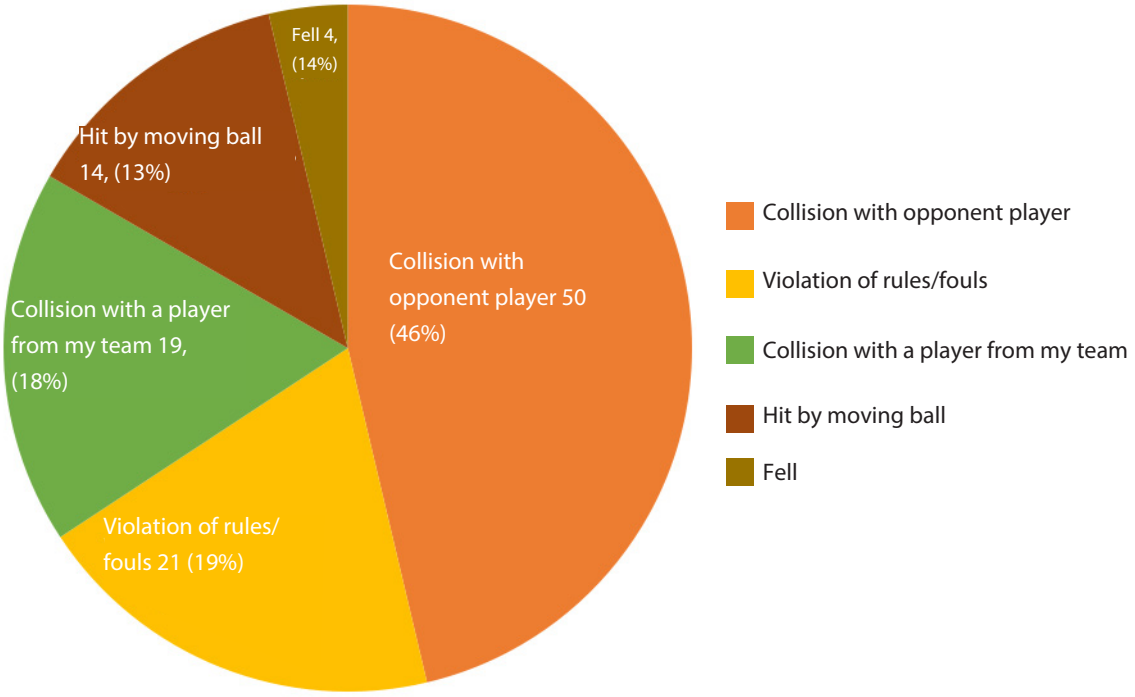
Distribution of injury types

Type of injury	Frequency (%)
Ligament sprains	77 (40.96)
Muscle injuries	68 (36.17)
Concussions	27 (14.36)
Skin injuries	10 (5.32)
Fractures	3 (1.60)

Mechanisms of injury: Collisions with opponents emerged as the leading mechanism of injury, accounting for 50 (46%) of cases. Other notable causes included rule violations (19%) and falls (4%) (Figure 2).

Figure 2

Mechanisms of injuries among participants



DISCUSSION

The study cohort comprised predominantly of male players (92.9%), reflecting gender disparities in football participation at the academy. This finding mirrors the general and specific gender disparities in sports participation globally. The low female participation warrants attention, as it may indicate gender-based barriers to sports involvement, including sociocultural norms or inadequate opportunities for girls. The mean age of participants was 10.76 years, with the Under-11 category representing the largest proportion (21.4%). Global trends report this higher youth engagement in football at younger ages (10).

Training practices were notably structured, with nearly all participants training twice weekly for an average of four hours per week. Flexibility exercises (96.7%) and skill drills (90.1%) were consistently prioritized, highlighting a focus on fundamental football techniques and injury prevention measures. However, lower engagement in strength (87.9%) and endurance (88.5%) exercises could suggest gaps in conditioning programs, potentially predisposing players to certain injury types. Strength and endurance training are critical for musculoskeletal resilience, and their incorporation into training routines may reduce injury rates.

The overall injury incidence of 17.22 per 1000 playing hours aligns with findings from international studies on youth football. Watson and Mjaanes (11) reported injury rates ranging from 2.0 to 19.4 per 1000 hours of play, with match play being more hazardous than training. Similarly, Faude et al. (3) documented match-specific injury rates between 15 and 20 per 1000 hours, consistent with this study's finding that 62% of injuries occurred during matches. The elevated risk during matches reflects the higher intensity, physical contact, and competitive nature of gameplay (12). The relatively high overall incidence in this study may be attributed to contextual factors such as inconsistent adherence to safety protocols, inadequate access to protective gear, and variable quality of playing surfaces in Kenyan football settings (13,14). This underscores the need for localized injury prevention strategies tailored to resource-limited environments.

Lower extremity injuries, particularly to the ankle (20.21%) and knee (16.50%), were the most common, consistent with global trends (6,15).

These injuries often result from rapid directional changes, pivoting, and physical tackles, which are intrinsic to football (16). The high prevalence of ankle injuries emphasizes the importance of neuromuscular training programs, including proprioceptive exercises and balance drills, to enhance joint stability (17).

The 13.82% incidence of head and neck injuries, including concussions, highlights the risks associated with physical collisions in football. This finding aligns with a study by Junge *et al*. (18), who noted that youth players are particularly susceptible to head trauma due to their developing musculoskeletal and neurological systems. Implementing stricter enforcement of rules, such as penalizing high-impact tackles, could mitigate this risk.

The predominance of ligament sprains (40.96%) and muscle injuries (36.17%) mirrors findings from European studies, where these injury types account for the majority of football-related trauma (19). Sprains often result from joint instability during rapid movements, while muscle injuries are typically linked to overuse or insufficient warm-up routines (20). The study's finding that all participants engaged in warm-up exercises before matches is encouraging but suggests that the quality and content of these routines should be examined to optimize their effectiveness. The less than 2% incidence of fractures in this study was relatively low compared to previous research, which attributes such injuries to high-impact collisions or falls (15). This could reflect differences in the playing environment or training practices at the academy.

Collisions with opponents (46%) emerged as the leading injury mechanism, underscoring the physical nature of football. Similar findings by Faude *et al.* (3) highlight that youth football carries inherent risks of direct trauma due to frequent contact during tackles and aerial duels. Efforts to minimize these risks should include stricter officiating, mandatory use of shin guards, and educational programs for coaches and players on safer playing techniques.

The findings of this study have several practical implications. First, injury prevention strategies should prioritize neuromuscular training programs to improve joint stability and reduce the risk of sprains and muscle injuries. Enforcing safety protocols, including proper officiating and mandatory protective gear, may also minimize the risk of collision-related injuries. Finally coaches and players should be educated on age-appropriate training and injury prevention techniques. Additionally, improving the quality of playing surfaces, as recommended by Arnason *et al*. (13), could further reduce the risk of non-contact injuries.

CONCLUSION

With an injury incidence rate of 17.22 per 1000 playing hours, the findings highlight a substantial risk of injuries in youth football, predominantly affecting the lower extremities, particularly the ankle and knee. Ligament sprains and muscle injuries were the most prevalent types, and collisions emerged as the leading mechanism, emphasizing the physical demands and contact nature of the sport. These findings underscore the need for targeted injury prevention strategies, including enhanced training on safe playing techniques, proper use of protective equipment, and increased focus on conditioning programs that build strength and flexibility.

Study limitations

This study, while offering important insights, is subject to several limitations. The research was conducted in a single football academy,which limits the generalizability of the results as the training practices, coaching styles, and playing conditions in this academy may not reflect those of other local institutions. The relatively short duration of data collection restricted the ability to capture injuries that occur over longer competitive cycles. Despite efforts to verify information, the study relied partly on self-reported data from players and parents, which introduced the possibility of recall bias and underreporting for minor overlooked injuries. Another important limitation was the imbalanced gender representation, only 7% female, which limited meaningful analysis of sex-specific differences in injury patterns. These limitations do not undermine the main findings of this study but they highlight areas where future research could build on the present work.

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CLINICAL AND RADIOGRAPHIC OUTCOMES FOLLOWING PLATE VERSUS ANTEGRADE INTRAMEDULLARY NAIL FIXATION FOR MIDDLE THIRD HUMERUS SHAFT FRACTURES

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ABSTRACT

Background: The choice of whether to perform Antegrade Intramedullary Nailing (IMN) or Plate Fixation (PF) for midshaft humerus fractures poses a conundrum for the surgeon who must strike the balance between anatomical restoration while reducing elbow and shoulder functional impairment.

Objective: This study is concerned with the patient reported outcomes regarding shoulder and elbow function for IMN and PF respectively, as well as an assessment of the radiographic outcomes for either treatment methodology.

Methods: A retrospective radiographic review, followed by a prospective cohort study was performed following up all the cases treated surgically for middle third humeral fractures from 2016 to 2022 at a single centre. An analogue pain score, an American Shoulder and Elbow Society (ASES) score for shoulder function and the Oxford Elbow Score (OES) for elbow function were obtained. Retrospectively radiographic union was assessed as well as the need for revision or conversion to an alternative treatment strategy.

Results: One hundred and three patients met the inclusion criteria. Twenty-four patients participated in the clinical aspect of the study where fifteen had IMN (62.5%) and nine had PF (37.5%.). The shoulder function outcomes showed no statistical difference with an average ASES score of sixty-six for the IMN group and sixty-nine for the PF group. The impairment of abduction score post antegrade nailing was higher in the antegrade nailing group than the plated group. The OES demonstrated greater variance in elbow function in the PF group with the IMN group expressing greater elbow disfunction. Eighty-seven cases were available and eligible for radiographic review where thirteen had delayed unions at 6 months and eight underwent re-operation at the end of the study period.

Conclusion: This study demonstrated that treatment of middle third humerus shaft fractures by plate fixation is marginally superior to antegrade intramedullary nailing in preserving elbow function and abduction ability.

Key words: Antegrade intramedullary nailing, Plate Fixation, Midshaft humerus fractures

INTRODUCTION

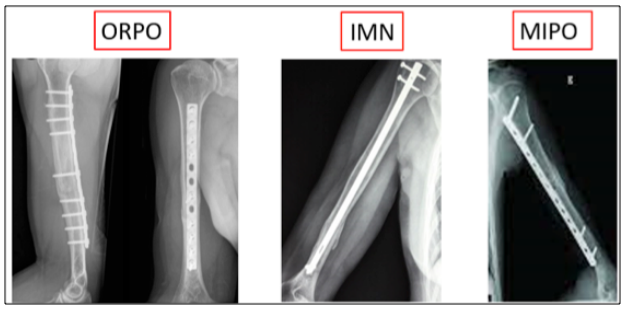
Humeral shaft fractures are the least common humeral fractures, with an incidence of 14.5 to 20 per 100,000 persons in the United States (1), representing 1-3% of all fractures and 20% of all humeral fractures (2,3). Most humeral shaft fractures are amenable to conservative management with satisfactory results attainable in over 90% of cases (2) because of the considerable amount of deformity that can be accepted in the humeral shaft which is well compensated for by patients (4). Klenerman (4) found good function with humeral deformities of 20° in the sagittal plane, 30° in the coronal plane, and up to 3cm of shortening. Surgical treatment should thus be reserved for cases that fall outside of these criteria as there are numerous well documented complications related to surgical treatment of the humerus shaft. Indications for operative treatment of humeral shaft fractures are open fractures, segmental fractures, pathological fracture, associated vascular injury, bilateral injury, polytrauma patients, inability to maintain reduction and failed conservative management (5,6).

There are currently three predominant operative techniques used for the management of humeral shaft fractures: Open Reduction with Plate

Osteosynthesis (ORPO), Intramedullary Nailing (IMN) and Minimally Invasive Plate Osteosynthesis (MIPO) (5,7) (Figure 1). The use of relative stability in the form of IMN and MIPO have gained increasing interest due to the primary advantage of less soft tissue stripping and damage as compared to ORPO (8). Although there is no difference in relation to infection and non-union between IMN and OPRO (9), there are other potential benefits noted in the form of lower radial nerve palsy, less bone grafting and simpler technique for comminuted fractures (7,10,11).

Figure 1

Three techniques for fixation assessed. Open Reduction Plate Osteosynthesis (ORPO), Intramedullary Nail (IMN), Minimally Invasive Plate Osteosynthesis (MIPO)



The choice of whether to perform antegrade or retrograde intramedullary nailing poses a new conundrum for the surgeon, with both options having benefits and drawbacks, especially regarding the functional impairment of either the shoulder or the elbow respectively (12). The disadvantage of antegrade nailing through a standard approach involves traversing the rotator cuff through supraspinatus as well as potential damage to the cartilage of the humeral head (12). Retrograde nailing on the other hand has the risk of worsening elbow function and iatrogenic supracondylar humerus fracture.

The functional and clinical outcomes comparing plate and nail fixation differ throughout literature, with some studies showing residual shoulder pain and higher reoperation rates (9,13,14), and others showing no difference in functional outcome in the long term at the shoulder or the elbow (15). Many of the published studies are from larger academic centres, and in the methods, they state the surgeries are performed either by a single surgeon or by a single team of trauma surgeons. In the South African Academic hospital setting the humeral shaft fractures are left commonly to the more junior orthopaedic registrars or medical officers to do and are often done after hours, as the daytime lists commonly are overburdened with a high load of more complex trauma requiring a consultant to perform or be a part of the case. Due to the unique situation in South Africa where the training system is vastly different and younger surgeons have far more responsibility, the question arises whether the functional outcomes would differ based on the rank of the operating surgeon (8,14-16).

The research of this study compares IMN vs plate fixation at an academic centre within a South African context. Within this, we hypothesised that shoulder function following antegrade humeral nailing is inferior to plate fixation due to rotator cuff damage during nail insertion.

MATERIALS AND METHODS

The objectives of the study were to compare the patient reported shoulder outcomes of surgically treated middle third humeral shaft fractures with both antegrade intramedullary nailing and plate fixation, and secondly to document any major complications related to treatment in terms of reoperation, vascular or nerve injury, hardware failure and non-union and lastly, to asses and compare radiographic outcomes between the two methods of fixation.

We conducted a retrospective radiographic review, with a prospective functional follow up of all the middle third humeral shaft fractures treated surgically from 2016 to 2022 at a single academic centre. Once our sample was identified, we telephonically interviewed the patients and via a questionnaire and obtained an analogue pain score. Using the questionaires an American Shoulder and Elbow Society (ASES) score and the Oxford Elbow Score (OES) was calculated to score shoulder and elbow function respectively. The data of which was then collected and tabulated on a spreadsheet on Microsoft Excel (Microsoft, Seattle, Washington) and was only available to our research team.

All patients treated for middle third humeral shaft fractures had their historic radiographs reviewed for radiographic union or evidence of hardware failure. Patients were also asked regarding any repeat surgery, post operative nerve injury or wound complications during the telephonic interview process.

The study inclusion criteria consisted of: patients over the age of 18 years who underwent surgery for the middle third humeral shaft fractures in Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) from January 2016 to March 2022, patients who could be telephonically contacted for feedback regarding functional and pain scores, and thirdly, patients who were able to provide verbal consent to be telephonically interviewed on shoulder and elbow function.

The exclusion criteria consisted of; patients presenting with old fractures or complications of previous treatment, patients who underwent multiple upper limb surgeries, patients who sustained vascular or nerve injury at the time of injury. And lastly, patients with any other fracture sustained around the shoulder girdle at the time of injury that could affect shoulder function.

Data analysis: All data were entered and organized using Microsoft Excel (Microsoft, Seattle, Washington). Continuous variables such as the American Shoulder and Elbow Society (ASES) score, Oxford Elbow Score (OES), and analogue pain scores were summarized as means with ranges for each treatment group. Categorical variables, including union rates, delayed or non-union, revision surgery, and hardware complications, were presented as frequencies and percentages. Comparative analysis between the Intramedullary Nailing (IMN) and Plate Fixation (PF) groups was descriptive in nature, highlighting trends and differences in functional and radiographic outcomes. No formal statistical significance testing was performed due to the limited sample size and variability of available data; results are therefore interpreted as observational findings rather than inferential conclusions.

RESULTS

The study identified 103 patients who had been surgically treated for midshaft humerus fractures between the years 2016 and 2022. Eighty-seven had sufficient radiographic follow up for review and twenty-four were contactable for clinical interview.

Twenty-four (23.3%) of these patients were available to be contacted telephonically after exhausting all methods of contact. Of these 24 patients, 15 (62.5%) underwent antegrade intramedullary nailing, while 9 (37.5%) received plate and screw fixation.

Thirteen (54.2%) of the 24 patients were affected on their left side, with 14 (58.3%) patients being injured on the ipsilateral side as their dominant hand.

There was no gender predisposition/bias with 11 respondents being female while 13 were male. The average age of the patients subset was 42-years old (range: 19 – 92 years). Males were more likely to have sustained injury by interpersonal violence in the form of assault and gunshots, whereas females were more likely to be involved in low energy falls and pedestrian vehicle accidents.

A total of 102 cases were available for radiographic review (Table 1). Of those 72 cases underwent antegrade nail fixation and 30 underwent plate fixation (13 posterior plates and 17 anterolateral plates). Thirteen delayed unions were noted at a minimum of 6 months follow up, of those 11 (85%) had undergone nail fixation with the remaining 2 (15%) having had initial plate fixation. Six delayed unions underwent revision, one patient had passed away and one was unfit for revision surgery and was given a brace. The remaining five had been lost to follow up. All non-union revisions underwent plate fixation with one still failing to heal and undergoing revision to plate plus external fixator. In total eight (9%) reoperations were noted, six for delayed unions, one for prominent hardware proximally at nail entry and one for malunion following nail fixation. Four other X-rays were noted to have proud nails into the subacromial space but these were not contacted for interview and were not noted to have come for removal of implants.

Table 1

Radiographic evaluation

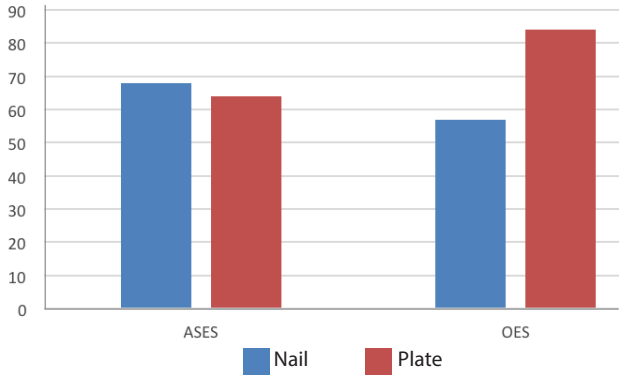
		Total cases		Union	Delayed / Non-union	Proud IMN	Revision surgery	Other complications
IMN		-	72 (71%)	61(85%)	11 (16%)	4 (5%)	7 (10%)	2 (3%)
PF	Post	13 (43%)	30 (29%)	28 ((93%)	2 (7%)	-	1 (3%)	1 (3%)
	ANT-LAT	17 (57%)						

The Oxford Elbow Score (OES) demonstrated greater variance in the plate fixation group with a mean value 84 (range 55-100), whilst the intramedullary nailing group expressed poorer elbow function with a mean value 57 (range 30 – 80).

The American Shoulder and Elbow Society Score (ASES) was similar between the two groups with antegrade nailing having an average score of 68 (range 30-100) and the plate group having an average score of 64 (range 33-98). The impairment of abduction range post operatively was higher in the antegrade nailing group compared to the plated group (Figure 2).

Figure 2

Functional outcomes



Intramedullary nailing showed a higher overall pain intensity (2.9/10, range 0-5) compared to an average pain score of 1.5 in the plate group, but still took majority as the technique of choice. Women and employed individuals had a greater overall functional impairment though not statistically significant.

DISCUSSION

This study considered the outcomes of IMN versus plate fixation at an academic centre within a South African context and found no statistically significant clinical differences between the operative techniques.

The initial hypothesis suggested that due to the operative entry point for the intermediary nail, this option would yield poorer patient reported outcomes as a result of possible rotator cuff violation. However, the results yielded that the IMN group expressed greater elbow functional impairment compared to plate fixation, whereas the shoulder function that was similar in both groups. This is thought to be the result of the distal locking screw placement of the IMN passing through the brachialis, whereas the plating was performed through an intermuscular plane anterolaterally or posteriorly.

Abduction at the shoulder was impacted most in the IMN group. The muscles responsible for this are the deltoid and supraspinatus muscles and are the muscles closely related to the IMN incision / entry point.

The IMN operative technique was the dominant choice in mid shaft humerus fractures. This option may be the preferred teaching or surgical style of the trauma unit within this centre. It is also felt to be more readily learnt by junior orthopaedic staff due to the high volumes of other intramedullary nails performed in the unit (tibia and femur). Many junior registrars and medical officers are hesitant to embark on open procedures such as the anterolateral approach to the humerus due to the unfamiliar anatomy and the concerns regarding direct exposure and injury due to neurovascular structures.

The overall reported pain was higher in the IMN group, and this was attributed to the direct involvement of the rotator cuff in the surgical approach.

On radiographic review it was noted that the intramedullary nailing group was noted to have the higher proportion of delayed union compared to plate fixation, as well as the higher rate for revision surgery. Majority of delayed unions were for more comminuted fractures as well as where a single distal locking screw was used. Hardware complications not relating to delayed union were isolated to the nail group, most commonly with proud nails at the entry point, one of which noted to have undergone removal of hardware.

Although the actual incidence of midshaft humerus fractures presenting to the centre within the stipulated period was higher, locating patients post operative and obtaining consent for participation in the study severely restricted the overall numbers.

On retrospective radiological review, the IMN group had higher rates of malunion. The ability and availability of patients to come in for clinical evaluation, with patients having transport problems and the cost associated made it impossible to correlate radiographic and clinical outcome sufficiently.

Surgeon preference and skill set may continue to guide the operative choice, while plate fixation has a marginally superior outcome on function, pain and union, either operative technique can be

safely employed to ensure acceptable outcomes for the patient. A clear understanding of the structures underlying the incision and respecting these to ensure preserved functional outcomes is paramount.

A limitation to this study is that the results are pooled from a small sample resulting in the outcomes being presented using descriptive analysis in the form of means, ranges and percentages. That being the case we believe the trends may be used to guide future research and management in patients sustaining midshaft humerus fractures even though definitive conclusions around statistical significance were not possible. The benefit of this study is that it has shown that the decision for midshaft humerus fracture fixation has many considerations including hand dominance, occupation or physical requirements and surgeon skill set and should be assessed and tailored to each case.

CONCLUSION

This study suggests that treatment of middle third humeral shaft fractures by plate fixation is marginally superior to antegrade intramedullary nailing in pain, preserving elbow function and abduction ability, but with no significant difference in overall patient reported outcomes. Plate fixation showed improved radiographic outcomes in terms of alignment and union, but with no clear correlation to reoperation or patient reported outcomes. On the whole, surgeon preference and fracture characteristics should guide management.

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PROPORTION AND RISK FACTORS OF SURGICAL SITE INFECTIONS AFTER ACETABULAR RECONSTRUCTION AT MUHIMBILI ORTHOPAEDIC INSTITUTE

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ABSTRACT

Background: Surgical Site Infection (SSI) is one of the negative outcomes of any orthopaedic procedure. Infection leads to devastating morbidity, mortality and increased resource utilization.

Objectives: This study was to assess the burden and risk factors associated with SSI post acetabular reconstruction in our establishment. The study also determined the proportion and risk factors of SSI post acetabular reconstruction at Muhimbili Orthopaedic Institute (MOI).

Methods: This was a descriptive prospective hospital-based study which included all patients who had undergone acetabular reconstruction surgery during the study period. Structured questionnaire was used to collect data. Variables were analyzed using SPSS version 23.

Results; A total of 37 patients were included in this study and the proportion of SSI was found to be 10.8%. *Staphylococcus aureus* and *Klebsiella pneumonia* were isolated in 75% and 25% of these patients respectively.

Conclusion: Burden of SSI is relatively high among patients undergoing acetabular reconstruction surgeries at MOI. Both gram positive and negative organisms were implicated in SSI.

Key words: Surgical Site infections, Acetabular reconstruction, Orthopaedic surgery, Risk factors, Muhimbili Orthopaedic Institute (MOI)

INTRODUCTION

Surgical Site Infection (SSI) is defined as infection occurring within 30 days after any surgical procedure in which only the skin and subcutaneous tissue are involved and must be associated with at least one of the following; (a) Purulent drainage from the incision, with or without culture testing; (b) Isolated organisms from an aseptically obtained specimen; (c) Superficial incision deliberately opened by a surgeon with at least one of the following signs or symptoms pain or tenderness, localized swelling, erythema, or heat and; (d) Diagnosis of a incisional SSI by the involved clinician (1).

Acetabular fractures are complex fractures resulting from high energy trauma in the young patients. These fractures are becoming increasingly common due to the increase in incidence of motor traffic crushes especially in low income and middle-income countries (2). They are also caused by low energy trauma in the elderly population with poor bone stock (3). The incidence of occurrence of acetabulum fractures is about three per 100,000 population worldwide (4).

Acetabular reconstruction using plates and screws achieves the best joint congruence and stabilization and functional outcome. The different types of acetabular fractures patterns dictate

different acetabular reconstruction approaches such as Langenback approach, ilioinguinal approach, iliofemoral approach, extended iliofemoral approach, modified Stoppa approach and combined approach.

SSI is a devastating complication of surgery leading to increased morbidity, extended hospital stay and death. SSI is associated with a mortality rate of 3% (5). Previous studies presented variable risk factors for SSIs during hospitalization after operation of bone fractures, including advanced age, sex, ASA score >3, higher BMI, smoking, diabetes mellitus, prolonged duration of surgery, blood transfusions and prolonged hospital stay due to associated injuries and others (6).

A World Health Organization (WHO) survey found that in low- and middle-income countries, the incidence rates of SSI ranged from 1.2 to 23.6 per 100 surgical procedures. This contrasted with rates between 1.2% and 5.2% in countries with more resources (7). Suzuki *et al*. (8) retrospectively reviewed total of 326 consecutive patients who underwent acetabular fracture surgery and reported that 17 (5.2%) patients developed SSIs with seven having superficial infections. A meta-analysis by Kelly *et al*. (9) on surgical management of actebular fractures reported local wound infections in 68 articles (6804 patients), occurred with an average incidence of 4.5%. A study conducted on functional and quality of life after surgical management of displaced acetabular fractures in Tanzania by Elizer *et al*. (10) in 2014 reported the overall incidence of SSI at 5.9%.

The male gender has been associated to be more at risk of SSI as reported by several studies (10,11,13,14). Male patients had multiple risk factors such as tobacco smoking and Human Immunodeficiency Virus (HIV) and so they will be more vulnerable to have SSI according to these studies. Increasing age has been reported to predispose patients to SSI due to the reduced immunity and existence other comorbidities as reported by Mukagendaneza *et al*. (12). Another study showed that high BMI is an independent risk factor for SSI following spinal deformity surgery, providing the fact that increased subcutaneous fat layer thickness increases the need for more retraction forces during the surgery to provide exposure and subsequently increases tissue necrosis and, therefore increased risk of SSI (13). Falagas *et al*. (14) found that obese patients were more prone to develop SSI than non-obese individuals. Yet another study done by Iqbal *et al*. (15) found increasing BMI predisposes one to SSI after surgical fixation of acetabulum. Other studies suggested special attention should be directed to the care of obese patients especially after acetabulum reconstruction (8,16). Pulido *et al*. (17) reported that longer hospital stay was an independent risk factor for SSI theorizing that the long duration exposes patients to nosocomial infections. Two studies reported increased incidence of SSI when pre-operative hospital duration was more than 7 days (11,18). Tobacco smoking has been found to impair tissue oxygenation and cause hypoxia via vasoconstriction, thus impairing wound healing. Veeravagu *et al*. (19) identified tobacco use as a significant predictor of SSI. Mills and his collegues (20) reported a risk reduction of 19% is seen for each week of cessation before surgery.

Several studies have found that the most common causative microorganism for SSI was *Staphylococcus aureus* (8,9,12). However there has been no study investigating the bacterial aetiology of SSI post acetabular reconstruction in Tanzania.

MATERIALS AND METHODS

Study design and area: This was a descriptive prospective hospital-based study conducted at Muhimbili Orthopaedic Institute (MOI) in Dar es Salaam, Tanzania from May 2021 to December 2021. MOI is the national referral hospital for orthopaedic, trauma and neurosurgical conditions. It is also the teaching hospital for Muhimbili University of Health and Allied Sciences (MUHAS) leading centre for excellence in orthopaedic conditions. The hospital has a capacity of 360 beds and 9 operating rooms. Currently MOI has 4 acetabular reconstruction surgeons often assisted by orthopaedic residents. The surgeries were all done by a team including an acetabular surgeon, two residents and one scrub nurse. The data was collected by one of the investigators and it was collected from the surgical notes, the ward and during patient visit at the out patient department as well.

Study population: The study population were patients aged over 18 years who had undergone acetabular reconstruction due to trauma from May 2021 to December 2021.

Inclusion and exclusion criteria

Inclusion criteria: All consenting patients aged 18 years and above who had undergone single staged acetabular reconstruction at MOI from May 2021 to December 2021.

Exclusion criteria: Patients with open infected fractures.

Sampling technique: All patients who had undergone acetabular reconstruction due to trauma related acetabular fracture from May 2021 to December 2021 at MOI were included in the study.

Data collection and study tool

A structured questionnaire was used to collect data which captured all the required information as per the objectives of the study. Information was obtained in 3 stages as illustrated below:

Preoperative assessment: This included the patient's demographic data, the preoperative risk factors for SSI like age, sex, comorbid conditions (diabetes, hypertension, HIV), BMI, duration of hospital stay before surgery, associated injuries, current smoking status, preoperative haemoglobin levels and ASA score.

Intraoperative assessment: This was filled from the operative notes. The surgeries were conducted by a team led by specialist orthopaedic surgeons. The following data were collected from theatre operative notes records: Type of approach, duration of surgery, type of transfusion if done and how many units.

*Postoperative assessmen*t: Postoperatively the wounds were assessed if a drain was left *in situ* or not. Sterile gauzes dressing were used to dress the wound. Dressings were changed after 48 hours or sooner depending on how soaked the dressing was (bleeding at incision site). The duration of post-operative stay was also recorded in the questionnaire. The researcher then graded and scored the wound as per the Southampton wound score at day 3, day 14 and day 30 post acetabular reconstruction. The Southmapton score is used to assess surgical wound healing and ranges from Grade 0 (normal wound) to Grade V (severe wound infection) (21).

Specimen collection: Wounds that scored grade III and above were regarded as infected and specimens were collected for Microscopy/Culture/ Sensitivity (M/C/S) in an aseptic method. The results were recorded as whether culture positive or negative and the isolated microorganism and their antibiotic sensitivity profile. The infected wound was treated appropriately thereafter.

Data management and analysis: Data obtained was managed and analyzed using SPSS version 23. Descriptive statistics was used for both categorical and continuous variables which were expressed in proportions and means. Pearson chi-square and Fisher's exact tests were used to determine the association between risk factors and SSI as opposed to logistic regression due to the limited sample size. P-value of less than 0.05 was considered statistically significant.

Ethical considerations: Ethical clearance was obtained from the ethical clearance committee of MUHAS. Also permission to conduct the study at MOI was requested and obtained from the administration. During and after the study period, the patients' confidentiality was maintained. The obtained information was used for research purpose only. The participants in this study signed the consent form after agreeing to participate. The participants were allowed to withdraw from the study at any point during the course of the study.

RESULTS

Socio-demographics characteristics of study participants: In the 6 months duration, a total of 37 patients underwent acetabular reconstruction and all were recruited in this study. The mean age was 37.54 ± 9.71 (18-62) years with age groups 18-29 and 30-39 years each comprised of 14 (37.8%). Thirty-five (94.6%) were male whereas only 2 (5.4%) were female (Table 1).

Table 1

Demographic characteristics of study participants

Variable	Frequency, n (%)
Age group (years)	
18-29	14 (37.8)
30-39	14 (37.8)
40-49	6 (16.3)
50-59	2 (5.4)
Above 60	1 (2.7)
Mean age	37.54 ± 9.71 (18-62)
Gender	
Male	35 (94.6)
Female	2 (5.4)

Clinical characteristics; Preoperative, intraoperative and postoperative

Preoperatively, 31 (83.8%) patients had normal BMI. Seven (18.9%) patients were current smokers and 30 (81.1%) patients had stayed at the hospital for more than a week before surgery. Three (8.1%) patients had hypertension with one (2.7%) having HIV infection. Preoperative haemoglobin was 12-15g/dl in 25 (67.6%) patients, and all patients had ASA score $\leq$3. About 14 (37.8%) patients had posterior acetabular wall fracture, 8 (21.6%) had both posterior column and posterior wall acetabular fracture. Associated injuries were; Extremities in 21 (56.8%) patients whereas head and neck were reported in 9 (24.3%) patients (Table 2).

Intraoperatively, 34 (91.9%) patients were operated with Kocher Langenbeck approach while combined approach was used in only one (2.7%) patient. Most of the patients (83.8%) duration of surgery was more than 2 hours whereas 89.2% of the patients received blood transfusion. All patients transfused received whole blood with more than half (59.5%) given only 1unit.

Post operatively, drain was used in 22 (59.5%) patients. Most (91.9%) patients were discharged within 7 days (Table 2).

Table 2

Clinical characteristics, preoperative, intraoperative and post-operative features

Variable		Frequency, n (%)
Preoperative		
BMI Kg/M^2	20- 25	31 (83.8)
	Above 25	6 (16.2)
Smoking status	Yes	7 (18.9)
	No	30 (81.1)
Comorbidity	Diabetes mellitus	0 (0)
	HIV	1 (2.7)
	Hypertension	3 (8.1)
Preop Hb levels	Below 10	0 (0.0)
	10-12	12 (32.4)
	Above 12	25 (67.6)
ASA score	<3	37 (100)
	>3	0 (0.0)
Fracture pattern	Posterior wall	14 (37.8)
	Posterior column	5 (13.5)
	Transverse wall	2 (5.4)
	Anterior wall	2 (5.4)
	Both columns	3 (8.1)
	Transverse posterior wall	3 (8.1)
	Post wall and column	8 (21.6)
Associated injuries	Abdomen	2 (5.4)
	Chest	0 (0.0)
	Extremities	21 (56.8)
	Pelvic ring	5 (13.5)
	Genital urinary system	0 (0.0)
Intraoperative surgical approach	Kocher Langenbeck	34 (91.9)
	Ilioinguinal	2 (5.4)

	Combined	1 (2.7)
Surgery duration	< 2 hours	6 (16.2)
	> 2 hours	31 (83.80
Intra-op. transfusion	Yes	33 (89.2)
	No	4 (10.8)
Post-operative		
Postop. stay at hospital	Less than 1week	34 (91.9)
	More than 1 week	3 (8.1)
Drain	Yes	22 (59.5)
	No	15 (40.5)

Proportion of SSI among patients undergoing acetabular reconstruction

SSI was assessed using Southampton grades at 3rd day, 14th day and 30th post-surgery respectively followed by culture and sensitivity for those who had grade III and above. Of all the patients in the study, all had scored less than Southampton grade III on the 3rd day after surgery, four patients scored grade III and above on the 14th day after surgery and after treatment all patients scored less than Southampton grade III on 30th day after surgery. Overall, four patients had Southampton grade III or above during study follow up (30 days).

Pus swabs culture were obtained for the four patients; out of which positive results were reported in all the four (10.8%) patients thus, the proportion of SSI was 10.8%.

Of the four patients who had SSI, 3 (75%) were aged below 50 years. Two (50%) of the patients were male and all the 4 (100%) patients had BMI score above 25kg/m^2. Three (75%) out of the four patients stayed at the hospital preoperatively for more than one week. None of them had diabetes or HIV however, 3 (75%) had hypertension. None of the patients with SSI had history of smoking. Two (50%) patients with SSI had posterior wall fracture, two (50%) had extremities fractures as associated injuries with 2 (50%) patients each having pelvic ring and head and neck associated injuries respectively. Two (50%) patients had preoperative haemoglobin levels between 10 and 12g/dl.

Three of these patients with SSI were operated with Kocher Langenbeck approach. Surgery duration was more than 2 hours for all patients who developed and all of them were given blood transfusion during surgery. Three of the patients had drains *in situ* after surgery, and also three of them had postoperative stay of more than 1 week. There was significant association between sex, BMI, comorbidity and post-operation hospital stay with development of surgical site infection (p-value < 0.05).

Table 3

Factors associated with SSI post acetabular reconstruction

		SSI (%)		
Variable		Yes, n=4 (%)	No, n=33(%)	P-value
Age (years)	< 50	3 (8.8)	31 (91.2)	0.298
	≥ 50	1 (33.3)	2 (66.7)	
Sex	Male	2 (5.7)	33 (94.3)	0.009
	Female	2 (100)	0 (0.0)	
BMI	≤ 25	0 (0.0)	31 (100.0)	0.005
	≥ 25	4 (66.7)	2 (33.3)	

Pre-op stay	<1 week	1 (14.3)	6 (85.7)	0.585
	≥ 1 week	3 (10.0)	27 (90.0)	
Diabetes mellitus	No	4 (10.8)	33 (89.2)	-
Hypertension	Yes	2 (66.7)	1 (33.3)	0.026
	No	2 (5.9)	32 (94.1)	
HIV	Yes	0 (0.0)	1 (100.0)	0.892
	No	4 (11.1)	32 (88.9)	
Smoking	Yes	0 (0.0)	7 (100.0)	0.570
	No	4 (13.3)	26 (86.7)	
Ass abdominal injury	Yes	0 (0.0)	2 (100.0)	0.713
	No	4 (11.4)	31 (88.6)	
Ass. pelvic ring injury	Yes	1 (20.0)	4 (80.0)	0.456
	No	3 (9.4)	29 (90.6)	
Ass. Head/neck injury	Yes	1 (11.1)	8 (88.9)	0.690
	No	3 (10.7)	25 (89.3)	
Ass. extremities injury	Yes	2 (9.5)	19 (90.5)	0.773
	No	2 (12.5)	14 (87.5)	
Pre-op Hb (g/dl)	10-12	2 (16.7)	10 (83.3	0.582
	12	2 (8.0)	23 (92.0)	
Surgical approach	Kocher	3 (8.8)	31 (91.2	0.579
	Ilioinguinal	1 (50.0)	1 (50.0)	
	Combined	0 (0.0)	1 (100.0)	
Surgery duration	<2 hrs	0 (0.0)	6 (100.0)	0.476
	≥ 2 hrs	4 (12.9)	27 (87.1)	
Blood transfusion intra-op	Yes	4 (12.1)	29 (87.9)	0.620
	No	0 (0.0)	4 (100.0)	
Drain *in-situ*	Yes	3 (13.6)	19 (86.4)	0.633
	No	1 (6.7)	14 (93.3)	
Post-op stay	Less than 7 days	1 (2.9)	33 (97.1)	<0.001
	More than 7 days	3 (100.0)	0 (0.0)	

DISCUSSION

Surgical Site Infections (SSI) are among the most frequently occurring healthcare-associated infections specifically in surgical practices. This study aimed at assessing the not only the burden of SSI and its associated factors but also its aetiological bacterial profile following acetabular reconstruction surgeries at Muhimbili Orthopaedic Institute (MOI). SSI is a devastating post-operative complication which may lead to permanent disability or long-term infection especially in orthopaedic surgeries. Understanding of its burden, associated factors and aetiological organisms is very important in minimizing the incidence, prevention and its management.

Overall the proportion of SSI in the index study was 10.8% after 30 days following acetabular reconstruction surgeries. This is consistent but relatively higher compared to other studies after acetabular fixation where 1.5% to 6.7% incidence of SSI was reported (8,9,10,11,12). Interestingly, a study done 9 years ago at MOI revealed a 25% prevalence of SSI however, this was specifically after long bones surgical operations (22). There is no clear reason to the observed higher proportion of SSI in this study compared to other studies on acetabular fractures. However, this could be attributed to the small sample size used in this study compared to others (8,9,10,11,12). A long-term duration study would help in establishing a reliable incidence of SSI in such patients.

Concerning factors associated with SSI, a number of studies have been published but there are limited studies on SSI post acetabular reconstruction. In this study; sex, BMI, comorbidities, and post-operative stay more than one week were significantly associated with development of SSI. Different studies have assessed the role of different factors influencing development of SSI.

With regards to age; there was no significant association with SSI however three quarters of patients with SSI in this study were aged below 50 years different from most of the studies which have reported a positive relation between advanced age and development of SSI (12,15). Notwithstanding, few studies have reported no association between age and development of SSI including one study on acetabular fractures fixation (15,18). The findings in this study could be attributed to the limited number of older patients, of all patients in the study only three were above 50 years of age with nearly three quarters aged below 40 years. Moreover, acetabular fractures are high energy associated fractures where in most cases road traffic accidents was the major cause in our settings where younger population was commonly affected.

Sex was significantly associated with SSI in this study similar to what was found in other studies. In those studies, male gender had increased risks for SSI as compared to female gender (22,23). However, a study done in Tanzania by Mawalla *et al.* (11) reported no significant association between sex and SSI. Nonetheless, Iqbal *et al.* (15) reported no significance between gender and SSI in their study done among acetabular fractures patients. There is no evidence on the role of gender on SSI. However, in most cases a higher proportion of male undergo orthopaedic surgeries due to high energy trauma compared to female which could account for similar raised proportion of SSI. Of interest, one study showed increased risk of SSI among female patients after heart and vascular surgeries rather than abdominal and orthopaedic surgeries (11).

Comorbidities was one of the factors that was significantly associated with SSI in this study. Half of the patients who had SSI were hypertensive which correlates with numerous studies that reported comorbidities increases the development of SSI, although hypertension has been less implicated in SSI as compared to diabetes or HIV (9,13). There were neither diabetic nor HIV patients among the patients who developed SSI patients in this study. The risk of pre-morbid illnesses is lowering the immunity to fight pathogens which predispose such patients to SSI. Uncontrolled hypertension increases chances for peripheral artery disease which has a direct effect on wound healing. In this study, it was not clearly stated whether hypertension was under control or for how long the patient was hypertensive.

BMI score was also demonstrated to be associated with development of SSI in this study, about three quarters of patients with SSI had BMI above 25kg/m^2. Several studies on SSI following acetabular fracture fixation also have shown a positive relationship between SSI and a high BMI (9,15,22). High BMI has been linked to increased risk of soft tissue injury and prolonged operation

time which in turn increased healing time and exposure to pathogenic organisms (16) .

This study demonstrated association between post-operative stay and SSI. Of all the patients with SSI about 75% had stayed at hospital for more than 1 week after surgery. This is consistent with findings from other studies where hospital stay has been associated with increased incidence of SSI (18,19,22). Hospital stay increases the exposure chances for wound contamination especially in most of developing countries where hospital systems lack materials and equipment to establish aseptic environment.

Other factors in the study like smoking, drain placement, ASA score, blood transfusion, surgical approach, surgery duration and associated injuries did not show significant association with development of SSI as it has been found in several other studies (12,15,22). The observed variations however, could be attributed to differences in study design, types of SSI (some studies are not specific whether superficial or deep), hospital settings, sample size even surgeons' experiences and post-operative care. This was a prospective study with limited number of patients enrolled which hinders detailed relationship between SSI and associated factors different from majority of the studies which were retrospective studies with large sample size. A long-term duration study with large sample size would be of much help to establish evident factors associated with SSI.

This study went further and assessed the SSI causative organisms; *Staphylococcus aureus* was the most common isolated organism in 3 out of 4 who had SSI. *Klebsiella pneumoniae* was isolated in one patient. This correlates with a number of studies that reported *Staphylococcus aureus* as the most commonly isolated organism in SSI post acetabular fixation (8,15,22). This also correlates with a study done at the same institution on post-operative wound infections at MOI by Assey in 2006 (24). *Staphylococcus aureus* is a normal flora bacteria found on skin which explains its easy penetration into the surgical site hence predominant as the common isolated organisms in SSI patients.

CONCLUSION

The proportion or burden of SSI is relatively high among patients undergoing acetabular reconstruction surgeries at MOI. Approximately 10.8% of patients developed SSI after acetabular reconstruction surgeries. Development of SSI is associated with sex, BMI, pre-morbid illness and post-operative hospital stay. *Staphylococcus aureus* and *Klebsiella pneumoniae* are the common causative bacteria of SSI.

Recommendations

(a) A prospective study with long-term duration needs to be done so that a significant number of patients is recruited to establish an evident influence of associated factors.

(b) The hospital management systems to establish a conducive environment where patients are managed based on the common isolated organisms with early discharge from the hospital to avoid cross-infection

(c) Encourage on health behavior practices among patients to control their BMI with proper active management in cases admitted where development of SSI can be anticipated.

(d) Proper care and management of patients with comorbid illnesses making sure their conditions are under control before surgeries except in emergency cases.

Study limitation

The major limitation was the small sample size of this study. This reduced the reliability and generalizability of the study findings.

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ANALYSIS OF SUPRACONDYLAR HUMERUS FRACTURES IN THE PAEDIATRICS POPULATION AT AN ACADEMIC HOSPITAL

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ABSTRACT

Background: Despite a marked rise in the burden of supracondylar humerus fractures among paediatric patients in South Africa, little is known about their profile characteristics.

Objectives: The aim of this study is to explore the profile of the paediatric population in Soweto with supracondylar humerus fractures seen at an academic hospital with respect to profile, risk factors, and associated injuries.

Methods: A retrospective review study of all paediatric patients who were operatively treated at Chris Hani Baragwanath Academic Hospital with supracondylar humerus fractures between 1st July 2022 to 30th June 2024.

Results: A total of 287 cases were identified from admission records. Twenty-one cases were excluded due to incomplete data, resulting in 266 cases available for analysis. There were 191 males and 75 females, with an average age of 6.3 years. All cases had a unilateral supracondylar humerus fracture. Gartland type 3 fractures accounted for 95.5% of all patients admitted for surgery, followed by type 2 fractures.

Conclusion: All supracondylar humerus fractures in this cohort were associated with trauma, and we advocate for continuous parental supervision at home and school for children.

Keywords: Africa, Humerus supracondylar fractures, Paediatrics, Soweto, Trauma

INTRODUCTION

Supracondylar fractures of the humerus are the most common fractures seen in the paediatric population with musculoskeletal elbow injuries (1). The prevalence of supracondylar fractures in the paediatric population has been estimated to be 177.3 per 100,000 (2). Supracondylar fractures typically occur after a fall from a height or during recreational or athletic activities (2). Supracondylar fractures occur more commonly in males, particularly in their non-dominant arm, with a 1.5-fold greater frequency (3). The highest incidence of supracondylar fractures often happens around the age of 6 years (4).

These fractures are associated with various additional injuries and complications, such as vascular injuries, nerve injuries, floating elbow, compartment syndrome, malunions, and infections (5). The aim of this study is to explore the profile of the paediatrics population in Soweto with supracondylar humerus fractures seen at an academic hospital with respect to risk factors, associated injuries, and treatment implemented.

We hypothesised that the demographics of supracondylar humeral fractures treated at our academic facility in a township setting in South Africa are comparable to those of the paediatric population treated in developed countries.

MATERIALS AND METHODS

This was a retrospective review study of all paediatric patients who were treated at an Academic Hospital with supracondylar humerus fractures between 1st July 2022 and 30th June

2024. All cases admitted with supracondylar humerus fractures aged < 14 years were included, and patients with missing medical records or incomplete notes from the available patient records were excluded. The parameters assessed included profile characteristics, injuries associated with supracondylar humerus fractures, as well as the risk factors and treatments implemented for these fractures at our institutions. The study protocol was approved by Human Research Ethics Committee (HREC), Medical, at our university (M240972) and medical ethics committee of our hospital. No informed written consent was required for the study.

Hospital patients medical records were reviewed for demographic details, treatment, radiographs and associated injuries, entered in Microsoft Excel (Microsoft, Redmond, WA, USA), and analysed using STATA software, version 18 (Stata Corp, College Station, TX, USA). Descriptive statistics were used to summarise the results. Categorical variables were presented as frequencies and percentages. The level of statistical significance was set at a $p < 0.05$.

RESULTS

A total of 287 cases were identified from admission records. Twenty-one cases were excluded due to incomplete data, resulting in 266 cases who underwent operative fixation of the SCF. At surgery, the median age was 6.0 years with a mean age of 6.3 years (range: 1- 13 years). Among the cases, there were 191 (71.8%) males and 75 (28.2%) females. Surprisingly, all the patients had sustained extension type humerus supracondylar fractures. The right-hand side was less involved compared to the left-hand side, 171 (64.3%) (Table 1). All cases had a unilateral supracondylar humerus fracture. Gartland type 3 fractures accounted for 95.5% of all patients admitted for surgery, followed by type 2 fractures. The mean hospital stay was 2.3 days (range 1-5 days). Associated injuries included one case of a distal radius fracture and another of median nerve injury (Table 2). All admitted patients that were included in the study underwent surgical treatment.

Table 1

Demographic characteristics of patients with humeral supracondylar fractures

Parameters	No. (%)
Age	
mean (range)	6.3 (1-13)
Gender	
Male	191 (71.8)
Female	75 (28.2)
Side	
Right	95 (35.7)
Left	171 (64.3)
Type	
Extension	266 (100)
Flexion	0 (0)
Gartland	
Type1	0 (0)
Type 2	12 (4.5)
Type 3	254 (95.5)
Type 4	0 (0)
Associated injuries	
Median nerve	1 (0.4)
Distal radius fracture	1 (0.4)
Length of Hospital stay	
Mean (range)	2.3 (1-5)

Table 2

Bivariate analysis of variables categorised by gender

Variables	Levels	Number (%) or Median (Q1-Q3)	Gender		*P*-value
			Male (191) No. (%) or Median (Q1-Q3)	Female (75) No. (%) or Median (Q1-Q3)	
Age		6 (5-8)	6 (5 - 8)	5 (4 - 7)	0.018
Side	Right	95 (35.7)	65 (68.4)	30 (31.6)	0.361
	Left	171 (64.3)	126 (73.7)	45 (26.3)	

Gartland	1	0 (0)	0 (0)	0 (0)	0.364
	2	12 (4.5)	10 (83.3)	2 (16.7)	
	3	254 (95.5)	181 (71.3)	73 (28.7)	
	4	0 (0)	0 (0)	0 (0)	
Associated injuries	Median nerve	1 (0.4)	1 (100)	0 (0)	0.673
	Distal radius fracture	1 (0.4)	1 (100)	0 (0)	
Length of stay		2 (2-4)	2 (2 - 3)	2 (2 - 3)	0.751

The predominant mechanism of injury in this group was falling while playing at home, accounting for 89.1%, followed by falling while playing soccer (Figure 1). Monday and Saturday had the same amount of admissions, with Sunday having the fewest admissions out of the seven days (Figure 2). The largest number of admissions occurred during the month of April, followed by the month of June, which had the lowest number of admissions.

The warmer seasons of the year experienced an increase in admissions: 67 cases were recorded in Spring, 76 cases in Summer , 78 cases in Autumn , and 45 cases in Winter (Figure 3). School vacations had a lower admission rate, which was 32%, whereas patients were admitted to hospitals more frequently during the days that were not school holidays (Figure 4).

Figure 1

Mechanism of injury of supracondylar fracture

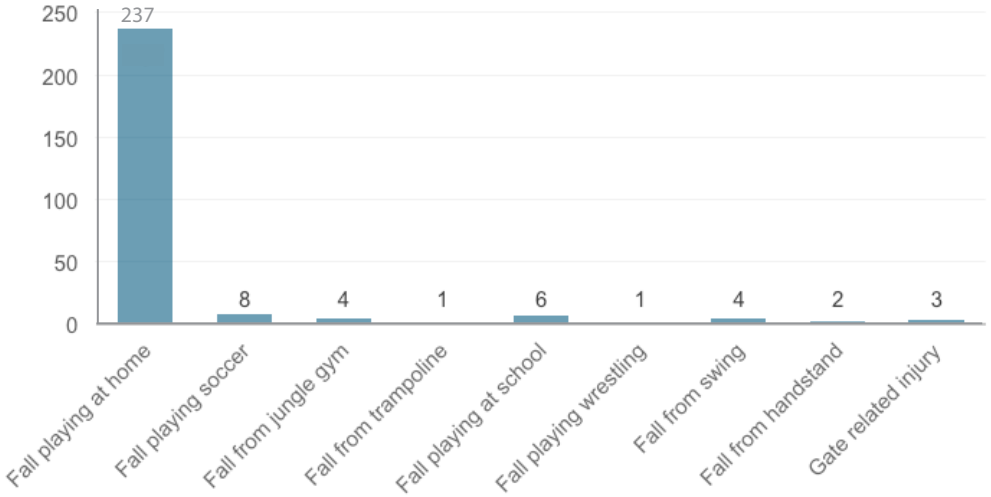


Figure 2

Weekly patient admissions

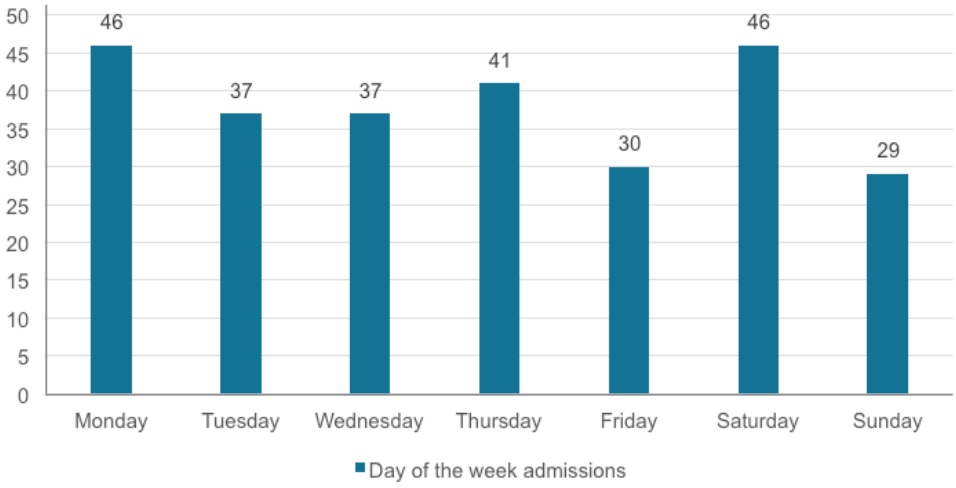


Figure 3

Monthly patient admissions

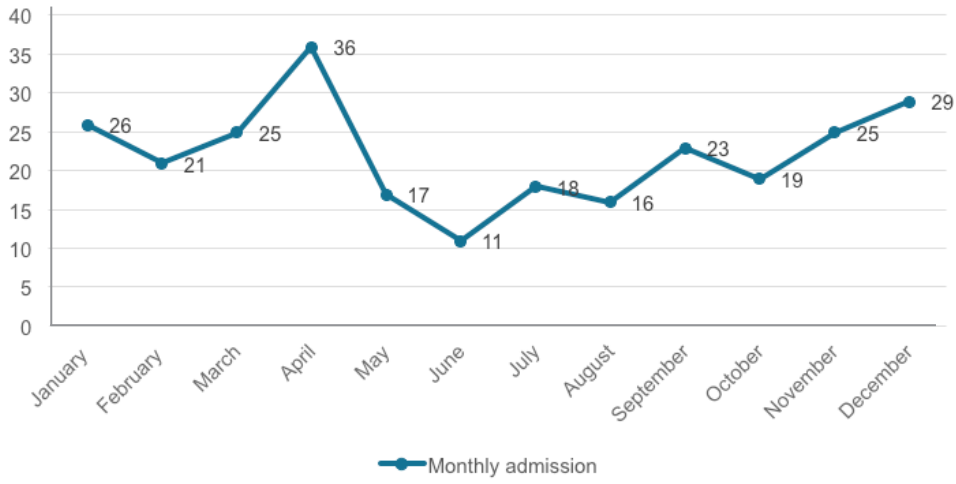
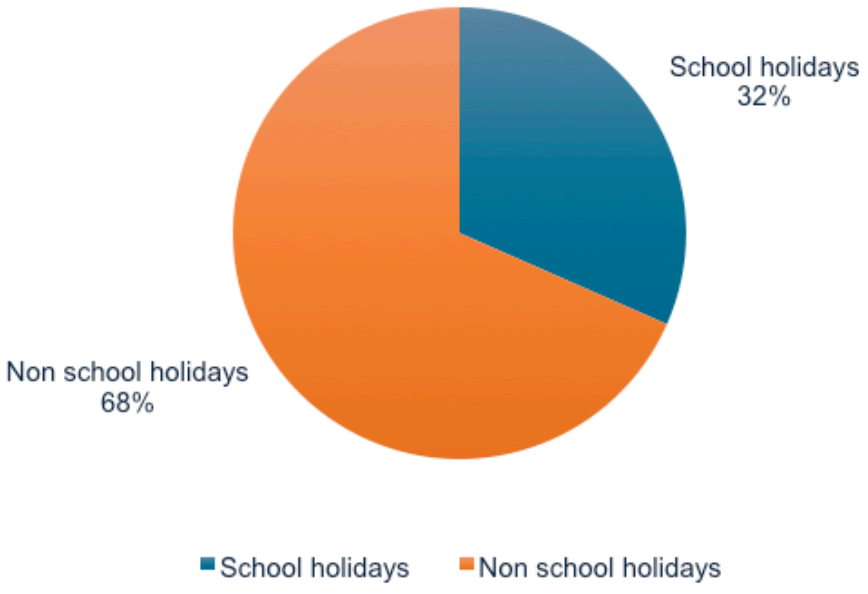


Figure 4

School recess admissions



DISCUSSION

The present study assessed the profile characteristics of SHF in a paediatric population admitted to the biggest paediatric unit in the African continent and one of the biggest hospitals in Africa. The overall mean age was 6.3 years (range 1-13 years). This finding is similar to the age range of 4-8 years reported in previously published studies (5-7). The average peak age for supracondylar humeral fractures in the paediatric population is 6 years (5,8).

In this study, there were 75 (28.2%) females and 191 (71.8%) males. According to a research by Khoshbin *et al*. (9), there were no gender differences among the paediatric population with supracondylar humeral fractures. The study conducted by Anjum *et al*. (1) revealed a greater incidence of affected males, although other studies indicated a greater incidence among girls.

The extension type of supracondylar fracture constituted 100% of the fracture types in this series. The extension type was previously reported as the most common category, representing 97-99% of cases (5,10). The left side accounted for 171 (64.3%) of the injuries, while the right side included 95 (35.7%). This data is similar to a study reported by Bahaeddini *et al*. (7), who reported high involvement on the left-hand side at 59.3%.

In this study, there were 98.9% supracondylar fractures were secondary to falling and 1.1% were due to gate related injuries. The most common mechanism of injury for supracondylar fractures, according to previously reported studies, is falling, with a rate of 97% (7). All cases in this study were closed fractures, while open supracondylar fractures are rarely seen (7).

In this cohort, Gartland type III was the most prevalent, accounting for 95%, while Gartland type II represented 4.5%. This study did not include patients who were seen and discharged from the emergency department, the majority of whom had Gartland type I supracondylar fractures. Gartland type III fractures are prevalent among the surgical cohort, with Khademolhosseini *et al.* (4) reporting that 71% (192/272) of patients presented with a Gartland type III fracture, followed by 29% with a Gartland type II fracture.

All patients admitted underwent operative treatment involving close reduction and percutaneous pinning. Only one patient had an injury to the anterior interosseous nerve, which is a branch of the median nerve, along with a distal radius fracture on the same side as the supracondylar fracture before the surgery. Median nerve neuropraxia is the most prevalent related nerve injury, followed by radial nerve involvement, whereas floating elbow occurrences are documented in at least 5% of cases (1,5,10).

The admission rates for Spring (25.2%), Summer (28.6%), and Autumn (29.3%) seasons were comparable, while the Winter season had a lower admission rate at 16.9%. Bahaeddini *et al.* (7) observed comparable admission rates in the spring and summer seasons, with a reduction in admissions during the winter season. These findings are comparable to those from this current study. Our study found that Saturday and Monday have high recorded admission rates. This data is similar to a study conducted by Ozbay *et al*. (11). Our study found that the length of hospital stay was 2.3 days, which was higher than the 1.1 days reported by Khoshbin *et al*. (9).

CONCLUSIONS

Paediatric supracondylar humerus fractures remain one of the most common orthopaedic emergencies, and the institution protocol recommends that the sun should not rise or set on a kid who is not being operated on. The profile, risk factors, and associated injuries of supracondylar humerus fractures in our institutional paediatric population are consistent with the published literature. Considering the high incidence of this type of fracture and the hospital admitting a child nearly every other day, enhanced treatment is imperative.

Declarations

The first author is responsible for misconduct in the research and writing process. The original images, data (including computer database) records and samples involved in the paper have been saved, Shared and destroyed in accordance with relevant regulations and can accept verification.

Ethics approval and consent to participate: Ethnical approval was received from the university of the Witwatersrand: M240972.

Consent for publication: No guardian / patient consent was needed for this study as this study was a retrospective review.

Conflict of interests: These authors, their immediate family, and any research foundation

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EFFECT OF TRANEXAMIC ACID ON BLOOD LOSS IN TOTAL HIP ARTHROPLASTY AT MUHIMBILI ORTHOPAEDIC INSTITUTE: A RETROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: Total Hip Arthroplasty (THA) is associated with significant intraoperative and postoperative blood loss. The use of tranexamic acid has been shown to reduce bleeding and the number of blood transfusions.

Objective: This study aimed at comparing blood loss and the need for blood transfusion in patients undergoing THA between those who received tranexamic acid and those who did not.

Methods: The study design was a hospital-based retrospective comparative study which included 204 patients. The patients were divided into two groups, the first group were those patients who received tranexamic acid preoperatively and the second group were those patients who didn't receive it. The number of patients who got blood transfusions in both groups was determined. The results were analyzed by Statistical Package for the Social Sciences (SPSS) computer program version 20 for the study variables.

Results: The study showed that among the participants who underwent THA, almost three quarter (74.4%) of those who did not receive tranexamic acid needed blood transfusion, whilst 60.3% of patients who received tranexamic acid required blood transfusion. This study also showed that amongst those who received blood transfusion, the number of units were less in the group that received tranexamic acid.

Conclusion: Pre-operative tranexamic acid administration to patients who underwent THA showed to be effective in significantly reducing the need and number of units of postoperative blood transfusion.

Key words: Tranexamic acid, Total Hip Arthroplasty, Blood transfusion

INTRODUCTION

Total Hip Arthroplasty (THA) is a procedure that involves surgical excision of the head and neck of the femur and removal of the acetabular cartilage replacing them with implants. THA is associated with significant intra and postoperative bleeding that can cause acute postoperative anaemia requiring blood transfusion. Blood transfusion is associated with risks of blood transfusion reactions, infections and fluid overload and these complications can delay a patient's functional recovery and consequent discharge from the hospital (1).

To avoid these risks, Tranexamic acid (TXA) is given preoperatively and it functions by inhibiting the conversion of plasminogen to plasmin, an enzyme that breaks down fibrin-containing blood clots, hence by stabilizing these clots, TXA reduces active bleeding (2).

Apart from TXA being used in reducing bleeding in other conditions like major trauma, TXA is currently being used in orthopaedic surgery through the intravenous route during hip and knee arthroplasty procedures either as primary or revision procedures. It has been shown to reduce perioperative blood loss and the need for blood transfusion without increasing the risk of deep vein thrombosis or pulmonary embolism (2,3). A study conducted by Shakya *et al*. (3) shows that TXA reduced blood loss by an average of 36.5% in patients undergoing THA. Another study showed that TXA reduced intra-operative blood loss by 104mL and postoperative blood loss by 172 milliliters (4). In a study done by Menezes (5) to assess transfusion practice among patients undergoing THA it was noted that the proportion of patients who were transfused blood decreased from 35% to 17%.

On the other hand, patients undergoing THA without preoperative tranexamic acid administration suffer a considerable perioperative blood loss which increases the need for blood transfusion and receive multiple blood transfusions (6). In another study by Carling *et al*. (7) it was documented that the prevalence of red blood cell transfusion was lower than previously reported in unselected total hip or knee arthroplasty patients, and routine use of tranexamic acid may have contributed to this. Low preoperative haemoglobin levels, low body mass index, and long operation increase the risk for red blood cell transfusion. The mean age in the study group was 66±12 for hip and 69±10 for knee surgery.

Administration of TXA in patients prior to THA exhibited significantly reduced prevalence of blood transfusions (8), while in another study by Hsuan-Wei *et al.* (9) based on a systematic review and meta-analysis, use of TXA was secure and efficient in primary THA in lowering blood loss and Hb decline.

This research was done to find the efficacy of tranexamic acid in decreasing the loss of blood, subsequent blood transfusion required and also the number of units required post-surgery for these patients.

MATERIALS AND METHODS

Study design: A hospital-based retrospective comparative study design.

Study area: The study was conducted at Muhimbili Orthopaedic Institute (MOI), Dar es Salaam, Tanzania. MOI is an autonomous institute established under the act. No 7 of 1996 with the main objective of providing primary, secondary and tertiary care of preventive and curative health services in the field of orthopaedics, traumatology, and neurosurgery.

MOI provides both emergency and non-emergency medical services in the field of orthopaedics, traumatology, and neurosurgery. The institute has a bed capacity of more than 380 beds. In the Department of Orthopaedic and Traumatology, there are three firms (A and B), and Paediatric Orthopaedics.

THA is done in firms A and B and about six to eight surgeries are done per week. Tranexamic acid gradually started to be given to patients who underwent THA at MOI in 2008 and gained momentum.

Study period: April 2018 to February 2019.

Study population: Adult patients who underwent THA between January 2007 to December 2017 at MOI.

Inclusion criteria: Participants > 18 years of age and those who underwent primary THA.

Exclusion criteria: Patients with sickle cell anaemia were excluded because of the inherent disease and the theoretical increase of thromboembolic event that could be triggered by use of tranexamic acid.

Data collection process: Data sheet with predetermined variables of interest was used and data were extracted from patient's files. From 226 postoperative patients' files who met inclusion criteria which were identified randomly from register books, 22 files were dropped from the study due to inadequate information and only 204 patients' files went for further assessment which included patients who underwent THA who received preoperative TXA and those who did not receive preoperative TXA. From patients' files, demographic data were taken, Case notes and anaesthetic notes were examined to extract data of amount blood loss, amount of blood transfusion and the number of patients who received preoperative tranexamic acid and those who did not receive tranexamic acid were taken.

The obtained data were entered in abstraction form and then transferred to Statistical Package for the Social Sciences (SPSS) computer program version 20 for analysis of study variables.

Data processing and analysis: Data processing and analysis were then done for the study variables. Continuous data were summarized via means and standard deviation whilst categorical variables were summarized by frequency distributions and Chi-square was used to test for association and the association for continuous variables was done by using the *t*-test. Using bivariate analysis, cross-tabulation was used to test the association between categorical variables. The odds ratio was used to find the association of continuous data. Statistical significance was set to a *p*-value of <0.05.

Ethical issues: Ethical clearance of extracting patients' information from the files and the electronic database was obtained from the MUHAS Institution Board (IRB) and permission from MOI administration was obtained. During and after the study period, the patient's confidentiality was maintained. The obtained information was used for research purposes only.

RESULTS

A total of 204 patients who underwent THA met the inclusion criteria and were recruited in the study, of those, 126 (61.8%) patients were male and 78 (38.2%) patients were female.

Table 1

Socio-demographic characteristics of respondents (n= 204) - Age

Characteristics	No. (%)
Age group (years)	
18-24	16 (7.8)
25-34	10 (4.9)
35-44	21 (10.3)
45-54	44 (21.6)
55-64	55 (27.0)
65-74	52(25.5)
>74	6 (2.9)
Total	204 (100%)

The age ranged from 18 to 84 years with a mean age of 57 years and (SD 17). The majority of the patients were between 55 to 64 and 65 to 74 years old which comprised of 27.0% and 25.5% respectively

Table 2

Comparison of the proportion of patients who received blood transfusion postoperatively among those who received preoperative TXA as compared to those who did not receive preoperative TXA

Tranexamic acid	Blood transfusion		
	Yes	No	Chi-square, p-value
Yes	73 (60.3%)	48 (39.7%)	4.541, 0.033
No	62 (74.7%)	21 (25.3%)	
Total	135 (66.2%)	69 (33.8%)	

Sixty two (74.7%) of patients who had not received tranexamic acid required post operative blood transfusion whilst 60.3% of those who had received tranexamic acid received blood and this had a *p*- value of 0.033.

Table 3

Correlations between blood transfusion and operation duration, haemoglobin (Hb) level, and age

Control variables			Op. duration	Hb. level	Age
BT	Op. duration	Correlation	1.000	.028	-.025
		Significance (1-tailed)	.	.348	.360
		df	0	200	200
	Hb level	Correlation	.028	1.000	.136
		Significance (1-tailed)	.348	.	.027
		df	200	0	200
	Age	Correlation	-.025	.136	1.000
		Significance (1-tailed)	.360	.027	.
		df	200	200	0

The results show that there is a strength of association between blood transfusion and haemoglobin level with Pearson correlation coefficient of 0.028, also there is a strength of association between blood transfusion and age with Pearson correlation coefficient of -0.025 because both are below 1 but no correlation between duration of operation because of the Pearson correlation is 1.

Number of transfused units of blood among patients who underwent THA: The results show that those patients who did not receive tranexamic acid have the probability of receiving one unit of blood transfusion per patient while those who received tranexamic acid have a range of blood transfusion of 0-1 unit blood per patient. With a *p*-value of 0.011, it showed that it is statically significant and tranexamic acid showed to reduce the number of units of blood transfusion to patients who underwent THA.

DISCUSSION

The majority of participants who underwent THA were males and also the majority of participants who underwent THA were between 55 to 64 years old which is slightly different as compared to another study by Carling *et al.* (7) which found most commonly the patients were between 70-79 years.

This study also showed that among participants who did not receive tranexamic acid and who underwent THA, 74.7% received blood transfusion. This shows that there is a higher rate of blood transfusion to participants who did not receive preoperative TXA. This was similar to the findings of another study conducted by Thapaliya *et al*. (8) which found that allogeneic red cells (RBC) were administered to 92% of patients who underwent THA without preoperative tranexamic acid. The findings have a negative effect on the reduction of blood transfusion due to a higher rate of blood transfusion post THA. These results were similar to another study which found that more blood transfusions were performed in the cohort that had not received preoperative tranexamic acid (25.37%) compared with 4.48% in the group with tranexamic acid and the amount of perioperative blood loss was determined to correlate rate of blood transfusions but this study looked only into on effect of tranexamic use on blood transfusion rate (9).

The odds ratio of received blood transfusion after receiving tranexamic acid was shown to be 0.515 and it was statically significant with p=0.033. Furthermore, the relative risk of blood transfusion when TXA is given outcome is 0.808 times a relative risk of blood transfusion when TXA not given outcome is 1.568 times. This finding shows that TXA influence the reduction of

postoperative risk of blood transfusion for those participants who receive preoperative TXA and is protective compared to those who did not receive preoperative TXA.

The results show that those patients who did not receive tranexamic acid have the possibility of receiving one unit of blood transfusion per patient while those who received tranexamic acid have a range of blood transfusion of 0-1 unit blood per patient, which means that some patients who got TXA did not receive any unit of blood. With a *p*-value of 0.011 which shows that it is statistically significant meaning tranexamic acid administration preoperatively reduces the need of blood transfusion to patients who underwent THA.

From this study among patients who received tranexamic acid preoperatively, 60.3% of participants got blood transfusion post-THA. The findings suggest that tranexamic acid reduce the rate of blood transfusion to patients undergoing THA as compared to those who did not receive although it is significantly higher than in the study done by Carling *et al*. (7) which showed 18% of patients who received tranexamic acid needed blood transfusion post operatively. The prolonged operation time was associated with increased blood loss and transfusion rate but in this study there was no correlation between blood transfusion and time of operation. But other risk factors like preoperative haemoglobin level and age were similar in both studies which were associated with increased transfusion rate.

These findings suggest that the administration of tranexamic acid has shown to be an effective method of reducing postoperative blood transfusion to participants who under went THA. The findings suggested a *p*-value of 0.033 and this shows that there is a statiscally significant difference in postoperative blood transfusion for post THA among TXA and non-TXA group. The statistical analysis shows that TXA reduces the need for blood transfusion for the patients undergoing THA.

Study limitations

Some files were excluded from the study due to inadequate information as they were missing completely at random. To avoid such setback to future researchers, every effort should be made to ensure that the medical records are complete.

CONCLUSION

Perioperative bleeding is the major cause of blood loss in major orthopaedic surgeries that lead to increased blood transfusion demands and tranexamic acid has been introduced to reduce the need of blood transfusion to patients undergoing THA. The administration of preoperative TXA to patients undergoing THA has proved to be an effective method to reduce the need for postoperative blood transfusion. Therefore, tranexamic acid treatment could reduce the burden of active blood product donation and reduce exposure to blood transfusion risks.

Recommendations

Tranexamic acid appears to reduce the need and the number of blood transfusions, so it can be included in standard operating procedures for THA after conducting more studies.

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PERCEPTIONS OF SURGICAL TRAINING BEFORE AND AFTER THE INTRODUCTION OF SUBSPECIALTY UNITS AT KENYATTA NATIONAL HOSPITAL: A RESIDENT ALUMNI AUDIT

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ABSTRACT

Background: In 2019, Kenyatta National Hospital (KNH) reorganized its orthopaedic service into seven subspecialty units to align training with global standards.

Objective: To evaluate how this reform influenced residents' perceptions of training quality, mentorship, and educational depth.

Methods: A mixed-methods survey was administered to alumni graduating between 2018–2023. Quantitative data were analyzed descriptively and with chi-square tests; qualitative responses were thematically coded.

Results: Of the 35 respondents, 71% rated overall training as excellent. Following subspecialization, 71% reported improved mentorship, 89% greater teaching depth, and most valued enhanced focus on areas of interest. All recommended the model for broader adoption. No significant differences emerged between earlier and recent graduates. Qualitative feedback highlighted increased technical confidence and clearer mentorship structures, but also noted challenges such as short rotations and inconsistent supervision.

Conclusion: The subspecialty model at KNH was positively received and perceived to improve training quality and readiness. The findings support expanding subspecialty-based education in low- and middle-income countries.

Key words: Subspecialty training, Orthopaedic education, Mentorship, Resident perceptions, Kenya

INTRODUCTION

While the primary motivation for establishing orthopaedic subspecialty units at KNH was to improve the quality, coordination, and outcomes of patient care, these structural changes inevitably had a profound effect on the training experience of residents. Recognizing the critical role that training environments play in shaping surgical competence, KNH collaborated closely with the University of Nairobi to align the implementation of subspecialty units with the objectives of both postgraduate and undergraduate medical education. This collaboration ensured a seamless transition that not only upheld but enhanced the educational mission of the institution.

Kenyatta National Hospital (KNH), Kenya's largest referral and teaching hospital, began a quality improvement initiative in 2019 by establishing seven dedicated orthopaedic subspecialty units. These included:

(a) Paediatric orthopaedics
(b) Hand surgery
(c) Foot and ankle surgery
(d) Orthopedic spine surgery
(e) Orthopaedic trauma
(f) Orthopaedic oncology
(g) A combined unit for complex pelvis, arthroplasty, and sports medicine

These units were formed to promote structured mentorship, optimize case exposure, and align the training environment with global standards. This paper evaluates how this structural change was perceived by orthopaedic residents who experienced both the generalist and subspecialty training models.

Literature review

Global context of orthopaedic subspecialty training

Surgical care is now recognized as central to global health, with over 5 billion people lacking access to safe surgery and 143 million procedures needed annually (1). The Lancet Commission highlights the need to expand surgical education, especially in Low- and Middle-Income Countries (LMICs), where system capacity shapes health and economic outcomes (1,2).

In high-income countries, orthopaedic training has shifted toward early subspecialization in areas like spine, arthroplasty, and paediatrics, reflecting growing complexity. Surveys indicate support for earlier operative exposure, simulation, and skills-based learning, reinforcing the educational principle that deliberate practice—not just time—drives expertise (5). Targeted subspecialty rotations build confidence in complex case management, a finding echoed across medical disciplines.

Subspecialty training in LMICs and Africa

African training has traditionally produced generalists due to resource constraints, yet rising trauma and musculoskeletal disease burdens demand subspecialists (1). Kenya recently reported only 86 orthopaedic surgeons for a population of 45 million, with wide variation in training (3). Regional initiatives such as COSECSA now integrate structured subspecialty rotations, with examples like CURE Kenya demonstrating improved local workforce capacity. Still, limited equipment, scarce mentors, heavy service demands, and funding constraints hinder broader adoption.

Mentorship and educational outcomes

Mentorship remains pivotal. U.S. data show residents with mentors achieve higher satisfaction and better learning outcomes (4). In LMICs, where trainee-to-trainer ratios are high, structured mentorship is even more critical and directly shapes subspecialty choices. Innovative solutions are helping bridge training gaps in resource-constrained settings.

MATERIALS AND METHODS

Study design: This was a retrospective qualitative audit using a mixed-methods questionnaire distributed to orthopaedic resident alumni. It included both structured Likert-style items and open-ended qualitative questions.

*Setting and participants***:** The study targeted orthopaedic surgeons who completed residency at KNH between 2018 and 2023 and who had rotated through both generalist and subspecialty models during training. A total of 35 responses were analyzed.

Tool development: A standardized survey tool was designed to evaluate training quality across multiple domains, including bedside teaching, surgical exposure, mentorship, and MDT participation. The tool was reviewed for face validity and clarity by two academic consultants.

Data collection and analysis: Data were collected through anonymous digital surveys. Quantitative responses were analyzed using descriptive statistics. Chi-square tests and confidence intervals were used to assess associations between graduation cohorts and response trends. Qualitative responses were coded thematically by two reviewers.

Ethical considerations: As this was a minimal-risk quality audit not involving patient data, formal ethics approval was waived. Participants were informed of the purpose, voluntary nature, and confidentiality of the survey.

RESULTS

Quantitative outcomes

A total of 35 respondents participated in the survey evaluating the subspecialty training model. Most respondents expressed high satisfaction with the overall training quality. Specifically, 25 (71.4%) respondents rated their experience as 5 out of 5, while the remaining 10 (28.6%) respondents gave a rating of 4 out of 5. Notably, 25 participants reported that accessing mentorship had become easier during their training, compared to six who observed no change and four who felt it had become more difficult. When asked whether the subspecialty model allowed them to better focus on their personal interests, 31 (88.6%) respondents agreed that it had. An equal number reported improvements in the depth of teaching received during training. Remarkably, all 35 (100%) respondents indicated that they would recommend the subspecialty training model to future cohorts,

underscoring broad-based support for the model. Table 1 summarizes these quantitative findings and presents the absolute number of participants reporting each outcome related to their training experience under the subspecialty model.

Table 1

Summary of participant responses on key metrics (n = 35)

Metric	No. of respondents
Rated overall training 5/5	25
Rated overall training 4/5	10
Mentorship became easier	25
No change in mentorship	6
Mentorship became harder	4
Ability to focus on personal interest improved	31
Teaching depth improved	31
Would recommend subspecialty model	35

Confidence intervals

The proportion of respondents rating the training experience as 5/5 was 71.4%, with a 95% Confidence Interval (CI) ranging from 55.3% to 83.8%. Similarly, 71.4% of respondents reported easier access to mentorship under the new model, with an identical CI range of 55.3% to 83.8%. The proportion of respondents who reported improved ability to focus on a personal area of interest was 88.6% [CI: 74.1% – 95.5%], the same interval recorded for those who observed improved teaching depth. Importantly, all participants endorsed the model to others, resulting in a 100% recommendation rate with a 95% CI of 90.0% to 100.0%. These confidence intervals affirm the reliability of the observed trends, indicating strong positive perceptions of the subspecialty model among trainees.

Comparison by graduation cohort

Respondents were grouped into two cohorts based on their year of graduation: early graduates (2021 and earlier) and recent graduates (2022–2023). Chi-square tests were performed to evaluate whether perceptions differed between these two groups. No statistically significant differences were found across any of the evaluated dimensions. The proportion of respondents rating their training as 5/5 showed no significant variation between the two cohorts ($\chi^2 = 0.001$, $p = 0.982$). Similarly, responses regarding improved mentorship ($\chi^2 = 0.000$, $p = 1.000$), enhanced focus on areas of interest ($\chi^2 = 0.001$, $p = 0.982$), and improved teaching depth ($\chi^2 = 0.000$, $p = 1.000$) also showed no statistically significant differences. These findings suggest consistency in the quality and perception of subspecialty training irrespective of graduation year.

Thematic analysis of qualitative feedback

Qualitative responses provided richer context to the quantitative data, highlighting both the strengths and challenges of the subspecialty model. Many respondents noted that the structured training enabled deeper engagement with complex pathology and that subspecialty rotations were associated with higher patient volumes, which helped build technical confidence. The presence of better-defined mentorship structures also emerged as a positive influence on trainees' professional development.

However, several challenges were also reported. A number of respondents felt that the duration of subspecialty rotations was too short to allow for meaningful immersion and continuity of learning. Others expressed frustration with inconsistent supervision due to consultant absenteeism, which undermined the training experience. In addition, fragmentation in patient care ownership across different subspecialties was cited as a barrier to comprehensive case follow-up, limiting residents' ability to see patients through the continuum of care.

Respondents offered several recommendations to address these shortcomings. Many suggested that extending the duration of rotations would allow for more meaningful engagement and skill acquisition. There was also a strong call for the introduction of structured post-residency fellowships to further deepen subspecialty expertise. Lastly, several respondents advocated for the implementation of consistent performance evaluation mechanisms to track trainee progress and ensure accountability from faculty.

DISCUSSION

Linking audit findings to global trends

The recent audit of orthopaedic subspecialty training reforms at Kenyatta National Hospital

(KNH) echoes global and regional shifts in surgical education. The data revealed strong support for the subspecialty model, with all respondents recommending its continuation. This aligns with broader literature which shows that structured subspecialty exposure increases both confidence and competence among surgical trainees (3,5). At KNH, 88.6% of residents reported improved ability to focus on areas of personal interest, and the same proportion noted improved teaching depth. These findings suggest that targeted subspecialty rotations, such as those now in place for paediatric orthopaedics and spine surgery, are providing the deliberate, hands-on learning needed to build expertise.

Thematic feedback reinforced this, with residents describing how focused exposure enabled deeper engagement with complex pathology and higher case volumes enhanced technical confidence. These benefits reflect global calls for structured exposure in orthopaedic training programs and align with recommendations for competency-based progression tied to procedural experience (3). KNH's positive trajectory supports the broader movement toward subspecialty differentiation within general surgical training, particularly in Low- and Middle-Income Countries (LMICs).

Mentorship and its role in learning

While the subspecialty model was well received, mentorship quality emerged as an area of variability. Quantitatively, 71.4% of respondents said mentorship had become easier to access, but nearly 29% noted either no change or greater difficulty. Qualitative comments provided more nuance: while some residents appreciated improved mentorship structures, others cited consultant absenteeism and inconsistent supervision as barriers. This reflects broader literature on mentorship gaps in surgical education, especially in resource-constrained settings (4).

Residents noted that the presence or absence of structured supervision directly affected their learning experience. This supports the widely accepted principle that mentorship enhances confidence, procedural skill development, and professional growth (4). To sustain progress, KNH may consider reinforcing mentorship by pairing residents with subspecialty advisors and creating systems for more consistent faculty engagement, especially in newer rotations. Such steps would help optimize the impact of subspecialty training and support the apprenticeship model long associated with surgical excellence.

Institutional commitment and flexibility

Another notable theme from the qualitative feedback was the recognition of institutional strengths and constraints. While respondents expressed overall satisfaction with the subspecialty structure, they also raised challenges such as short rotation durations and fragmented ownership of patient care. These issues are not unique to KNH; they are common in the early phases of implementing subspecialty training in LMIC hospitals where service pressures are high and resources stretched.

Despite these constraints, the audit responses reflect a degree of institutional support for reform. The introduction of dedicated rotation blocks and perceived improvements in teaching suggest that efforts were made to prioritize training needs. As emphasized in implementation science frameworks, (6) such changes require both leadership engagement and a culture that values education. The KNH experience illustrates that even in a high-demand clinical environment, incremental changes can improve training outcomes when backed by institutional will.

Addressing persistent gaps

The results also pointed to structural issues that could dilute the benefits of subspecialization if left unaddressed. Residents noted that supervision was inconsistent and that educational continuity was at times disrupted by absenteeism. Some also found the rotation lengths too short to allow for full immersion in complex areas. These gaps, while not surprising in the context of large public hospitals, underscore the need for programmatic refinement.

One potential strategy is the formalization of evaluation processes to ensure consistency in mentorship and faculty accountability. Another is to explore structured post-residency fellowships in areas where deeper expertise is needed. Although these ideas go beyond what the current audit measured directly, they are consistent with recommendations made by residents in the qualitative section and supported by educational literature from similar LMIC programs (3).

The road ahead

While the audit did not measure patient outcomes or graduate career trajectories, it sets the stage for such evaluation in the future. Subsequent audits could assess how training reforms translate into improved clinical outcomes, retention of trained subspecialists, and the decentralization of specialist services to underserved areas. Monitoring these parameters would provide a fuller picture of the reforms' long-term value.

The audit itself represents a valuable quality improvement tool. KNH's willingness to undertake this review suggests an emerging culture of reflection and improvement, which is crucial for sustaining innovation in postgraduate medical education.

Frameworks such as the Consolidated Framework for Implementation Research and established change management models (6,7) remain useful lenses through which to evaluate and sustain reforms. These frameworks emphasize the importance of contextual factors—such as organizational readiness and leadership—which appeared to play a positive role in the success of KNH's training redesign. The gains observed must be institutionalized through policy changes, resource allocation, and ongoing communication of success to ensure their permanence.

Study limitations

This study is limited by its retrospective design and reliance on self-reported perceptions, which may introduce recall and social desirability bias. Because the sample was drawn exclusively from one institution, the findings may not be generalizable to national surgical training trends. The lack of external validation or triangulation with objective educational performance data limits the ability to assess the accuracy of self-assessed gains in confidence or competence. Additionally, qualitative analysis was interpretive and, while independent coding was employed to minimize bias, some subjectivity in theme identification may remain. Future studies should consider integrating direct assessment metrics, such as simulation performance or examination scores, and exploring longitudinal follow-up to understand the sustained impact of subspecialty reforms.

CONCLUSION

The introduction of subspecialty training reforms at Kenyatta National Hospital (KNH) marks a significant step forward in orthopaedic education within a low-resource setting. The findings from this institutional audit align with global literature emphasizing the importance of structured rotations, enhanced mentorship, and targeted exposure to complex pathology (1,3,4). Residents perceived improvements in teaching depth, focus on personal interests, and mentorship access, underscoring the value of intentional design in postgraduate training programs. These results also reflect familiar challenges—such as limited supervision continuity and short rotation durations—that echo trends seen in other LMIC contexts.

The KNH experience offers a model for how locally led, evidence-informed reforms can be implemented even in resource-constrained environments. By continuing to evaluate and adapt the program using implementation science frameworks, and by embedding mentorship more systematically, the institution can further strengthen the foundation laid by these reforms. While future research is needed to assess long-term outcomes and broader system effects, this case study affirms that high-quality orthopaedic training—attuned to both international standards and local realities—is attainable and impactful. As similar reforms take root elsewhere in Africa, KNH's approach may offer valuable lessons in designing specialty training that is both context-specific and globally relevant.

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