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Treatment Outcomes of Orthopedics in Ethiopia

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Editorial

The Journey of Orthopedics and Trauma Care in Ethiopia: Challenges, Opportunities, and Lessons Learned at a Tertiary Hospital in Ethiopia

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The history of modern medicine in Ethiopia is a complex and multifaceted one. It dates back to the time of King Libne Dengel in the 16th century, but organized and sustainable modern medical practice began after the battle of Adwa in 1896 (1). The first Ethiopian medical doctor was Hakim Workineh also called Charles Martin who was born in 1865 in Gondar. Subsequently, Negadras Gebrehiwot Baykedagn and Melaku Beyan were two of Ethio- pia's earliest formally trained medical doctors (2). To the knowledge of Ethiopian Orthopedic surgeons, Brigadier General Dr. Tadesse Melka is the first formally trained Ethiopian orthopedic surgeon. He did his medical & ortho- pedics specialty training in Yugoslavia and trauma sub-specialty training in Italy. He served as a combat medic of United Nations (UN) operations during the peak of the Congo crisis in 1962.

Since then, the journey of Orthopedics and Trauma care in Ethiopia has been that of growth despite the numerous challenges and shortcomings. This editorial navigates the journey of Orthopedics and Trauma Care mainly at the nation's largest tertiary hospital and tangentially, the journey of the field in Ethiopia.

Four schools provide training in the major health sciences under the umbrella of the College of Health Sciences (CHS) of Addis Ababa University and contribute for around 60% of AAU's research output- making the College a significant contributor to the University's current high academic status among African Universities. (Consistently ranked in the top 10) (4). The Department of Orthopedics in the School of Medicine (SOM) of the College of Health Sciences at Addis Ababa University was established as an independent department, separated from general surgery on September 25, 1987. For over three decades, it was the only Orthopedic Specialty training departmentin Ethiopia. To date, 302 Specialists and sub -specialists have graduated and are serving in different parts of the country and abroad. The Department has been contributing a lot in treating injured patients during peace and war over the years. Currently, there are 65 orthopedic residents and over 16 general surgical residents under training. There are also students from neighboring countries. The Department currently has 30 permanent Ethiopian staff with different academic ranks. There are four orthopedic major operation rooms with state-of-the-art C-arm, 125 beds in three wards, Outpatient departments, fracture clinics, casting rooms, physical therapy, and orthotic units. Complex and advanced surgeries are being performed routinely. The department receives complicated orthopedic cases including fractures, trauma, tumors, congenital deformities, infections, Arthritic changes, degenerative dis- eases, geriatric and post-menopausal issues, and several late presenting musculoskeletal conditions from all over the country. Complex fractures resulting from road traffic, machine injury, conflict, sports accidents, falls, and construction site injuries are the main sources of emergency mass causality to the department. Road traffic acci- dents are a major contributor to these injuries, with lower limb fractures being the most common type (3).

The Department has strong, long-standing, and impacting collaborations with great international organizations like SIGN Fracture Care International, AO Foundation, Australian Doctors for Africa, World Orthopedic Concern, and more. This has helped the Department to develop orthopedic infrastructure, import expensive implants and equip- ment, and bring skills and technology into the country.

Apart from training and patient care, several research projects are run in the department to address and solve local orthopedic problems. Publishing an article in peer-reviewed journals is one of the mandatory requirements for the successful completion of residency or fellowship training at Addis Ababa University (AAU). Challenges frequent- ly mentioned are lack of research funds, lack of time to complete and publish two articles while in a busy 2-year clinical training, delays in the review processes of journals, and lack of committed research advisors. Regardless,

these research studies are of paramount importance for generating data that can be translated into evidence-based clinical practice.

Currently, two urgent orthopedic service-related issues demand attention in Ethiopia. First, there is heavy reliance on imported instruments/implants, and second, scarcity of trained biomedical engineers to maintain expensive surgical equipment. Addressing these challenges requires private sector involvement to manufacture basic fracture care instruments/implants locally and to train biomedical engineers in equipment maintenance and operation. The growth of specialized Orthopedic Surgeons and the expansion of service centers are positive developments in hu- man resources and infrastructure. However, there still is a long way to go in terms of making these services readily available and accessible to all Ethiopians.

As a product of its commitment to research, the Department has compiled original research articles covering wide areas of orthopedic practice and clinical service in this special issue. We hope the evidence generated from these research studies will be an invaluable input for making informed decisions to advance the caliber of orthopedic and trauma care in Ethiopia.

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Original Article

Effectiveness of Continuum of Trauma Care System in Trauma Centers in a Resource Limited Setup: A Multi-Center Mixed Method Study

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Abstract

Background *Trauma is the leading cause of death in Ethiopia, with a rate of 26.7 deaths per 100,000 population. Emergency care systems have been shown to reduce trauma deaths, but the effectiveness of the emergency care system in Addis Ababa is not studied well. The aim of the study was to assess the effectiveness of the continuum of the trauma care system in selected emergency departments and trauma centers in Addis Ababa.*

Methods *A sequential explanatory mixed-methods approach was utilized, with in-depth interviews (N = 23) and focus group discussions (N = 17) with trauma team members, as well as a concurrently structured emergency care system assessment questionnaire (N = 333). The Chi-square test was used to show a significant association (P< 0.05) between the type and mechanism of trauma and patient condition categorization. The qualitative data were analyzed using Colaizzi's seven-step procedure.*

Results *The present study showed that Road Traffic Injury had been the most common cause of trauma (87.1%), with only 8.4% of trauma patients having received airway intervention during prehospital care. Out of 126 pa- tients who had required emergency surgery, only 38.10% of injured patients received a prompt decision regarding the need for emergency surgery, and 78.7% couldn't have received rehabilitation service. The Chi-square test re- vealed a significant association (p < 0.05) between type and mechanism of trauma and patient condition categori- zation. Five themes had emerged from the qualitative analysis, and hospitals had faced difficulties in providing trauma care due to a lack of leadership, coordination, cooperation, referral links, knowledge gaps, poor organiza- tion, and insufficient medications and medical equipment.*

Conclusion *This study found that the trauma care system in the city is ineffective due to systemic gaps in emergency departments, policies, Resources, documentation, referrals, and communication. These gaps contribute to the high death and illness rates of trauma patients. To improve trauma care and reduce death and illness, the system needs to be improved and strategy has to be developed.*

Keywords*: Trauma Care System, Prehospital care, Continuum of Trauma Care and rehabilitation*

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Introduction

Road Traffic Injury (RTI) is the eighth leading cause of mortality worldwide, causing over 1.3 million deaths annually and injuring 20-50 million more. By 2030, it is predicted to become the fifth leading cause of death. RTI is particularly prevalent in poor and middle-income countries (1). The number of individu-als killed in RTIs has increased dramatically in sub-Saharan Africa, with higher rates of 26.6, 20.7, and 26.7 deaths per 100,000 inhabitants in Western and Southern Africa, South-East Asia, Africa, and Ethiopia, respectively (1)

In 2018, Ethiopia's 2018 study revealed a 31.5% preva - lence of RTI among trauma patients, with a higher rate

in the southern, nation, nationalities people's regions (58.3%), and Addis Ababa (33%). The time-trend analysis has shown an increasing burden of RTI in Ethiopian hospitals (2).

A ten-year study in Ethiopia's Emergency Department found that 53.4% of trauma cases were in Addis Ababa, followed by Gondar and Jimma. Major risk factors included severe traffic Injuries, occupational injuries, and surgical patients (3).

The UN 's 2020 Sustainable Development Goal 3.6 targets halving traffic-related fatalities and injuries. Despite stabilization, the goal has not been achieved. The WHO and Global Surgical Societies recommend developing a strong trauma care system to reduce traffic-related deaths by half by 2030(4,5).

A trauma care system is a coordinated effort to provide the best possible care to injured patients, from the time of injury to rehabilitation. The Trauma System Agenda for the Future outlines four fundamental components of a trauma care system: injury prevention, prehospital care, acute care facilities, and post-hospital care, emphasizing eight core infrastructure components (5).

Trauma continuum care is a holistic approach to caring for trauma victims from the moment of injury through recovery and rehabilitation (6). It involves a coordinated network of services that provide personalized care based on the individual's needs and the severity of their injuries.

Standardized trauma training, prehospital care, and trauma centers have improved RTI mortality in developed countries, but sub-Saharan Africa, particularly Ethiopia, faces increased mortality due to inadequate trauma systems (7).

Addis Ababa has the highest rate of RTI deaths and injuries in Ethiopia. Despite having several hospitals providing emergency care, the quality of care varies widely, and many patients die after admission. A study found that 604 out of 30,086 patients who visit- ed the emergency department died within 72 hours of presentation (8).

Many studies have found that factors such as transportation mode and referral channel contribute to poor hospital care outcomes for admitted RTI pa- tients. Post-trauma mortality was substantially associ- ated with poor physical and infrastructure, insuffi - cient resources, on -time monitoring of admitted pa- tients, provision of suitable medical and surgical careprovider skill levels, and access to interventions. (9– 19).

This study aims to provide insights into the challenges of providing effective trauma and emergency care in Addis Ababa, Ethiopia, to healthcare providers, administrators, and policymakers.

Materials and Methods

The study employed a mixed -methods approach. Quantitative data were collected from nine hospitals and patients' medical records (N = 333) and analyzed using the chi-square test, revealing a significant association ($p < 0.05$) between the type and mechanism of trauma. Qualitative data were gathered through in-depth interviews and focus group discussions to enrich the quantitative findings.

Study setting

According to the 2007 national census, Addis Abeba has 5,006,000 residents. It has 99 health centers, 14 state hospitals, and 42 private hospitals. Nine public hospitals were chosen for the study, including TASH, SPHMMC, Alert Hospital, Yekatit 12 Hospital, Mene- lik II Hospital, Zewditu Hospital, Ras Desta Hospital, and Tirunesh Beijing Hospital.

Study Participants

Three different approaches were used to sample and recruit participants for this study. 333 medical records from a one-year period were randomly selected from nine hospitals for document analysis. single proportion with corrective formula was used to determine the sample size. and purposive sampling was used to select 23 participants for in-depth interviews and 17 participants in 5 groups for focus group discussions. The final sample size for the in-depth interview was determined by the saturation of information during data collection.

Data collection

The study collected data from March 1 to October 30, 2022, using interviews, open discussion forums, and a structured questionnaire to assess hospitals' continuum trauma care practices and the experiences of trauma team members. The study analyzed medical records of 333 adult emergency trauma patients. The other data collection method was in-depth interviews and FGD to capture the lived experiences of trauma team members.

Data Analysis

The study analyzed quantitative data sequentially, followed by qualitative data analysis. The principal investigator revised data, computed descriptive statistics, and performed bivariate and multivariate analysis to identify relationships between trauma severity and emergency trauma care factors, with P-values less than 0.05. SPSS version 28 software used to make analysis.

The audio recordings of the interview and focus group in Amharic were translated into English and checked bya professional qualitative research researcher for accu-racy. The descriptive phenomenology and the Colaizzi method were utilized in the analysis, supported by AT-LAS ti.23 software. During the qualitative phase, tran-scripts of in-depth interviews were prepared to uncover

recurring themes and build a coding scheme. The data was coded into 180 different codes, which were then sorted into 17 subthemes. From these categories, five overarching themes emerged. The study followed the concepts of credibility, transferability, dependability, and authenticity.

Inclusion and Exclusion Criteria

This study examined two inclusion criteria; Medical records of RTI patients aged 18-60 who were admitted to the study hospitals and underwent trauma care were included in the study. Trauma team members and clinical personnel who had worked in the nine research institutions for more than six months were also included.

Results

Quantitative findings

Continuum of Trauma care

The study assessed the continuity of trauma care for 333 patients in emergency departments and hospital wards, revealing that patients receiving the best pos - sible care had improved outcomes and quality of life.

Demographic characteristics of the reviewed patient records.

Figure 3 presents the age distribution of patients admitted to emergency departments following road

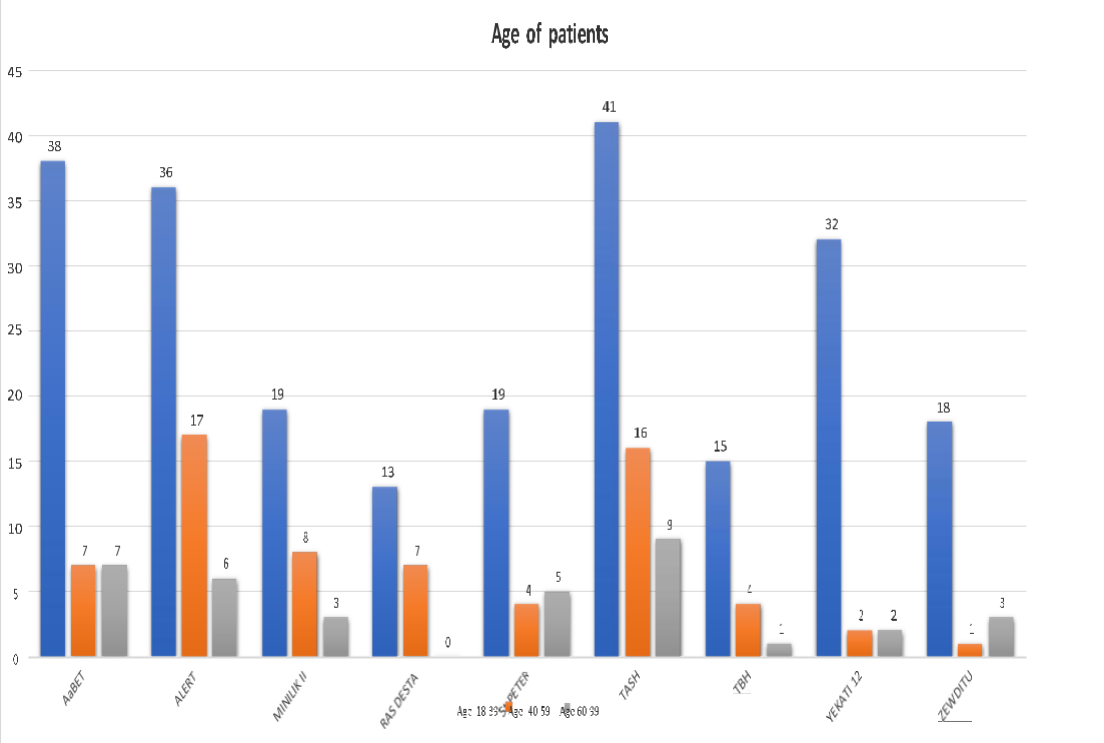

Figure 3: Age distribution based on reviewed patient records.

Demographic Characteristics of In-Depth Interview Participants

The study involved a diverse group of participants, with 23 members of the health workforce purposeful- ly chosen from nine hospitals. From this 19 (82.6%) were men and 4 (17.4%) were women, with 65.2% of participants aged 30-39 were conducted, and 26.1% aged over 39 years. Their levels of education, were 10 (43.5%), 8 (34.5%), 3 (13%) , 2 (8.7%) first degree, specialty degrees, subspecialty degrees, and master-degree respectively. Furthermore, the participants included clinical nurses and chief residents in orthopedic surgery, as well as emergency and critical medicine specialists, emergency and critical nurses, public health officers, general surgeons, general orthopedic surgeons, general practitioners Leaders and coordinators.

Demographic Characteristics of Focused Group Discussions participants

The participants in the FGD were mostly aged 30-39 (70.6%), male (70.6%), and had a first-degree education (52.9%). They had a range of work experience as health care providers (6-10 years), with most being Emergency and Critical Nurse professionals or clinical nurses (29.4% each, and (58.8%) were Unit heads.

Patient referral status and Mode of transportation
Most patients (67.6%, N=225) admitted after RTIwere from Addis Ababa, followed by the Oromia Region (23.4%, N=78) and Amhara Region (4.8%, N=16). Transportation modes included ambulances (20.7%), taxis (55.3%), and private cars (15.3%).

The cause of trauma
This study found that RTIs were the most common cause of trauma for admitted patients, accounting for 87.1% of cases. Falling accidents accounted for 6.6% ofcases, and gunshot injuries accounted for 3.3% of cases.

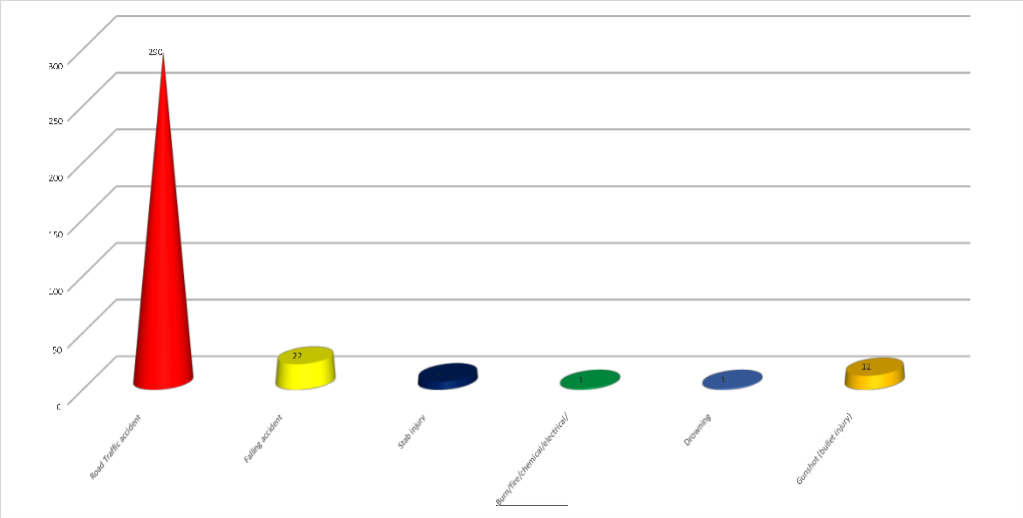

Figure 4 : The cause of trauma among admitted patients

The pattern of Trauma death happened on arrival or after admission.
The tri-modal distribution of trauma deaths that occurred on arrival or after admission is presented on (Figure 5)

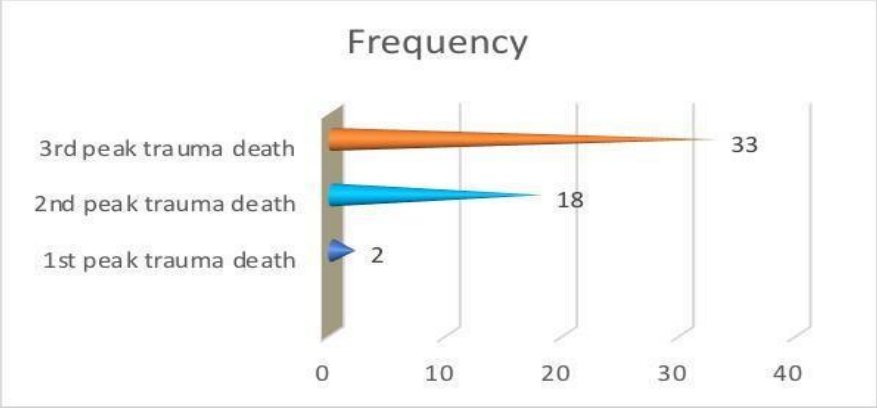

Figure 5: The trimodal distributions of trauma death.

traffic accidents. Of the 333 patient medical records analyzed, 74.2% were male (N=247) and 25.8% were female (N=86).

Type of Trauma, Patient Condition at Admission, and Admission Pattern of Trauma Patients During Golden Hour

The study examined trauma types, patient conditions, admission patterns (Table-1).and time intervals during the

Table-1 Association of the type and mechanism of trauma patient condition categorization.

	Patient condition at admission					
Type of trauma	**Immediate Category (red Zone)**	**Urgent Category (yellow)**	**Delayed (green)**	**Expectant category (black)**	**Total**	**P- value**
Airway Injury	1	2	1	0	4	**< 0.001**
Head & Neck (TBI)	82	42	7	0	131	
Spine injury	3	3	0	0	6	
Thoracic/Chest injury	1	7	4	0	12	
Abdominal injury	1	3	1	0	5	
Orthopedic injury	29	62	30	0	121	
Other	20	15	18	1	54	
Total	137	134	61	1	333	

Table 2- The admission pattern of trauma patients during Golden Hour

	< 30 minutes		**Not documented**	
Time duration	(N)	Percent	(N)	Percent
Total duration of time between occurrence of trauma and getting prehospital trauma care	119	35.7%	214	64.3%
Total duration of time between occurrence of Trauma to admit in nearby hospital	127	38.1%	206	61.9%
Total duration of time between admission and getting trauma care at hospital	138	41.4%	195	58.6%
Total duration of time stays in the emergency department.	79	23.7%	254	76.3%

Delivery of prehospital emergency patient care

A study of 333 medical records revealed that only 8.4% of trauma patients received airway intervention during prehospital care, as shown in Table 3.

Table 3 - Delivery of prehospital emergency patient care

Prehospital emergency care given to the patient	**Yes**		**Not Documented**	
	f(N)	(%)	f(N)	(%)
Is air way intervention done to the patient?	28	8.4%	305	91.6%
Did chest drain placed to treat the tension. pneumothorax/haemothorax/?	31	9.3%	302	90.7%
Is pulse oximeter placed on functioning?	223	67.0%	110	33%
Is Large bore IV placed and fluid started?	232	69.7%	101	30.3%
Did full survey done for (and control of) external bleeding, including Scalp, perineum and back.	262	78.7%	71	21.3%
Assessed for Pelvic Fracture by physical Exam, X-ray, and CT	273	82.0%	60	18.05%

Assessed for Internal bleeding by: Exam, Ultrasound, CT, and Diagnostic peritoneal Lavage.	258	77.5%	75	22.5%
was spinal immobilization needed?	81	24.3%	252	75.7%
Did Neurovascular status of all Limbs check?	277	83.2%	56	16.8%
was the patient Hypothermic?	28	8.4%	305	91.6%
Did the patient need (If not contraindication): Urinary Catheter, Chest Drain, Nasogastric tube and not indicated.	153	45.95%	180	54.05%
Has the patient been given Tetanus vaccine, Antibiotics and Analgesics?	262	78.7%	71	21.3%
Have all testes and imaging been reviewed?	263	79.0%	70	21.0%
Do Plan of care discussed with patient/family, Primary team, Receiving unit and other specialist.	7	2.1%	326	97.9%
Did Relevant trauma chart or form complete?	92	27.6%	241	72.4%

Review of Clinical care at admission and follow-up care

The clinical trauma care provided to patients during the admission period was evaluated as part of the continuum of trauma care. 52.0% of patients had all vital signs taken at admission. Primary and secondary trauma surveys were not documented in 54.4% and 55.0% of medical records, respectively. Management plans were not included in 29.7% of documented medical records.

Follow up trauma care.

Trauma care in the emergency department necessitates multisystem support and constant monitoring of the patient's condition. The analysis of the medical records shows on (table 4).

Table 4 : Follow up trauma care in emergency department and documentation.

Trauma care and documentation	**No**		**Yes**		**Not A vailable**	
	f (N)	**(%)**	**f (N)**	**(%)**	**f (N)**	**(%)**
Using of the minimum standard monitoring timely	47	14.1%	208	62.5%	78	23.4%
Pain control was done and documented	28	8.4%	276	82.9%	29	8.7%
Fluid management was done & documented	15	4.5%	198	59.5%	120	36.0%
the patient needed immediate surgery	70	21.0%	126	37.8%	137	41.1%
Any intraoperative surgical related incident	178	53.5%	1	0.3%	154	46.2%
Any intraoperative Anaesthesia related incident.	188	56.5%	2	0.6%	143	42.9%
Any complication detected at any stage of trauma care	30	9.0%	52	15.6%	251	75.4%
the patient managed in line with Advanced trauma care management for trauma related complications	25	7.5%	34	10.2%	274	82.3%

The decision, start and outcome of immediate surgery.

Nearly one-third of the 333 patients involved in RTI 126 patients required emergency surgery. Only 38.10% (N = 48) of injured patients received a prompt decision regarding the need for emergency surgery. (Table 5) and (figure 6) shows the detail. 50 patients were saved with complications after surgery. 17 patients were saved without any complications, while 10 patients died on the operation room table.

Table 5: The decision and start of immediate surgery.

	The recommendation for immediate surgery		**The immediate surgery starts.**	
	f (n)	(%)	f (n)	(%)
Less than 30 minutes.	1	0.80%	1	0.80%
From 30 minutes to 1 hr.	1	0.80%	1	0.80%
From 1hr to 2 hrs.	6	4.76%	7	5.60%
Greater than 2hr.	48	38.10%	47	37.30%
Not documented	70	56.56%	70	56.56%

The outcome of trauma care for the injured patient

The outcome of trauma care for injured patients in the study hospitals is Indicated on Table 6 below. **Table 6:** The outcome of trauma care for the injured patient

The outcome of trauma care for the injured patient	**F(N)**	**(%)**
No major complication.	19	5.7%
Developed severe trauma related complication and managed at the same facility.	106	31.8%
Developed severe trauma related complication and referred to other facility.	7	2.1%
Died /death during the time of trauma care.	53	15.9%
Unknown/not documented.	148	44.4%

Cause of death during the time of trauma care

The reasons of death during trauma care were,66% (N = 35) of all deaths occurred due to multiple organ failure, 22.7% (N=12) and 11.3% (N=6) of patients died due to delayed referral and trauma care, respectively, and direct vital organ harm from the RTI.

Rehabilitation service to the injured patient

The rehabilitation service provided to patients had also been evaluated, and the results shown on (table 7).

Table 7- Rehabilitation service

Rehabilitation service	**No**		**Yes**		**not Available/not documented**	
	F(N)	(%)	F(N)	(%)	F(N)	(%)
Did Physiotherapy for recovery of extremity injuries done?	261	78.4%	1	0.3%	71	21.3%
Did the patient received psychological counselling?	259	77.85%	2	0.6%	72	21.6%
Did the patient receive Specialized rehabilitative nursing?	262	78.7%	1	0.3%	70	21.0%
Was there Discharge planning?	258	77.5%	9	2.7%	66	19.8%

Qualitative findings

The continuum of trauma care in the study hospitals was also studied qualitatively to identify the lived experiences of trauma team members. Five themes were emerged from the qualitative analysis and Trauma care challenges in study hospitals were Lack of leadership, coordination, and teamwork, Insufficient communication and referral links, poor prehospital and continuum of Trauma care, Insufficient drug, and medical equipment and poor documentation.

Leadership, coordination, and teamwork

The outcomes of the study show a lack of effective leadership, coordination, and synergy within emergency trauma facilities. The following are the evidence stated by the study Participates.

> *"As an empathetic healthcare practitioner, you want to do more for trauma patients than merely treat their wounds. You're attempting to save their lives. In this context, finding the time and space to interact with them is difficult. You regularly feeloverwhelmed and confused, and you wonder who is in charge. You have the impression that you are fighting a losing war due to poor leadership or a lack of coordination."*

Another highly respected superspecialist physician stated that:

"There is no practical leadership and coordination in the emergency department. Residents ask the seniors for assistance; however, the situation is not ideal for providing care for the patient who is in need ".

The researcher noted that a lack of excellent leadership, coordination, and team spirit threatened the provision of emergency trauma care.

Access to Trauma Care

In-depth interviews demonstrate that the overloading of Addis Abeba City hospitals by road traffic accident patients is related to a lack of trauma care in their local districts or communities. This topic was repeatedly mentioned by the participants as.

> *"Car accident victims from different regional states should receive better care in their commu- nities, as hospitals in Addis Ababa are congested and under-resourced."*

The Participants also put their recommendations regarding access to trauma care.

"The government should prioritize improving hospitals in regions rather than overspending on Addis Ababa's overcrowded and resource-dense hospitals, as well as addressing the imbalance in doctor distribution, with half of Ethiopia's doctors working in Addis Ababa, to ensure better access to trauma care."

The research reveals that establishing trauma care centers across the country was a challenging task due to the high costs involved.

"... One such challenge is the issue of affordability - Trauma care comes at a high cost. Thismakes emergency medical services inaccessible to a large segment of society…"

Prehospital trauma care

In-depth interviews with trauma team members demonstrate that prehospital care for road traffic accident patients is deficient at the national level, with many causes identified. One of the in -depth interview participants expresses his emotions as follows:

"*The lack of adequate prehospital care nationwide is a significant concern for medical practitioner working in this big Hospital. The lack of well-structured and organized treatment has led to the loss of patients involved in road traffic accidents."*

The other participant also describes his feelings as:

"*There is no coordination or continuity from prehospital care to rehabilitation service. Many lives could have been saved if there was a strong prehospital service. Many complications and disabilities could have been prevented if there was a good trauma care system."*

Ambulance service

In an interview, participants repeatedly criticized the prehospital ambulance service for providing insufficient care due to a lack of emergency medical supplies, life-saving medications, and poor equipment.

"There is no oxygen, pulse oximeter, or monitor in the ambulances or cars that transport patients to the hospital. Furthermore, the majority of patients arrive without the assistance of medical professionals because patients or families are unable to pay for their services. If a nurse is added to the ambulance, the patient or their family would be required to pay the nurse's al- lowance, which they are often unable to do. Be- cause the sending institution cannot afford to pay the nurse's allowance, the nurse is left be- hind, and only the driver arrives."

Communication and Referral Linkage

The participants emphasized the inadequacies in the trauma care system, highlighting the need for improved communication and referral linkage for effective emergency trauma care.one of the participants in the interview said:

"……We have poor team spirit and communication…."

Health professionals discussed communication failure during refer-out and refer-in, highlighting that a communication gap leads to congestion in trauma centers, patient complications, and even death.

"Communication with other hospitals is difficult, especially when referring patients due to a lack of space and resources. The hospital's lack of Orthopedic surgery and a C-RM machine causes referral delays, which can lead to complications like DVT, wound healing, deformity, and even death."

The interviewee also stated on referral linkage among health facilities:

"The referral linkage coordination is too passive; patients frequently linger here for more than 10 days without receiving definitive trauma therapy. The city's liaison mechanism is becoming inefficient. When a referral request was submitted, all receiving hospitals responded that they were full of trauma patients."

GG27ttss Before patients are taken to the emergency room, the analysis's results show that there is a communication gap and disjointed referral connection.

Continuum of care (from acute care to rehabilitation)

The trauma care continuum assures high-quality care for injured patients from injury to recovery, however it is not effectively supported in study hospitals.

"The care for RTI patients is generally good once they are treated for an emergency life-threatening condition and linked to a specific department or specialty."

This quote was also supported by the participant from the orthopedic department.

"Regarding to continuum of trauma care particularly for Orthopedics trauma patients it is good. Once the RTI patients are transferred to orthopedics ward, the follow up care and definitive care is good "

The interview and FGD revealed that the city's ICU service, a crucial component of trauma care, is restricted and not easily accessible.

> *"The city faces a shortage of ICU care services, with public hospitals occupied and private hospitals expensive. Patients may struggle to afford ICU beds, and rehabilitation services are not available in the hospitals they work in. Physiotherapy is outdated and professional."*

Drug and medical equipment availability

The study found that the trauma department's shortage of pharmaceuticals and medical equipment is disappointing, with staff members expressing irritation about the lack of resources One of the emergency department's final-year chief resident students said:

> *"The department lacks government and hospital support, resulting in insufficient resources, medications, and supplies for patient care. This has resulted in trauma team members staying awayfrom patients, which has led to complications and even death. The shortage of emergency medica- tions and equipment is widespread."*

The other participant stressed out that:

> *"Uh The other challenge is extreme shortage of emergency medical supplies, it is difficult to get cervical collars, even gloves are not available. So, in an emergency situation how can a health professional give support without Gloves. There are no emergency drugs used for treatment of life threating condition."*

Participants emphasized the chronic shortage of medical drugs and equipment in their institution. They regularly see road traffic accident victims suffer due to this lack of resources. A young emergency and critical care nurse said:

> *"There are resource limitations. One of the cru- cial pieces of equipment we were unable to find forour RTI patient was a collar. A cervical collar isan essential piece of equipment for RTI patients who have suffered a cervical spine injury. It is, however, unavailable.*

A study found that an extreme shortage of emergency drugs and medical equipment makes it impossible to care for RTI patients.

Documentation in trauma care

Trauma team members frequently neglected to accurately record patient information and information produced during medication administration or procedural planning.

> *"The patient's documentation is unclear and not recorded in accordance with the WHO trauma registry, indicating poor quality."*

Another interviewee frequently mentioned the limitations on the documentation raised by the previous participant.

> *"The patient's incomplete medical record hinders access to treatment and management plans, potentially leading to repeated treatments or diagnostic tests by subsequent doctors."*

Some FGD participants noted responsible health professionals accurately documenting patient information despite the complexity of the WHO register form. A female participant mentioned this as :

> ***"****The registration form is quite comprehensive. It may be relevant to medicolegal issues; thus doctors fill it out. They are carefully filled. Throughout the trauma care procedure, it is simultaneously filled."*

In contrary to this a female FGD participant highlighted the issue of incomplete referral forms, which can hinder the provision of continuous trauma care.

> *"The referral paper for certain RTI patients is often incomplete, with preceding actions not documented. For instance, an old man with rib fractures was arrested after an accident, but CPR was not noted on the referral page. "*

According to the research, trauma team members were not recording all relevant patient medical information or following the WHO trauma register format, which could have hampered the delivery of treatment.

Discussion

The study highlighted the strengths and weaknesses of the current trauma care system in Addis Abeba, Ethiopia, and provided a comprehensive overview of trau- ma and emergency care service delivery. It identified five key themes: 1) Basics of the trauma care system, 2) Prehospital trauma care service, 3) Trauma care continuum, 4) Competency of trauma team members, and 5) Trauma team member perceptions.

To begin with, the pattern of trauma patient flow into the ED was presented as follows: the study found that 67.6% of trauma patients were from Addis Abeba, followed by Oromia and Amhara Regions. This suggests that trauma care services were concentrated in metropolitan areas. Most patients used taxis or minibuses (55.3%) to travel to medical facilities. A similar study identified that in 46.2% of cases, care was not given at the scene, but the main reasons for this were lack of knowledge and equipment (20). Many Similar studies also highlighted challenges in emergency trauma care due to information systems and poor communication in Addis Ababa (21–23). The study suggests the need for decentralized trauma care services, support for metropolitan trauma centers, and improved communication and information systems.

The study discovered that Addis Ababa's trauma care referral linkage system is insufficient, with patients coming without warning. This makes it harder to refer

people to emergency services and find ward beds.

Because the system is still dormant, patients will not receive definitive trauma therapy for several days. Similar problems existed in Cambodia and Sub-Saharan Africa. (11)(24)

This study found that RTIs are the most common cause of trauma among admitted patients, accounting for 87.1% of cases, followed by falling accidents and gunshot wounds. These findings are consistent with earlier research emphasizing RTIs as a major factor to trauma cases (25). Understanding the various causes of trauma can help guide preventive efforts and fo-cused interventions to reduce the frequency of such episodes.

Furthermore, the study looked at the trimodal distribution of trauma deaths that happened before or after admission. The third peak trauma death accounted for 62.3% (N=33) of cases, followed by the second peak trauma death at 33.9% (N=18) and the first peak trauma death at 3.7% (N=2). This distribution pattern provides insights on the provision of continuum of trauma care that was ineffective and the severity of trauma-related fatalities, which can drive resource allocation and the development of trauma care procedures (26).

The study also examined the type of trauma, patient condition at admission, and admission pattern of trauma patients and admissions in the Golden Hour. Head and neck injuries were the most common type of trauma, accounting for 39.3% (N=131) of admitted patients. Among these patients, 62.6% were admitted as red category (immediate) and 32.06% as (Yellow category) urgent cases. Orthopedic injuries were the second most common type, accounting for 36.3% (N=121) of admitted patients. The varying admission patterns for different types of traumas highlighted the need for tailored approaches to patient management during the critical Golden Hour (26).

The researchers also found an association between the type and mechanism of trauma and the patient's condition (injury severity). Airway, head, neck, thoracic/chest, abdominal, and orthopedic injuries were the most serious with (P-0.001). This finding is consistent with a Korean study that revealed a significant relationship between injury sites and trauma mechanisms in severely damaged patients with trauma, with the head, neck, and chest being the most related (27).

According to the findings of this study, only 8.4% of trauma patients received airway help during prehospital care, while 91.6% were not documented. While the vast majority of injured patients underwent cru- cial procedures such as wide bore IV placement and hydration delivery, screening for external bleeding,and pelvic fracture diagnosis. The lack of recorded data and complete trauma charts raises concerns about care quality and continuity. Similar studies found that some sort of prehospital care was delivered at the scene in 46.2% of cases, but the most common reasons for not giving care were a lack of knowledge andequipment (20).

Prehospital care capabilities vary significantly inLMICs but are generally less developed in LICs and rural areas (28). Addis Ababa's prehospital care was inadequate due to lack of coordination and guidelines. Ambulances lacked essential supplies and trained per- sonnel, forcing patients to rely on private cars or taxis to get to the hospital. Poor communication between departments and hospitals further complicated care,leading to delays in referrals and worsening injuries.in congruent to this study Nigeria lacks a national pre- hospital trauma care system, while other African countries have improved prehospital services (29,30).

The study found that emergency departments and trauma centers in Africa lack specialized policies, protocols, and practice guidelines, similar to Nigeria (29). Poor coordination in the trauma care system leads to unsatisfactory treatment services (30). Barriers include lack of funding, leadership, and regulation. The researcher recommends expanding prehospital care and improving organization and leadership to improve trauma care in Addis Ababa.

Trauma care coordination necessitates strong leadership, community engagement, and regional collaboration (31). Many hospitals lack a dedicated individual to handle emergency preparedness, response, and recovery, resulting in resource shortages, duplication of services, and low staff morale. Clear policies, protocols, and standards of practice guidelines are required to improve trauma care.

The continuum of trauma care is crucial for injured patients(32) The study highlights the inefficiency of hospitals in providing continuous trauma care, leading to delays and gaps in patient care. This can result in longer hospital stays, higher healthcare costs, and psychological impacts. In Ghana, delays in trauma care result in emergency surgeries being postponed by an average of 12 hours (29), increasing mortality and morbidity rates, longer hospital stays, higher healthcare costs, and psychological effects for pa- tients. Addressing these issues is crucial for improvingpatient outcomes and overall healthcare delivery.

Trauma care quality in the study was low, with only 62.5% of patients monitored to minimum standards and 59.5% receiving good fluid management. Only 10.2% of patients received advanced trauma care management. Similar findings have been reported in Ghana and Tanzania(17,33). These findings highlight the need for more research to assess trauma care quality across Africa and to develop interventions to improve

it. Possible interventions include promoting evidence based trauma care, improving resource access, and developing quality improvement programs.

Only 38.10% of patients obtained timely emergency surgery, and 37.30% underwent surgery within two hours of injury. Only 13.50% of patients survived without issues, while 39.70% survived with complications. These findings are similar to those of other studies conducted in (17,34,35), and they suggest that there was room for improvement in emergency surgery timeliness and quality. This could be accomplished by ATLS training, improving resource access, and addressing underlying causes of road traffic injuries.

The trauma care outcomes for injured patients were assessed and found that 15.9% died during care, 31.8% developed severe complications, and 44.4% lacked clear documentation. This is consistent with other Ethiopian studies, indicating a need for im-proved trauma care outcomes (36)). Interventions included training and implementing quality improve- ment programs. Addressing underlying trauma causessuch as road traffic accidents, violence, and occupa- tional accidents was also crucial.

The causes of trauma-related mortality were also investigated. Multiple organ failure accounted for 66% of deaths, while delayed referral and trauma care accounted for 22.7%, and direct critical organ injury accounted for 11.3%. There was no recorded proof in 88.6% of patients' medical records. A study conducted in Addis Ababa's Tikur Anbessa Hospital found similar results, with multiple organ failure (36.7%), respiratory conditions (30%), and sepsis (16.8%) being the three main causes of death for RTI patients. The researchers of this study suggest a need to im- prove trauma care by training healthcare workers, increasing resources, and reducing referral times.

The study found that 78.4% of trauma patients did not receive physiotherapy, 77.85% did not receive psychiatric counseling, 78.7% did not receive specialist rehabilitative nursing care, and 77.5% did not receive effective discharge planning. Almost 20% of patients' medical records contained no information on their rehabilitation service status. This is similar to other African studies (17,37). Lack of qualified healthcare staff, resources, inadequate coordination, and excessive expenses are all factors contributing to this shortage. The researchers of the study recommend additional research to examine the state of rehabilitation services throughout Ethiopia.

The study found that there is gap in the documentation of clinical care for trauma patients. Primary and secondary trauma surveys were not documented in 54.4% and 55.0% of cases, respectively. Factors contributing to inadequate documentation include lack of time, lack of training, poor coordination, and complex medical records systems. Interventions include developing standardized protocols, training healthcare providers, improving coordination, and simplifying medical records systems.

The study examined the prehospital care continuum of trauma care in Ethiopia, highlighting areas for improvement in leadership, coordination, resource availability, communication, referral links, and documentation. It highlighted the high number of trauma patients in Addis Ababa, and the challenges in emergency trauma care due to poor communication and information systems. The study recommended expanding prehospital care, improving organization and leadership, and promoting regional collaboration to enhance trauma care in Addis Ababa.

Limitation

The study has the following limitations, such as its limited applicability, reliance on self-reported data, and focus on public hospitals in Addis Ababa. It also did not consider patient satisfaction, treatment quality, or cultural factors' impact on care delivery, and did not assess implementation costs.

Recommendations

The researchers recommend the following to improve trauma care in Addis Ababa and Ethiopia: Establish responsive prehospital services, establish guidelines for trauma care, provide medical supplies for trauma care, Train healthcare workers in trauma care, Im- prove hospital care for trauma patients, Address the underlying causes of trauma. The researchers also call for further research to assess trauma care quality across Ethiopia.

Abbreviations

ATLS: Advanced trauma life support; **ATLAS.ti:** Archive of Technology, Life world and Language; **CPR**: Cardio Pulmonary Resuscitation; **CT** scan :Computerized Tomography; **DVT**: Deep vein thrombosis ; **ED**: Emergency Department; **FGD**: Focused Group Discussion; **ICU** :Intensive Care unit; **LIC:** Low Income Countries ; **LMIC**: Low- and Middle-Income Countries ; **IV**: Intravenous ; **RTI**: Road traffic Injury ; **SPSS**: Statistical Package for the Social Sciences **;TBI:** Traumatic Brain Injury**; TASH**: Tikur Anbessa specialized Hospital ;**TTM**: Trauma team member; **WHO** : World Health Organization; **UN**: United Nations ; **SPHMMC:** *St. Paul's Hospital Millennium Medical College.*

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Ethics consideration

Ethical approval was obtained from the Addis Ababa University HSC ethical review committee, the Addis Ababa Regional Health Bureau, and the study hospitals. Before taking part in the study, all individuals provided written informed consent, and waiver consent was obtained for secondary data.

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AAU provided financial assistance for data collection. The founder was not involved in the study.

Data availability

The datasets used and analyzed during the current investigation are available upon reasonable request from the principal investigator.

Operational Definitions

Trauma: Refers to physical injuries that occur unexpectedly and need quick medical intervention.
Prehospital care: Pre-hospital care, also known as emergency medical services or ambulance care, involves providing medical care to patients before they reach a hospital.

Continuum of Trauma Care: is the highest quality of care to injured patients from the moment of injury through rehabilitation and recovery

Trauma care: Trauma care refers to the accessibility of a well-organized and coordinated effort in a defined hospital to provide the full spectrum of care to an in- jured patient, from the time of injury to transport to an acute care facility and rehabilitative care.

Trauma Team: describe a group of healthcare professionals including emergency medicine, orthopedic surgeons, neurosurgeons, anesthetists, intensive care, surgeons, nurses, allied health, and support staff.

Rehabilitation: is a set of interventions aiming to optimize functioning and reduce disability inindividualswith health conditions.

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Original Article

Functional Outcome Following Non-surgical Management of Pelvic Ring Injury

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Abstract

Introduction: *Pelvic fractures are among the most severe and life-threatening orthopedic injuries, accounting for approximately 1.5% to 3% of all skeletal injuries. These fractures can occur in up to 20% of severely injured patients and have a mortality rate of up to 10%. The burden of trauma is substantial in countries with limited resources, including Ethiopia. However, there is limited data concerning the outcomes of non-operative management of pelvic ring fractures and associated injuries in Ethiopia.*

Objectives: *The objective of this study is to assess the functional outcomes following non-surgical management of pelvic ring injuries at Tikur Ambsessa Specialized Hospital, Orthopedic and Trauma Care Center from April 2019 to August 2022.*

Methods: *This study is an institution-based Retrospective Record Review of patients treated for pelvic ring injuries at TASH from April 2019 to August 2022. A total of 50 patients were treated non-surgically for pelvic ring injuries during this period. Data were extracted from patient medical records using a structured data collection form. The Majeed pelvic scoring system was used to evaluate functional outcomes by phone or email. Data entry and analysis were performed using SPSS version 26 software.*

Results: *The overall Majeed score for pelvic ring injuries in this study was 82.92 ± 11.04 SD (95% CI, (80.13, 85.12)). At the end of the assessment, the majority of patients (26, 52%) had excellent functional outcomes, fol- lowed by 19 (38%) with good functional outcomes, 4 (8%) with fair functional outcomes, and 2 (4%) with poor functional outcomes.*

Conclusion: *According to this study, the mean Majeed score for pelvic ring injuries was found to be considerable. Notably, approximately half of the patients achieved excellent functional outcomes.*

Keywords*: Functional outcome, Non-surgical, Pelvic Ring, Injury, Ethiopia*
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Introduction

Pelvic fractures are among the most severe and life-threatening orthopedic injuries, comprising approximately 1.5% to 3% of all skeletal injuries [1]. These fractures can occur in up to 20% of severely injured patients and have a mortality rate of up to 10% [2-4]. Studies have shown that pelvic injuries account for 2% of all orthopedic admissions and 3% of all skeletal injuries[5]. Although pelvic fractures represent only a small percentage of injuries, they are associated with significant morbidity and mortality [6].

Pelvic ring injuries are increasingly common in motor vehicle trauma. The minority of pelvic ring injuries re- occur as a result of associated injuries and complica- quire operative fixation. Other causes include falls from tions rather than the pelvic injury itself [8]. The man-height and the fall of heavy objects [7,12]. Patients with pelvic injuries often have associated multiple systemic injuries, contributing to the overall morbidity and mortality [7]. The pelvis is a ring formed by the fused bones of the ischium, ilium, and pubis, which attaches to the sacrum, housing vital structures such as major blood vessels and nerves, as well as digestive and reproductive organs.

Major pelvic fractures can be fatal, primarily due to blood loss. These fractures are often associated with a number of complications that may require extensive rehabilitation. Deaths from pelvic trauma frequently

agement of pelvic fractures requires a specialized facility and a multidisciplinary team-based approach [9].

In Ethiopia, the incidence of injuries in general is on a rise due to sub optimal roads and traffics, currently few tertiary hospitals are treating pelvic injuries across the country almost all of them are in the capitalcity. The trained specialists managing this complex injury are also few and most of working in Addis Ababa. There are limited data concerning the func- tional outcome of conservatively managed pelvic ringinjury in Ethiopia. Therefore, this study aimed to assess functional outcome following non-surgical management of Pelvic Ring Injury at Tukur Anbessa Specialized Hospital Orthopedic and trauma center.

Methods and Materials

Study setting

The study was conducted in Tikur anbessa specialized hospital, Department of Orthopedic Surgery. It was founded and established on September 25, 1987 as the premier orthopedic center in the country. The department gives a full-fledged Musculoskeletal clinical service, offers specialty and sub-specialty training, and conducts research.

The study participant were identified using the Patient charts. The study was retrospectively consider- document of patients who had pelvic fracture from April 2019 to august 2022.

Study population:

The study population included all patients who were treated non-operatively for pelvic fracture at Tikur Ambessa Orthopedic and Emergency Clinic from April 2019 to August 2022.

Eligibility Criteria

Adult Patients who had closed isolated or associated pelvic fractures treated non-operatively at TASH and had Type A and Type B pelvic treated non -operatively at TASH. Incomplete medical records are excluded.

Sample Size and sampling procedure

We included all eligible Patients who fulfilled the inclusion criteria.

Study Variables

Dependent variable

Functional outcome (Excellent, Good, Fair, Poor)

Independent variables

Age, Sex, Type of fracture, Side of fracture, Mechanism of injury, any associated injury, Type of associated injury, Occupational change and Neurological deficiency.

Operational Definitions

Pelvic Fracture Tiles Classification [10]

Stability:- is the ability of pelvic ring to withstand physiologic forces without abnormal deformation. Stability of the pelvis following trauma is assessed by clinical and radiological parameters. Clinically stability is examined by pelvic compression and distraction test. Radio-logically the criteria for instability are sacroiliac joint displacement of 5 mm in any plane, -posterior fracture gap (rather than impac-tion), and avulsion of fifth lumbar transverse pro- cess, lateral border of sacrum (sacrotuberous liga- ment), or ischial spine (sacrospinous ligament)

Tiles Type A: stable

Tiles B: Partially Stable, vertically stable but rotationally unstable

Tiles C: unstable both rotationally and vertically, due to complete disruption of the anterior arch, posterior arch, and pelvic floor. The patients' functional outcome was assessed by Majeed pelvic scoring which is currently is the most widely used disease-specific instrument.

For measuring outcomes after pelvic fractures, it has been done via phone call based interview**.** The scoring system devised by Majeed is a well-established self-reported questionnaire, which is considered functionally oriented and is a valid pelvic specific outcome scoring system.

Instruments

A checklist was developed by reviewing relevant worksing of literature on the problem under the study to include variables that address the objective of the study. It was designed in the English language; and it had information including socio-demographic profile age, and sex, mechanism of injury, associated injury, radiologic patterns pelvic ring injuries, duration of presentation Vs. at presentation, duration of in-hospital stay, types of management given, complica- tions encountered, condition on discharge and early outcomes, etc. Majeed derived self-reported questionnaires will be used. Five criteria were chosen for func- tional assessment after major pelvic fractures: pain, sitting, sexual intercourse and performance at work. Each of these clinical parameters is scored, the total being a maximum of 100 points for patients who were working before the injury and 80 points for those who were not. The five sections of the assess- ment are scored as shown in (ANNEX) and discussed below:

Pain: Pain is an important sequelea of major pelvic injury and is given a score of 30 points, allocated according to the six grades listed in annex.

Standing: Weight bearing in the erect position is given 36 points, in three main categories (aids, gait and walking ability), each of which has six grades.

Sitting: Sitting is an important function in relation to the pelvis, but less so than gait or walking ability. A total score of 10 points is given in four grades.

Sexual intercourse: For both men and women, four points are allocated for comfort during sexual inter-

course. This does not take account of neurological or psychological impotence and is recorded in four grades. If, for any reason, sexual intercourse has not been attempted, a score of four points is given.

Work: Work performance is allocated 20 points in five grades, ranging from no regular work to return to the same job as before injury with no loss of performance. A patient who was not working at the time of his injury is not scored.

This overall assessment is then out of 80 points. The accumulative grading system is shown in the following Table. This gives a breakdown into excellent, good, fair and poor for both working and non-working pa- tients (**Table 1**).

Table 1: Accumulative grading system according tothe Majeed scale score

Working before injury	Not working before injury	Grade
>85	>70	Excellent
70 to 84	55 to 69	Good
55 to 69	45 to 54	Fair
<55	<45	Poor

Data Collection and procedure:

Data were extracted from morning report sheet, pa-tient's charts in TASH Orthopedics department over study period. Data were extracted by a trained junior orthopedics resident. The principal investigators super- vised and provided all items necessary for data collec- tion. To assure the quality of data, properly designed data collection format was prepared; training was giv-en for data collectors about research objective, the data collection format, how to review chart and fill the data to assure the quality of data. The principal investigator controlled all activities daily for the collected data completeness and clarity. After all the data on the chartsof patient chosen in the study period had been collected the principal investigator then called or emailed each study subject on their address and per- form the questionnaires according to the majeed scor- ing system.

Data Analysis Procedures

The collected data were coded, entered and analyzed using SPSS Version 23 for windows. It was checked for its completeness cleaned, processed and analyzed accordingly. Frequency and cross tabulation were used to summarize descriptive statistics. Means for contin- ues variables and percentage for nominal variables were used. Fisher's exact test was used to assess asso- ciation between dependent and independent variables. Graphs, pie charts and tables were used as appropriate for data presentation and dissemination.

Results

General characteristics of the study participants

In this study, a total of 58 cases of pelvic ring injury were identified, out of which 8 cases were excluded due to incomplete relevant information. Hence, 50 files were considered for analysis. Among these, 34 (68%) were male, and 33 (66%) were in the age range of 20-24 years, with a mean age of 31.5±13.7 years. The overall median follow-up duration was 3.5 months (± 3 IQR). More than four-fifths (82%) of the participants had a road traffic accident, and 29 (58%) of them were man- aged using weight-bearing as tolerated and anti-pain.

Almost one-third (74%) of the participants had closed types of pelvic fracture, and 10 (41.67%) had associated injuries on the lower part of the extremities, followed by the upper part of the extremities (7, 29.17%). Twenty (40%) of the participants remained unchanged in their occupational status, followed by 16 (32%) who experi- enced a reduction. The reduction in occupational status was due to the consequences of trauma complications. Among the total participants, 44 (88%) had no neuro-

logical deficiency (**Table 2, Fig.1 and Fig. 2**).

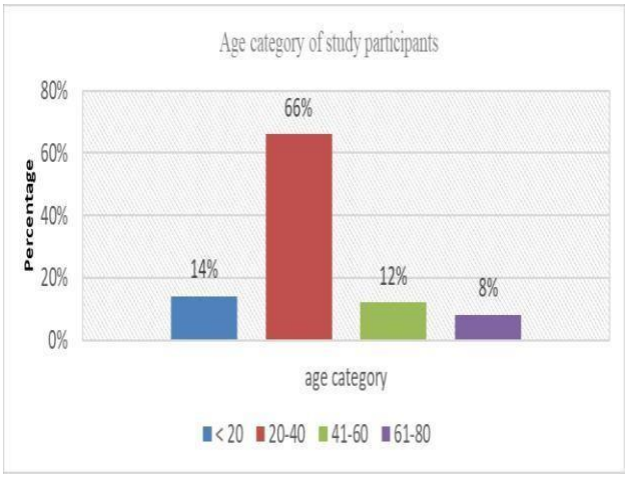

Figure 1: Age distributions of study participants at TASH Department of Orthopedic Trauma Centre, 2019-22, (n =50)

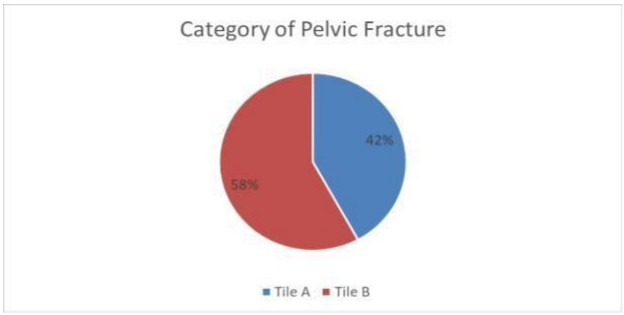

Figure 2: Category of Pelvic Fracture of study partici- pants at TASH Department of Orthopedic Trauma Centre (n =50)

Table 2:-General characteristics of study participants at TASH Department of Orthopedic Trauma Centre, 2019-22, (n =50)

Characteristics	Frequency	Percentage
Sex		
Male	34	68
Female	16	32
Age of Patient(n=50)		
< 20	7	14
20-40	33	66
41-60	6	12
61-80	4	8
Duration of follow up	3.5	±3 IQR
Mechanism Of Injury		
Road traffic accident	41	82
Fall down	6	12
Other	3	6
Category of Pelvic Fracture		
Type A	21	42
Type B	29	58
Management protocol		
Protected weight bearing and anti-pain	21	42
Weight bearing as tolerated and anti-pain	29	58
Side of pelvic fracture		
Right	14	28
Left	18	36
Bilateral	18	36
Type of pelvic fracture		
Closed	37	74
open	13	26
Presence of associated injury		
Yes	24	50
No	24	50
Site of associated injury		
Brain	4	16.67
Upper extremities	7	29.17
Lower extremities	10	41.67
Bladder	3	12.50
Neurologic deficiency		
Yes	6	12
No	44	88
Occupational status		
Unchanged	20	40
Reduced	16	32
Incapable	14	28

Functional outcome based on Majeed scale score

The overall mean score for pelvic ring injury in this study was 82.92 ± 11.04 SD, with a 95% confidence interval of (80.13, 85.12). In terms of pain, the average score was 27, indicating that the majority of patients rarely experienced pain (Table-3). According to the different score categories, 26 patients (52%) achieved excellent functional outcomes, while 19 patients (38%) achieved good functional outcomes (Table-4).

Table 3: Functional outcome according to the Majeed scale score, TASH, 2019-22

Component of the Majeed score	Mean	±SD	95% CI
Pain/30	27	±4.52	25.95, 28.05
Work/20	13.22	±5.57	11.82, 14.62
Sitting/10	9.68	±1.02	9.34, 10.02
Sexual intercourse/4	3.26	±1.21	2.93, 3.59
Walking aids/12	9.2	±3.40	8.30, 10.10
Gait unaided/12	10.16	±3.02	9.15, 11.17
Walking distance/12	10.4	±2.88	9.65, 11.15
Overall majeed score	82.92	±11.04	80.13, 85.12

Table 4. Categories of functional outcome, TASH,2019 -22

Majeed score	Frequency	Percentage
Excellent (>85)	26	52
Good (70-84)	19	38
Fair (55-69)	4	8
Poor (<55)	1	2

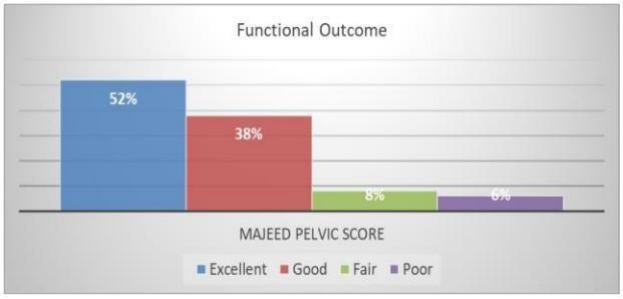

Figure 4: Functional outcome using majeed pelvic score at TASH Department of Orthopedic Trauma Center, 2019-22

Factors associated with functional outcome following non-surgical management of pelvic ring injury
Several factors were found to be associated with the functional outcome. These findings show that there is no statistically significant association between the level of functional outcome and sex, age, mechanism of injury, pelvic fracture category, or other factors. However, there was a statistically significant association between functional outcome and neurologic deficiency (Fisher's exact p = 0.001), (table-5).

Table 5: Factors associated with functional outcome following non-surgical management of pelvic ring injury at TASH Department of Orthopedic Trauma Centre, 2019-22

Characteristics	Frequency	Percentage	Fisher's exact (p-value)
Sex			
Male	34	68	0.606
Female	16	32	
Age of Patient(n=50)			
< 20	7	14	
20-40	33	66	0.551
41-60	6	12	
61-80	4	8	
Mechanism Of Injury			
road traffic accident	41	82	
fall down	6	12	0.103
Other	3	6	
Category of Pelvic Fracture			
Type A	21	42	0.171
Type B	29	58	
Side of pelvic fracture			
Right	14	28	0.695
Left	18	36	
Bilateral	18	36	
Type of pelvic fracture			
Closed	37	74	0.605
open	13	26	
Presence of associated injury			
Yes	24	50	0.320
No	24	50	
Site of associated injury			
Brain	4	16.67	
Upper extremities	7	29.17	
Lower extremities	10	41.67	0.103
Bladder	3	12.50	
Neurologic deficiency			
Yes	6	12	0.000
No	44	88	

Discussion

Assessment of pelvic ring function and related quality of life has been employed. Majeed pelvic score (MPS) is the most frequently used[13, 14]. However, adequate prospective follow-up studies that evaluate functional outcomes after these injuries following non-surgical management are still lacking. Therefore, this study was aimed to assess functional outcome following non-surgical management of Pelvic Ring Injury.

The overall majeed score for pelvic ring injury in this study was 82.92 ± 11.04 SD (95% CI, (80.13, 85.12)). With average follow up duration was 3.5 months with (± 3 IQR). At the end of the assessment, the majority of patients 26(52%) had excellent functional outcomes, followed by 19(38%) with good functional outcomes, 4 (8%) scoring fair functional outcomes, and (2%) with poor functional outcomes. This is in line with study in India on functional outcome of ' LC-1 pelvic ring injury with incomplete sacral fracture' managed non-operatively indicating mean Majeed score was 82.59 ± 6.77[15] and similarly, its supported by the study inIndia on functional outcome of pelvic fractures and the factors affecting it– A short term, prospective observa- tional study at a tertiary care hospital, revealing Majeed scores was good in 29 patients[16].

The findings of the current study was lower than a retrospective study in Germany on functional outcome and quality of life after surgical fixation of insufficiency pelvic ring injuries in which patients scored in average 85.92 points (± 23.39) of a maximum of 100 points using the Majeed score[17], and according to a retrospective study conducted in Indonesia on Management of pelvic ring fractures in limited resources country revealing 93 median Majeed score [18].

Possible explanations include study settings where better outcomes were likely due to available resources and specialists in their various hospitals, which were mostly in developed countries, and other possible explanations include differences in management where patients underwent a variety of interventions. However, findings of this study was higher than a systematic review of the literature conducted in Netherland on Patient-reported physical functioning and quality of life after pelvic ring injury reporting mean scores of 75 [19] .

Findings from the study conducted in India regarding Functional Outcome of Internal Fixation (INFIX) in Anterior Pelvic Ring Fractures reporting Majeed score of 78 [20], study in India on Factors affecting quality of life after pelvic fracture where the average Majeed score was 76.65 ± 14.73[21].

Less comparable study conducted in Lithuania on the Short-Term Functional Outcomes and Quality of Life after B2.1 Type Pelvic Fractures -according to AO/Tile classification- for Surgically and Non-Surgically Treated Young Patients, indicating majeed score was 31.44 ± 14.41 for non-operatively treated patients[22], and a 10-year prospective observational study conducted in Cameron on functional outcome of unstable pelvic fractures treated in a level III hospital in a developing country reported that the overall average majeed score was fair[23]. This disparity could be attributed to the standardization of evaluation methods, study period, study design, and follow-up length, among other factors.

Several factors have been identified as being related to the functional outcome. According to the findings, there is no statistically significant association between the level of functional outcome and sex, age, mecha- nism of injury, pelvic fracture category, or other characteristics. However, a statistically significant relationship was observed between functional outcome and neurologic deficiency (Fisher's exact $p = 0.001$). It is possible that patients who have no history of neurological deficiencies are more likely to achieve a desired functional outcome compared to those who do have such deficiencies.

Conclusion

According to this study, the mean Majeed score for pelvic ring injuries was found to be considerable. No-tably, approximately half of the patients achieved ex-cellent functional outcomes by the end of the assess-ment. In order to prevent poor functional outcomes,the Orthopedic Trauma Centre should focus on en- hancing specialized care and standardizing the contin- uum of care from admission to discharge. It is essen- tial to prioritize early mobilization and rehabilitation, with rehabilitation programs tailored to each patient's unique needs and initiated as soon as possible post- injury. Effective pain management is crucial to enable patients to engage in rehabilitation exercises, and providing patient education and support is vital to help patients understand their condition and the treatment process.

Limitations

The incompleteness of medical records is one limitation of this study. Furthermore, the study had a small sample size and was conducted in a single center. Hence we recommend a multicenter study with a ro- bust sample size.

Acronyms and Abbreviations

TASH - Tukur Anbessa Specialized Hospital, ER-emergency room, FDA-falling down accident, GCS-

Glascow Coma Scale, OR -Operating Room, RTA-road traffic accident, UK- United Kingdome, V/S-vital sign, ZMH-Zewuditu Metassebia Hospital

Ethical Clearance
Ethical clearance was obtained from the research review board of Addis Ababa University. Official letter for cooperation was sent to TASH. As this was a Phone call based study, verbal informed consent was given by study participants. Participant data were kept confidential and were only used for the study purpose.

Consent for publication
Not applicable

Availability of data and materials
All necessary information was included in the manuscript.

Competing interests
The authors declare that they have no competing interests.

Funding
The authors have declared that there was no funding

Authors' contributions
MY, BL, RM, and AE, conceived the idea and designed the study; led data analysis and interpretation; developed the first draft of the manuscript and made all revisions based on coauthors comments and suggestions. MY, BL, RM, and AE, critically revised the manuscript for im- portant intellectual content; ensured the requirements of submission of the manuscript are met. MY, BL, RM, and AE, contributed towards analysis and data interpretation; revision and editing of the manuscript. All authors read and agreed to final version of the manuscript for publica- tion.

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Original Article

Referral Pattern to Pediatric Orthopedic Clinic at Tikur Anbessa Specialized Hospital

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Abstract

Background: *Pediatric musculoskeletal problems are increasingly becoming a major public health problem worldwide. Developing countries are disproportionately affected by this issue. However, there is a scarcity of epidemiological data describing the magnitude of these issues in low resource settings. Understanding the pattern and burden of musculoskeletal problems helps in objectively understand the issue. This in turn will aid in the for- mulation of evidence driven policy and decision making. This study tries to summarize the pattern of all pediatric orthopedic conditions seen at Tikur Anbessa specialized hospital over the study period.*

Objective: *To describe the pattern of patient referral to the pediatric orthopedic clinic in Tikur Anbessa Special- ized Hospital.*

Methods: *Hospital-based retrospective record review was conducted from January 2022 to January 2023, at Tikur Anbessa Specialized Hospital. Data were collected from medical records of all pediatric patients seen at the pediatric orthopedic clinic at Tikur Anbessa Specialized Hospital and diagnosed with orthopedic conditions were included in the study to determine the pattern of patient referral. Descriptive statistics were computed to describe the study population and variables.*

Result: *Of the pediatric patients who visited pediatric Orthopedics clinics 195 (32.3 %) were due to trauma, 139 (23.1 %) were due to a congenital disorder, 72 (11.9%) were due to developmental problems, 55 (9.1%) were due to neuromotor problems, 46 (7.6) were due to infection problems, 27 (4.5) were due to tumors, 24(4%) were due to metabolic (all constituting rickets) problem and 46 (7.6 %) constitute miscellaneous conditions.*

Conclusion: *The most common musculoskeletal diseases/conditions were trauma, followed by congenital disorders and developmental disorders/diseases.*

Keywords*: Pediatric Orthopedics, Referral pattern, Referral patterns of Pediatric patients.*

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Background

Musculoskeletal (MSK) diseases, defined as diseases that affect the locomotor system including muscles, bones, joints, tendons, and ligaments, have a growing impact worldwide (1).

Musculoskeletal diseases are a major contributor to the global burden of disease and disability, and disproportionally affect low- and middle-income countries; however, there is a lack of epidemiological data from low- and middle-in- come countries. Affected children often face in-creased morbidity, social isolation, and econom- ic hardship (2).

According to the World Health Organization, MSK Diseases (MSKD) are the second leading cause of years lived with disability and the largest contributor to persis-tent pain globally. However, data relating to the spectrum and burden of pediatric MSKD globally are limited, with few studies from low- and middle-income countries (LMIC), of which only a handful are specific to East Africa, although the burden of disease is thought to disproportionally affect LMIC (3).

The causes and pattern of pediatric injuries have been reported to be influenced by age, gender, environmental and socio-economic factors (4). Children sustain injuries from several causes including road traffic injuries (RTCs), falls from heights, burns as well as during birth. Several studies reported that land transport- related injuries continue to dominate among the variouscauses of trauma in children in developed and as well as developing countries (5).

According to the 2020 report on child mortality pub-

lished by the United Nations Inter-Agency Group for Child Mortality Estimation, injury is the leading cause of mortality for children, adolescents, and youth aged 5–24 years (6). Children from low and middle-income countries (LMICs) are disproportion- ately affected, accounting for over 90% of uninten- tional injury-related mortalities globally (7).

There are few studies from developing countries describing the prevalence and potential risk factors of Pediatric trauma. A study on the epidemiology of pediatric trauma can help to formulate effective injury prevention programs and hence decrease the pediatric trauma burden and disability level (8).

Fractures are a common and significant injury in childhood, but information about the pattern of fractures among children is scarce (9). Fractures of the long bones were more often caused by falls whereas fractures of the axial skeleton, hand, and foot were often caused by collisions, blunt trauma, and traffic accidents (10).

Fractures were more often caused by falls, followed by road traffic accidents in children presentingtoTikur Anbessa Specialized Hospital, a tertiaryteach- ing hospital in Ethiopia (11).

Congenital abnormalities affect between 1% and 2% of all live births. Of these, around 10% have upper-limb deformities. Some of these deformities occur in isolation, but there are some associations with systemic syndromes (12). The prevalence of congenital limb deficiencies is reportedly 4.91 per 10,000 live births in South America (1967–1992), 5.5 per 10,000 total births in Alberta, Canada (1980–2012), and 6.9 per 10,000 total births in Northern Netherlands (1991 –2010). According to the International Clearinghouse for Birth Defects Monitoring Systems (IBDMS), the prevalence of congenital limb deficiency in Japan is reportedly 3.81 per 10,000 total births (2007–2011) (13). Congenital disorders, non-congenital deformities, and traumatic conditions are the most common musculoskeletal disorders affecting Zambian children aged less than 15 years (14).

Approximately 6% of all childhood malignancies are malignant bone tumors, of which the two most frequently encountered are osteosarcoma and Ewing sarcoma. In the United States, the annual incidence in children under 20 years of age is 8.7 per million (15).

The epidemiology of musculoskeletal infection is evolutionary. The potential for change in the epidemiology of musculoskeletal infection within a given community suggests that a periodic review may be beneficial to ensure that the current methods of evaluation and treatment go with the current manifestations of the disease (16). Musculoskeletal pathologies due to trauma were caused by various mechanisms of injury. Fall from height was the most common cause of trauma in children. That was followed by road traf - fic accident-related injuries. Sports-related traumas and domestic violence were the 3rd and 4th common- est causes of trauma respectively (17). There havebeen reports on the variation of specific patterns of various foot deformities across the world (18). De- formities like clubfoot, pes cavus, flatfoot, and meta- tarsus adductus represent some of the commonly seen foot pathologies (19).

There are many children with different orthopedic/ musculoskeletal problems referred to Tikur Anbessa Specialized Hospital pediatric orthopedic clinic. However, there is a lack of studies describing the pattern of these referrals. This study aims to describe the pattern of referral to a pediatric orthopedic clinic, at Tikur Anbessa Specialized Hospital, for whom the final diagnosis was orthopedic condition/s.

Methods and Materials

Study design

One year hospital-based retrospective record review was conducted from January 2022 to January 2023, at Tikur Anbessa Specialized Hospital.

Study area

Tikur Anbessa Specialized Hospital was established in 1961 by Emperor Haile Selassie I as “Prince Mekonnen Memorial Hospital” and got its current name in 1976. The School of Medicine at Tikur Anbessa Specialized Hospital was established in 1972 under AAU and is one of the earliest medical schools in the country. The school has been providing quality medical education to students from Ethiopia and other African countries for more than five decades. It is now treating over 500 thousand outpatients and more than twenty-one thousand inpatients annually.

Study populations

The study population included all pediatric patientswho were diagnosed with orthopedic problems or conditions at Tikur Anbessa Specialized Hospital, pediatric orthopedic clinic from January 2022 to January2023.

Eligibility criteria

All pediatric patients diagnosed with orthopedic problems or conditions at Tikur Anbessa Specialized Hospital, pediatric orthopedic clinic from January 2022 to January 2023. Patients with incomplete charts, or charts that not feasible were excluded from the study.

Sample size determination

All medical records that fulfill the eligibility criteria were included in this study.

Study variables

Age, sex, region of referral, diagnosis, and causes of the injury or trauma.

Data collection procedures
Data collection was done by two trained junior orthopedic residents. Demographic data, referring institution, and final diagnosis were collected retrospectively on all patients who were evaluated at the pediatric orthopedic clinic.

The HIMS logbook of the pediatric orthopedic clinic was used as a sampling frame. After selecting the patient's registration number on the logbook, the patient's chart, electronic medical records, and x-rays were traced and considered to extract selected information.

Data analysis procedures
The collected data was processed and analyzed by using SPSS version 26. Descriptive statistics were computed to describe the study population and variables.

Results
Between January 2022 and January 2023, 2824 patients who were under 15 years of age visited pediatric Ortho- pedics clinics in Tikur Anbessa Specialized Hospital. Of these 662 patients are new patients that came from eight regions and two city administrations within the country.

Of the 662 patients, 59 were excluded from the analysis due to a lack of documented diagnosis on the chart and electronic medical record.

Patient characteristics:
Among 603 patients seen at pediatric Orthopedics clinics during the study period, 342 (57%) were male, and the median age was 6 years.

The top three areas of patient inflow were from Oromia region 271 (44.9%), Addis Ababa city 227 (37.6%) followed by Amhara region 33 (5.5%) and there was no patient referred from Tigray region (table1).

Table 1: shows cases referred from each region and city.

	Oromia	**Addis Ababa**	**Amhara**	**Harar**	**SNNP**	**Somali**	**Gambe la**	**Benishangul Gumuz**	**Dire Dawa**	**Afar**
	271	227	33	18	17	14	9	7	5	2
	44.9%	37.6%	5.5%	3%	2.8%	2.3%	1.5%	1.2%	0.8%	0.3%
Trauma	64	116	10	0	1	1	0	0	1	1
Infection	19	11	6	0	0	1	4	2	0	0
Tumor	9	0	2	3	5	5	2	1	0	0
Congenital MSK Disorders	74	44	5	8	3	2	1	0	0	1
Developmental MSK disorders	46	17	4	0	3	0	0	1	1	0
Metabolic	17	8	0	1	0	4	0	0	0	0
Neuromotor Disorders	20	26	2	1	2	1	0	2	1	0
Miscellaneous	22	5	4	5	3	0	2	1	2	0

Most traumas and neuromotor disorders were referred from Addis Ababa city 116(59.5%) and 26(47.3%) respectively. While most of the congenital, developmental, metabolic disorders, infections, and tumors were from Oro- mia region 74 (53.3%), 46(63.8%), 17(77.3%), 19(42.2%), and 9(33.3%) respectively (table 2).

Table 2: shows the frequency of cases of the patients.

Problems/Diseases	**Frequency**	**Percent**
Trauma	195	32.3
Congenital Disorder	139	23.1
Developmental disorder	72	11.9
Neuromotor Disorder	55	9.1
Miscellaneous	46	7.6
Infection	45	7.5
Tumor	27	4.5
Metabolic	24	4.0
Total	603	100

Table 3: shows the distribution of the trauma within the body.

Locations of trauma w ithin the bod y						
Trauma	Upper limb injuries	Lower limb injuries	Shoulder girdle injuries	Pelvic girdle injuries	Total	Percent
Supracondylar humerus fracture	31	0	0	0	31	15.9%
Femur shaft fracture	0	26	0	0	26	13.3%
Tibiofibular fracture	0	19	0	0	19	9.7%
Radioulnar fracture	16	0	0	0	16	8.1%
Soft tissue injury	7	5	0	0	12	6.2%
Clavicle fracture	0	0	12	0	12	6.2%
Isolated ulna fracture	11	0	0	0	11	5.6%
Isolated Radius fracture	8	0	0	0	8	4.0%
Metacarpal fracture	8	0	0	0	8	4.0%
Metatarsal fracture	0	6	0	0	7	3.6%
Humerus shaft fracture	7		0	0	6	3.1%
Distal femur fracture	0	6	0	0	6	3.1%
Toe	0	6	0	0	6	3.1%
Finger fracture	6	0	0	0	6	3.1%
Humerus lateral epicondyle	6	0	0	0	6	3.1%
Elbow Dislocation	4	0	0	0	4	2.1%
Femur neck fracture	0	4	0	0	4	2.1%
Pelvic ring injuries	0	0	0	4	4	2.1%
Hip Dislocation	0	2	0	0	2	1.5%
Proximal humerus	1	0	0	0	1	0.5%
Total	105	74	12	4	195	100%

Most of the trauma occurred in the upper limb 105/195 (54% of the trauma) accounting for 17% (105/603) of all conditions. And forearm fracture (including radioulnar, isolated radius, and ulna fracture) was observed in 35 (18%) of the trauma patients, followed by supracondylar humerus fracture 31 (16%) and femur shaft fracture 26 (13%). No multiple traumas were found (table 3).

Locations of trauma within the body

The mechanism of injury for 25 (12.8%) out of the 195 patients who sustained trauma is missing. One hundred fourteen (67% of the 170 for whom the causes of injury are known) are due to fall down injury. While the rest are caused by road traffic injury, metal injury, stone injury, birth trauma, fight, sport, and bullet injury 24(14%), 12 (7%), 7(4%), 5 (3%), 4(2%), 3(1.8%), and 2(1.2%) respectively (figure 1). The data about the nature of 20 (11.4 %, excluding soft tissue injury) fractures, whether they were open or closed were missing. One hundred fifty one (excluding the soft tissue injury) (92%) of the frac- tures were closed while the rest were open (table 4).

Developmental dysplasia of the hip accounted for 20 (27.8%) of the observed developmental disorders, and 3% of all the conditions. Followed by genu varus deformity accounting for 16.8% of the observed developmental disorders. Nine (45%) of the developmental dysplasia of the hip occurred on the left side and 7 (35%) were bilateral. It was noticed that females were affected more than males, two times. Nosecondarycauses of the disorders were found.

The most commonly observed infections were chronic osteomyelitis 17 (38% of all infections), accounting for 2.8% (17/603) of all the conditions. Followed by arthritis accounting for 29% (13) of all infections and 2% of all cases.

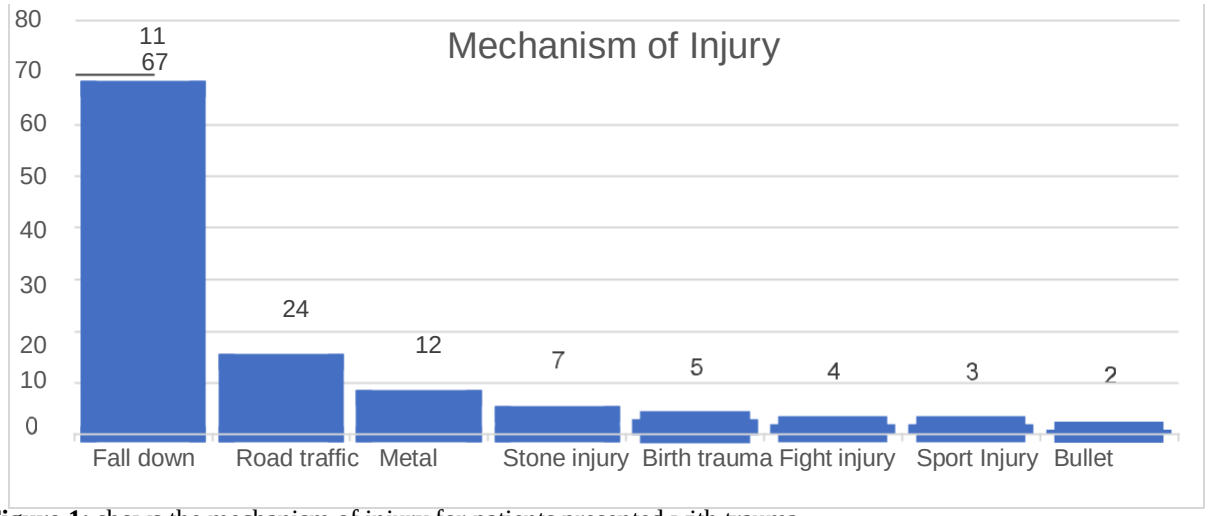

Figure 1: shows the mechanism of injury for patients presented with trauma.

Table 4: Showing the observed nature of the fractures.

Fracture	Nature of fracture	
	Closed	Open
SCH fracture	26	1
Radioulnar fracture	18	1
Femur shaft fracture	17	1
Clavicle fracture	11	0
Humerus shaft fracture	9	0
Isolated Radius fracture	8	0
Isolated ulna fracture	8	0
Metacarpal fracture	8	0
Tibiofibular fracture	8	4
Distal Radius	6	1
Distal femur fracture	6	0
Toe	5	0
Elbow Dislocation	4	0
Metatarsal fracture	4	3
Pelvic ring injuries	3	0
Humerus lateral epicondyle	3	0
Finger fracture	2	2
Hip Dislocation	2	0
Femur neck fracture	2	0
Proximal humerus	1	0
Total	151	13
Percent	92%	8%

The most commonly observed neuromotor problems were Erb`s palsy 26 (47%), accounting for 4% (26/603) of all the cases, followed by cerebral palsy 20 (36%) also accounting for 3% (20/603) of all the conditions.

The miscellaneous conditions were selected because these cases either could not be classified under the other seven groups (Trauma, Congenital, Disorder, Developmental disorder, Infection, Neuromotor Disorder, Tumor, and Metabolic diseases) or they have systemic manifestations within the body which make the data grouping and analysis difficult. It consisted of 46 disorders (7.6% of all the conditions).

Discussion

This study aims to describe a pattern of patient referral to the pediatric orthopedic clinic at Tikur Anbessa Specialized Hospital, a tertiary teaching hospital in Addis Ababa, Ethiopia.

Over twelve months, 603 new pediatric patients with musculoskeletal diseases/ disorders were identified in this study. The majority of patients did not have referral paper attached to their charts. This may be because the country is replacing the charts with digital medical records.

Although referral papers could not be found for most of the patients the residence of the patients could be inferred from their charts and HIMS logbook. Most of the patients were out of Addis Ababa, where TikurAnbessa Specialized Hospital is located, a place where this study is conducted. The three most common mus- culoskeletal diseases found in this study were trauma, followed by congenital Musculoskeletal disorders, and developmental musculoskeletal disorders. These findings are similar to a study on an Audit of Pediatric Orthopedic surgical admissions in a Tertiary Health Cen-

tre in Enugu, Nigeria, where they found trauma as the most prevalent case (17). These findings are different from that of the study on Patterns of Musculoskeletal Diseases seen in Zambian Children, where they found congenital anomalies to be the commonest followed by deformities and trauma (14).

The most common mechanism of injury was fall down injury accounting for 67% of the causes of trauma followed by road traffic injury which accounts for 14% of the causes. This may be explained by the fact that chil- dren are adventurous and explorers they are often pre- disposed to an increased risk of falldown injuries. The-se findings are similar to the study on the Audit of Pe-diatric Orthopedic Surgical Admissions in a Tertiary Health Centre in Enugu, Nigeria (17), and the study on patterns of long bone fracture in the pediatric popula-tion at Kenyatta national hospital Kenya (20), theyfound fall injuries as the commonest cause of trauma in a pediatric population, followed by road traffic inju- ries.

As to the trauma, most fractures were observed in the upper limb accounting for 57% of the injury in this study. This finding is similar to the result of a study on patterns of long bone fracture in the pediatric population at Kenyatta National Hospital Kenya, where the commonest fractures were found to involve the upper limb (20).

The most common fracture involved forearm bones (including radioulnar, isolated radius, and isolated ulna fracture altogether), followed by supracondylar humerus fracture and femur shaft fracture. This result differs from the study on pattern of childhood limb fracturesat Tikur Anbessa Specialized Hospital, where the most common fracture involved the humerus (11).

The most common congenital anomaly identified was clubfoot accounting for 62% of the observed congenital anomalies. This finding is similar to a study on patterns of pediatric orthopedic pathology in Zambian children where clubfoot was the commonest congenital anomaly (14).

Some of the limitations of the study are being conducted only in a single institution, a retrospective nature, difficulty in accessing X-rays of some study participants, and a short study period.

Conclusion

The top three musculoskeletal disorders presenting to TASH pediatric orthopedic clinic were trauma, congenital anomalies and developmental disorders. And one-third of all the cases were trauma. Most of the patient flows are from the Oromia region.

Recommendations

A prospective multicenter study should be done to establish the national musculoskeletal burden. Development of safety guidelines to reduce the risks of fall injury and road traffic injury.

Ethical Considerations

The study was conducted after being granted ethical clearance from Addis Ababa University Institutional Review Board (ERB/OTHO/461/14 /2022). No personal identifiers of the patient were used in the research report. Patient confidentiality was maintained throughout the research project.

Conflicts of interest

None

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Original Article

Association of Birth Weight and Birth-Related Fractures in Neonates Aged 0-15 Days in Resource Limited Setting : A Case Control Study

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Abstract

Background: *The occurrence of birth related fractures is linked to various factors, encompassing maternal as- pects, fetal conditions, and the skills of the obstetrician. In this study, our aim was to evaluate the correlation be- tween birth-related fractures and both high and low birth weights.*

Methods: *The study is a case-control study, spanning from August 2019 to August 2023 G.C. The sample size determination relies on birth weight as a variable, considering a type 1 error rate (alpha) of 0.05, a beta of 0.2, and a power of 80%, resulting in a total sample size of 36. After importing the data into a Microsoft Excel file, thor- ough cleaning procedures were applied. The refined dataset was entered into SPSS 26 for analysis. Statistical significance was assessed using a 95% confidence interval and a p-value threshold of < 0.05.*

Result: *The mean birth weight of neonates with birth related fractures was 3115 grams. Fifty-eight percent of the neonates had fracture of the humerus followed by femur (25%) and clavicle fractures (16.7%). The mean weight of neonates with clavicle fracture, humerus fracture and femur fracture was 3950, 3054 and 2700 grams respectively. Birth weight and breech presentation correlations were statistically significant for birth related fracture at a p- value of <0.05.*

Conclusion: *The findings of this study indicated that both lower and higher birth weights, along with breech presentation, elevate the risk of birth-related fractures. In light of these results, we recommend optimizing the maneuvers of fetal body extraction through practical training.*

Keywords*: Birth trauma, Birth injury, Birth related fractures, Birth weight , Neonatal fractures*
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Introduction

Neonatal birth injuries are defined as physical impairments that newborns experience during labour and delivery (1-3). Clinical findings such as swelling, crepitus, and mostly the newborn's discomfort are used to identify fractures. The primary clinical indicator is the restricted Moro reaction sign, which displays the affected arm's decreased abduction and external rotation in response to the sense of falling (Moro (startle) reflex) (3). Birth-related fractures can result from injuries sustained during labor and delivery both of which are preventable and unavoidable. The occurrence of these fractures is associated with various parameters, such as maternal, fetal, and obstetrician competence. There have been reports of 2 to 7 cases per 1000 live births (4-5).

Less than 1% of live deliveries result in birth trauma (6). If a fracture is discovered within the first week of a newborn's life and there is no documented postnatal trauma, the fracture is regarded as abirth fracture (7). Fractures in neonates have been linked to difficult births needing significant traction (8).

Despite advancements in obstetric and perinatal care, particularly in developing countries, obstetric fractures can result in a marked rise in neonatal morbidity. (9). Although any bone may be affected, the most frequently broken bones are the clavicle, humerus, femur and other long bones. High birth weight, a challenging delivery, an unusual fetal presentation, the inaccessibility of hospital facilities, the accompanying healthcare providers' abilities, and other factors may be risk factors. It's unclear if caesarean sections are beneficial in lowering these birth traumas. Parents may believe that birth fractures are preventable, and this could lead to litigation (10-11).

A birth fractures is a common quality control indicator used by many hospitals. Neonatal birth fractures have most often occurred in the clavicle, with the middle part

of the clavicle being the most typical site of injury (11-13). There could be risk of fractures or birth inju-ries due to the predisposing conditions. According toa study conducted by Nasser et al., neonates with a mean birth weight of more than 4500 grams had a 7.7% incidence of birth injuries (14).
Our hypothesis is that both higher and smaller birth weights increase the risk of birth related fractures.

Methods and Materials
The study design was a case control study. The study was conducted from August 2019-August 2023G.C.The study population was all neonates age from 0-15 days. These neonates were grouped into two groups [cases and controls]. The case groups were those that had birth related fractures of tibia, femur, humerus, forearm and clavicle who came to Tikur Anbessa Specialized Hospital as a referral case or directly from maternity ward to neonatal intensive care unit. The control groups were those neonatesborn with out any fractures in the specified time frame at Ghandi Memorial Hospital. For sample size calculation, an online sample size calculator from the link https://clincalc.com/stats/SampleSize.aspx, was used. The sample size was calculated based on birth weight as a variable with type 1error rate alpha of 0.05, beta of 0.2 and a power of 80%. Two groups of patients used as a variable for sample size calculation was heavier (increased birth weight) babies with a mean weight of 3800 ± 500 gram and normal birth weight babies with a mean weight of 3300 gram. By this calculation , a total sample of size 36 was re- quired. Out of this participants 12 were those that hadbirth related fracture and 24 were those that did not have birth related fracture. The control groups were picked randomly.

After ethical approval from the department and Informed verbal consent was taken from the newborns legal guardians by phone; data were collected with a structured questionnaire by a research assistant and Principal investigator. The data were checked for cleanness and completeness and imported into a Microsoft excel file and further cleaning was done. The refined data were entered to SPSS for analysis. The data were analyzed by odds ratio, 95% confidence interval and a p value of < 0.05 was used to asses statistical significance. Means and percentage were used for nominal variables. Chi square test was used to assess association between dependent and independent variables.

Results
Demographic characteristics of birth related trau-ma
In this study, 12 cases and 24 controls with a total of 36 participants were enrolled participants. Majority (52.8%) of the study participants was female and 97.2% were delivered at term. Eighty-six percent of the study participants were delivered vaginally and 83.3% were a vertex presentation. Eighty-three percent of the study participants of the neonate had a normal birth weight (table 1).

Table 1. Demographic characteristics of the study participants

Variable	Frequency	Percent
Sex		
Female	19	52.8
Male	17	47.2
Gestational age at delivery		
Preterm	1	2.8
Term	35	97.2
Mode of delivery		
Vaginally	31	86.1
Caesarean section	5	13.9
Fetal presentation		
Vertex	30	83.3
Breech	6	16.7
Birth weight		
<2500	4	11.1
2500-3999	30	83.3
≥4000	2	5.6

Characteristics of birth related fracture
In this study, 66.7% of the study participants were present in the hospital within 24 hours of delivery and 58.3% of them had humerus bone fracture followed by femur (25%) and clavicle (16.7%). Two-third (66.7%) of the fractures were in the left side, while 1/3 of the fracture was in the right side (table 2).

The association of birth related fracture and independent variables
The case control ratio revealed that, 58.3% of the case were female while it was 50% in the control group. Ninety two percent of the cases were delivered at term and 8.3% were delivered at preterm period while all the control group were delivered at term period of gestational age. Seventy-five percent of the study participants were delivered vaginally and the breech to vertex presentation ratio was equal in the case group. With regard to the case group's birth weight; 66.6 percent (n=8) was in normal birth weight range 16.7 percent (n=2) had low birth weight and 16.7% (n=2) had big baby (table 3). The determinant factors of birth related fracture was assessed using chi-square test. Accordingly, study participant whose fetal

presentation and birth weight had a statistically significant association with the presence of birth related

Table 2: Study participants birth related fracture characteristics

Frequency	Frequency	Percent
Age at presentation in hours		
≤24	8	66.7
>24	4	33.3
Types fractured bone		
Humerus	7	58.3
Clavicle	2	16.7
Femur	3	25
Hand side of fracture		
Left	8	66.7
Right	4	33.3

Table 3: The association of birth related fracture and independent variable

Variable	case	control	X^2 test
Sex			0.637
Female	7(58.3)	12(50)	
Male	5(41.7)	12(50)	
Gestational age at delivery			0.151
preterm	1(8.3)	0	
Term	11(91.7)	24(100)	
Mode of delivery			0.173
Vaginally	9(75)	22(91.7)	
Caesarean section	3(25)	2(8.3)	
Fetal presentation			0.000
Vertex	6(50)	24(100)	
Breech	6(50)	0	
Birth weight			0.048
<2500	2(16.7)	2(8.3)	
2500-3999	8(66.6)	22(91.7)	
≥4000	2(16.7	0	

The mean weight of the birth weight among birth related fracture

The mean weight of neonates with birth related fracture was 3115 gram, while that of the control group was 3025 grams. From those of the fractured bone, the mean weight of clavicle fracture, humerus and femur were 3950, 3054 and 2700 grams respectively (table 4).

Table 4. the mean and SD of birth weight among birth related fracture.

Birth related fracture	N	Mean	± SD
Yes	12	3115	858.4
No	24	3025	387.0
Types of bone fractured (n=12)			
Humerus	7	3054	947.2
Clavicle	2	3950	494.9
Femur	3	2700	519.6

Discussion

Birth related fracture is one of the obstetric related complications and it is stated as part of poor perinatal outcome. In this study, we assessed the association of fetal birth weight and birth related neonatal fractures using a case control study. The finding of this study showed that the mean birth weight of the fractured neonate was 3115gram, Which was higher than the control means birth weight (3025gm). This finding is consistent with that of study done in Nigeria (19). This similarity may be due to the impact of selecting criteria for the control group. In this study, the control group were randomly chosen from those of non-fractured neonate.

The finding of the mean birth weight of the fractured neonates was lower than the study done by Nasab S, et al (3735gm) (18). This was may be due to the current fracture was not associated with only birth weight, but also with breech presentation and may also be affected by maternal pelvic, and skill of the provider attending the labor and delivery.

In this study, majority of the left side fractures were in breech presentation and majority of the right frac-ture were in the vertex presentation. This finding was not supported in the literature due to the limita- tion of study in the area. This might have occurred as a result of the mother's pelvis' anatomical impact or the way the newborn was handled during deliv- ery.

In this study, 58.3% of the neonate had humerus bone fracture followed by femur (25%) and clavicle (16.7%). This finding is not supported by the majority of literatures which indicate that the clavicle is the most often fractured bone in birth traumas. This raises a question if clavicular fractures were missed in our study population and warrants shoulder examination for highrisk newborns. The mean weight of clavicle fracture, hu - merus and femur were 3950, 3054 and 2700 grams respec-tively. The finding implies that the mean weight of the clavicle was 3950 gram which was a border of big weight.Majority of the clavicle fracture may be related with shoulder dystocia as they have occurred in larger birth weight babies.

The study participants whose fetal presentation was breech were statistically significant for birth-related frac- tures, according to the chi-square test. The results also showed that participants with breech presentations had a higher likelihood of experiencing a birth-related fracture than those with normal birth weights. This might have been brought on by a poorly executed extraction maneu- ver during delivery.

The finding of the study also revealed that birth weight was a statistically significant for birth related neonatalfractures at a p- value of <0.05. This finding was support- ed with the study done in Tertiary Care Hospital in Thai- land (16), Nigerian tertiary health facilities (19), Sweden
(20) and Northeast Ethiopia (21). This may be because as birth weight increase it might be hard for fetus to pass through the maternal pelvic easily and pressure may be used by provider to expel the fetus. The fracture might have occurred with those providers who used only powerat emergency rather than an obstetric maneuver.

Conclusion and Recommendation

The findings of this study suggest that there is an in-creased risk of birth-related fractures associated with both high and low neonatal birth weights. Moreover, breach presentation contributes to an increased likelihood of birth
-related fractures. We propose incorporating training sessions utilizing simulations for maneuvers involved in fetal body extraction during challenging deliveries. Additionally, we also suggest implementing routine shoulder examinations for high-risk newborns, considering the possibility of overlooking clavicle fractures. It is advisable to conduct further research with a larger sample size to explore additional determining factors for birth-related fractures.

Limitation of the study

This study was conducted in small sample size whichmade it difficult to assess the associated risk of birth weight and birth related fractures in newborns using odds ratio by logistic regression.

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Original Article

Predisposing Factors for Recurrence Idiopathic Club Foot After Successful Ponseti Treatment at Tikur Anbesa Specialized Hospital

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Abstract

Background: *Idiopathic clubfoot is treated with the Ponseti treatment all over the world; yet, the deformity's recurrence is a major complication and not studied in Ethiopia. This research aimed to determine predisposing factors for recurrence of idiopathic club foot after successful ponseti treatment. The objective of this study is to asses predisposing factors for idiopathic club foot recurrence following successful ponseti technique correction.*

Method: *All children with corrected idiopathic club foot who started abduction brace and on follow up from September 2021 to September 2023 after Ponseti treatment who fulfilled the eligibility criteria were included. From medical and club foot register and telephone call interview, data were collected and analyzed by SPSS version 29 software. Descriptive statistics, bivariable and multivariable analysis were used.*

Result: *There were 104 patients (136 feet) followed for average of 3.4 years. Thirty-two (31.7%) were right side clubfoot, 38(36.5%) were left side and 33(31.7%) were bilateral. Sixty-six (63.5%) children were males. There were 39(28.7%) feet which had recurrence. Place of residence shows 62(59.6%) were from urban. Chi-square testsfound associations between recurrence and, awareness level of treatment (p=0.0001), parent's education status (p=0.002), job (p=0.003), satisfaction of parent with treatment (p=0.004), poor compliance (p<0.001), dis-comfort during wearing brace (p=0.01), pretreatment Pirani scores (p<0.001) and longer follow up age (p=0.014). Logistic regression identified pretreatment Pirani score (p=0.024), and poor brace compliance (p=0.022) had major predictive significance for recurrence.*

Conclusion*. Pretreatment Pirani score and poor brace compliance are independent significant predictors of recurrence.*

Keywords: *Club foot, Relapse club foot, Bracing for club foot, Brace compliance, Recurrent club foot.*

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Introduction

Congenital Talipes Equinovarus (CTEV) is the most prevalent congenital abnormality affecting the musculoskeletal system that requires orthopedic treatment(1). Clubfoot can manifest as either non- idiopathic type or idiopathic type when it occurs in healthy ba- bies (2). It is estimated that Ethiopia sees 3,000–5,000 new CTEV cases annually (3).

The specific etiology is still unknown (4). Prior to the introduction of ponseti treatment, conventional kite manipulation and plastering were used for treating idiopathic clubfoot in Ethiopia(5).The ponseti treatment, which is currently regarded as the gold standard of care, can effectively treat clubfoot in up to 95% of cases without the need for surgery. It is gradually re- placing previously used conservative and surgical pro- cedures. In June 2005, the Ponseti treatment started for the first time in Ethiopia at Tikur Anbesa Specialized Hospital (TASH).

It has been progressively accepted in a number of locations by the partnership of TASH and cure international, Ethiopia (3). Currently, around 56 club foot centers are available in Ethiopia. The Ponseti method involves weekly foot manipulation and serial casting, with the

possibility of a percutaneous Achilles tenotomy if necessary. To preserve the correction achieved, a foot abduction brace (FAB) is utilized. Initially, the FABis worn continuously (23 hours) for the first threemonths, followed by a gradual decrease to 18-23 hours for another three months. Subsequently, during the maintenance phase, the FAB is worn for 12-18 hours per day until the patient reaches the age of four to five years (6).

Currently, the Ponseti method is widely accepted on a global scale with remarkable success in achieving primary correction rates (7) . The objective of clubfoot treatment is to have fully corrected, mobile, plantigrade feet at maturity, capable of walking with shoes without discomfort (8). The substantial prob- lem with the ponseti procedure is a relapsed or recur- ring deformity, which ranges from 11% to 48% (8).

Predisposing factors for recurrence are still vary and debatable and no consensus except brace compliance as predisposing factor for recurrence According to Dobbs *et al.* there is a substantial risk of noncompliance for the return of clubfoot deformity. Haft *et al.* more recent research, further demonstrated how important it is to follow the post-correction abduction-bracing strategy in order to prevent clubfoot from recurring.(9,13,14). Dobbs and Associate came to the conclusion that the factor most strongly linked with recurrence is failure to comply with brace use.(4). Azipra *et al.* and many other researcher also showed poor compliance as major risk factor for recurrence (7,11,15,16).

The primary trigger of recurrence is brace intoler-ance, though certain individuals may still experienceit even after maintaining braces effectively(10). In Harvard medical school, Boston ,children who expe- rienced recurrence before turning two years old had a substantially greater chance of not wearing their braces as prescribed than those who experienced recurrence after that age in 2017 (12).

Clubfoot and its recurrence is an extremely disabling illness that causes discomfort, hinders moving, and creates marginalization and discrimination from a variety of daily life, including work and education (17) . To the best of our knowledge, no research has been done in Ethiopia regarding to predisposing factors for recurrence. The identification of key risk factors could ultimately contribute to improved choice of patients for congenital clubfoot treatments now readily available as well as the possibility of prompt intervention to enhance outcome and compliance. This study intended to assess predisposing factors for recurrence of idiopathic club foot after successful ponseti treatment in our set up. It also aimed to assess sociodemographic factors which affect poor compliance.

Methods and Materials

A retrospective record review was conducted in TASH. All idiopathic club feet children who had a successful ponseti treatment with a minimum of half year follow-up time after the start of brace application and who were on follow up from September 2021 to September 2023 were included in the study.

Eligibility Criteria

Patients were excluded if they had an incomplete medical record, late presenting club foot (>2 year) and those whose parents declined to give verbal consent to participate in the study.

Data collection

Data were collected from clubfoot registry log book, patient's chart, computer follow up, and parents telephone interview conducted to complete the data using a structured questionnaire. Age at first casting and last follow-up, gender, pretreatment Pirani score, number of casts, unilateral or bilateral, tenotomy, address, parent marital status, satisfaction level to treatment, family history, awareness to brace treatment, and education level were recorded. Size of brace fit to feet, discomfort to brace and compliance to brace were also recorded.

Operational definitions

Recurrence was defined as the return of any deformity within the key components of clubfoot that requiring further treatment. Adherence is defined in subjective way as consistent usage most of the time of the foot abduction brace without problem, as reported by the parents or caregivers.

Address is defined as Addis Ababa verses outside Addis Ababa. Adequate income is subjective defined as when it is enough to fulfil their basic needs perceived by the parent.

Statistical analysis

The collected data were coded, and entered to excel. After exporting, the data were cleaned and analyzed using the Statistical Package for Social Science (SPSS) version 29 software. The descriptive data were summarized using descriptive statistics. Tables and graphs were employed appropriately for sharing and presentingdata. The chi-square test was employed to examine the association between variables, using the Pearson correlation coefficient. The logistic regression was used to analyze the statistical association between the independent and outcome variables. The 95% confidence interval is derived for crude and adjusted of odds ratios. The original multivariable logistic regression includes those factors that demonstrate a p- value < 0.2. The results of this study were deemed statistically significant if the P-value was less than 0.05.

Ethical Considerations

The study was conducted after getting departmental ethical approval with reference number ERB/ ORTH/324/2023. Permission for data collection was

secured from the hospital authorities. The purpose of the study was explained & verbal informed consentwas obtained from each participant.

Result

Sociodemographic data

One hundred four patients with idiopathic club foot were included. Male participants were 66 (63.5%). Thirty-two (31.7%) were right side clubfoot, 38 (36.5%) were left and 33(31.7%) were bilateral. Sixty - two (59.6%) came from Addis Ababa. Thirty-one patients with 39(28.7%) feet had recurrent clubfoot. Average Pretreatment Pirani score was 5 with 0.7 SD, and age at initiation was 5 weeks with 2 SD (Figure 1).

Association between independent and outcome variable

Chi-square tests found significant associations between recurrence and lack of awareness of treatment (p=0.0001), poor educational status (p=0.002), job of parent (p=0.003), neutral or dissatisfied with treatment (p=0.004), discomfort during wearing brace (p=0.01). Whereas sex, place of residence, parent marital status, income level, and laterality had no significant association with recurrence (Table1).

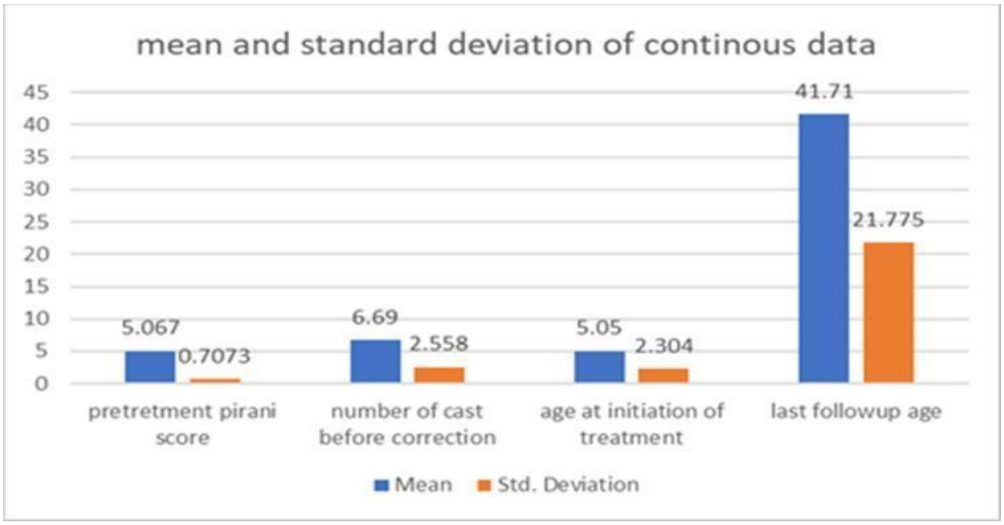

Figure 1. Mean and standard deviation of continuous data

Table 1: chi square analysis of independent and outcome variables, TASH, 2021-23

		Recurrent		P value
		Yes	No	
Sex	Male	17	49	0.234
	Female	14	24	
Awareness	Yes	21	73	0.001
	No	10	0	
Income level	Adequate	23	61	0.268
	Not adequate	8	12	
Education status	University	8	28	0.002
	High school or less	8	34	
	Not able to read and write	15	11	
Poor compliance	Yes	14	6	.0.0001
	No	17	67	
Job of parent	Government worker	7	27	0.003
	Private worker	15	39	
	Farmer	4	7	
	Jobless	5	0	
Satisfaction level	Very satisfied	3	6	0.004
	Satisfied	14	56	
	Neutral	12	11	
	Dissatisfied	2	0	
Discomfort to brace	Yes	7	2	.0.01
	No	24	71	

Descriptive statics for continuous data

Mean and standard deviation of continuous variable of recurrent and non-recurrent group (Table 2).

Table 2: descriptive statics for continuous data, TASH, 2021-23

	Recurrent	Number	Mean	Sd
Number of casts before correction	Yes	31	7.42	2.248
	No	73	6.38	2.633
Pretreatment Pirani score	Yes	31	5.484	0.6517
	No	73	4.89	0.6575
Age at initiation of treatment	Yes	31	4.94	2.366
	No	73	5.1	2.292
Last follow up age	Yes	31	49.68	20.615
	No	73	38.33	21.501

Binary logistic regression,

The variables which had predictive significance were pretreatment Pirani score (p=0.024) and poor brace compliance (p=0.022) as significant predictors of recurrence after adjusting for other factors. Last follow up age and discomfort to brace had marginal significance (p=0.06) (Table3).

Table 3: Logistic regression analysis with adjusted and crude odd ratio, TASH, 2021-23

	P value	Crude Odd ratio	Adjusted Odd ratio
Sex	0.957	2(0.712-3.972)	
Last follow up age	0.06	0.976(0.956-0.996)	0.982(0.959-1.0009)
Discomfort on brace	0.06	10.354(2.012-53.2810	6.552(0.559-42.6)
Poor compliance to brace	0.022	9.196(3.078-27.4)	5.582(1.514-20.02)
Pretreatment Pirani score	0.024	0.216(0.095-0.493)	0.355(0.141-0.892)
University level	0.607	1	1
High school or less	0.881	1.214(0.404-3.649)	1.705(0.444-6.552)
Unable to read and write	0.485	0.210(0.069-0.633)	0.425(0.100_1.802)
Parent marital status	0.08	2.191(0.771-6.232)	
Number of casts	0.239	0.854(0.722-1.008)	
Proper information given to the parent	0.031	4.966(0.433-56.9)	
Size of brace fit to shoes most of time	0.437	0.130(0.013-1.299)	
Income	0.28	1.7668(0.641-4.879	

Factor associated with poor compliance

On logistic regression analysis discomfort to brace with p value 0.002, (AOR 20.639), size of brace with p 0.007, (AOR 46.236) had independent significance on poor compliance. Education status of patient showed marginal significance of 0.065 with odd ratio of 5. The remaining factors had no significance (Table 4).

Table 4: Factors associated with poor compliance, TASH, 2021-23

Variables	P value	COR	AOR
Awareness of parent	0.08	0.514(0.114-3.005)	
Sex of patient	0.164	1.52(0.621_4.35)	
Income of parent	0.466	3.2(0.55-12.6)	
Level of education	0.061	1.004(0.66_1.67)	
Laterality of club foot	0.0771	1.97(0.71_7.430	
Address of patient	0.138	0.851(0.711_1.06)	
Parent marital status	0.105	0.21(0.01_24)	
Family history of club foot	0.08	0.39((0.22-32)	
Job of parent	0.244	3.51(0.86-52.2)	
Size of brace	0.004	0.09(0.002-0.922)	0.07(0.006-0.797)
Discomfort on brace	0.000	13(5.21-60)	11.39(2.44-53)

Discussion

Our study has retrospectively reviewed104 children to asses clinical and sociodemographic factors affecting recurrence of club foot. Our study revealed that the relapse rate was 28%, consistent with research done in China 2018 by zaho et al.(16).

In many studies, it is evident that after ponseti method, non-adherent to the FAB was thought to be the primary contributing factor of relapse (9,13,14). Consistent to many studies our study found that patients who had poor compliance to wearing the FAB had a significantlyhigher correlation rate for recurrence and observed that 5.6 times odd of having recurrence relative tothose who had good compliance. This is a serious problem because of the cost, the longer brace time, and the social factors that affect compliance,like the stigma associated with wearing an ortho- sis for an extended period of time.

Patients who had discomfort on brace were odd of **6.55** times more likely to have recurrence of club-foot compared to those who had no discomfort on brace which has marginal significance. In association with this discomfort to Abduction foot brace had major predictive effect on poor compliance ,

it is consistent with dobs et *al.* 2004 (USA), Zhao *et al*. 2014 (China), and Dobbs *et al*. 2009 (10). This research also found that well fit size of brace had significance predictive effect on poor compliance. According to our finding, the initial Pirani score was major predictive of relapse. The mean pretreatment Pirani score for the recurrent group was 5.5 vs 5 for non-recurrent group, consistent with studies of hemo *et al.* and zhao *et al* and many other research (7,16,18,19). Higher pretreatment Pirani score suggests a more severe initial deformity, which appears to be a significant predictor of recurrence, so it is preferable to closely monitor kids with high initial Pirani scores as this will assist pick up relapses early.

In our study we found that there was a negative correlation of recurrence of clubfoot with regards to level of awareness to brace treatment and higher education level (university level) which is consistent with finding ofDobs *et al.*2010, Azipra *et al.* and Goksan *et al* . in 2015 and many other researches (2,20–23). Thus, it is vitally necessary to use every chance to educate parents about the significance of wearing FAB.

The mean last follow-up age had positive association for recurrence and marginal predictive significance, Aza-pira *et al*. Own *et al.(*Uk,2015), Gelfer *et al*. (UK,2019) associated longer follow up with detecting more relapses, in agreement with this study results (2,24,25).This validates importance of long-term monitoring. Age of initiation and number of casts had no significance association in our study.

Being jobless has positive association but not predictive significance. Recurrence was higher among patients whose parents had neutral or dissatisfied satisfaction levels on treatment compared to those satisfied but no predictive significance.

Our research is novel in a way that it is pioneer and it will serve as baseline for further research for our setup and the country level. The limitation of our study was that it involved only one center which might not lead to generalizability. There was also difficulty in accurately assessing compliance objectively.

Conclusion

Poor compliance to brace and higher Pirani score poses higher recurrence risk, should be considered in treatment plan. Based on the findings, the following recommendations are made: educate parents on importance of brace compliance through simplified counseling tools. Strengthen follow-up systems to regularly monitor recurrence particularly with higher Pirani score. Prioritizing patient comfort through proper sizing and adjustment over time. Conduct further prospective studies to validate the risk factors identi - fied and evaluate interventions to promote brace wear.

Declaration

We hereby certify to the accuracy and completeness of the information given in this paper. We sincerely declare that the information provided in this paper is accurate to the best of our understanding and that all the facts are true.

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Competing of interest

The authors declare that there are no competing interests and all authors approved the manuscript. The study has no outside financial support source.

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Original Article

Being Children and Delayed Presentation are Main Risk Factors for Developing Complications Following Traditional Bone Setting in Southern Ethiopia: Findings from a Facility Based Study

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Abstract

Background *Traditional bone-setting (TBS) can be associated with many life - and limb-threatening complica - tions. The aim of this study was to explore risk factors for complications among trauma patients who presented to our institution after TBS.*

Methods*: A prospective institutional -based study was conducted from July 2020 to June 2021. Two hundred thirty patients who first visited Traditional Bone Setters and presented to hospital were included. A structured, pre-tested questionnaire was used to collect data by trained healthcare professionals through face-to-face interviews. Binary logistic regression analysis was used to measure the association between independent and dependent variables. The presence of a statistically significant association was declared using a 95% confidence interval (CI) and a P-value less than 0.05.*

Results*: Over two-thirds (62.6%) of the patients suffered a complication requiring presentation to the hospital. In the multivariable logistic regression model, younger age (AOR = 2.43, 95% CI = 1.21, 4.92), longer time interval between initial injury and arrival at the hospital (AOR = 7.40, 95% CI = 3.86, 14.20), and the region where the patients live (AOR = 2.05, 95% CI = 1.06, 3.40) were significantly associated with complications.*

Conclusions*: The magnitude of complications among trauma patients who first visited TBS was unacceptably high. Younger age, delayed presentation, and the region where the patients live were the main risk factors. Thereis a need for a collaborative effort by stakeholders to increase the safety, affordability, and accessibility of modern musculoskeletal care throughout the country.*

Keywords*: Trauma, Traditional bone setting, Complication, Ethiopia, BOSAD study*

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Introduction

Traditional bone-setting (TBS) is a practice by a non-medically trained practitioners who care for musculoskeletal (MSK) injury without having any formal training. It is deeply rooted in the community and patronized with many individuals living mainly inrural areas where the availability and access for mod- ern orthopedic service is significantly limited (1–4). TBS has been practiced widely all over the world before modern medicine became available (5).

Despite the access and availability of modern orthopedic care, in most African countries including Ethiopia, TBS has been patronized in the community as an effective alternative to modern orthopedic care for MSK injuries (6–11). More than 80% of trauma patients in Sub-Saharan Africa and two-thirds of patients with frac- tures and dislocations in Nigeria use TBS as a first port of treatment (9,12–14).

TBS practice is associated with many life-and limb-threatening complications. For example, a study done in Nigeria has shown that 41% of patients had a non-union and 24.5% had a mal-union after sustaining a fracture (13,15).

Ethiopia is also one of the countries where TBS practitioners are deeply rooted in the community and result in catastrophic preventable complications, including death and disability. A study done in the southern part of Ethiopia has shown that more than 57% of the patients with a fracture first visited a TBS before presenting to an orthopedic clinic. At that time, most of the patients presented with many complications, including joint stiffness (53%), severe infection, mal-union (9%), limb length discrepancy (6%), and 4.3% gangrene (16).

In Ethiopia, despite the increasing number of orthopedic surgeons and the uplifting availability of modern orthopedic care, the practice of TBS remains popular with many devastating complications (17). These complications vary from country to country, bone setter to bone setter, and method of splinting, either bamboo, wood, or carton with tight rope. Most of the complications are preventable if appropriate application is taken with the responsible stakeholders.

To our knowledge, we haven't seen any nationally organized prospective study in Ethiopia to decrease the rate of amputation and prevent other complica- tions, despite numbers of retrospective study that have been published. To provide valuable infor- mation for policymakers, a large multicenter national Bone Setting Associated Disability (BOSAD) study was initiated. Before launching to the national label, apilot study was conducted to assess the data collec- tion questionnaires, and the nature of the BOSAD study website for competency and validity.

Our hypothesis was patients who visited TBS prior to the modern orthopedic services are at increased risk of developing complications. The objective of thisstudy was to describe the determinants of complica- tion among patients first visited TBS before present- ing to Hawassa University Comprehensive Special- ized Hospital (HUCSH) for orthopedic care.

Methods and Materials

Study setting, study design and study period

The study was conducted at HUCSH, Hawassa City, Ethiopia, which is the capital of Sidama Region, located 275 kilometer south of Addis Ababa (capital of Ethiopia). It was an institution-based prospective observational study conducted from July 2020 to June 2021, over one year period, as part of a large multicenter BOSAD study.

Sample size calculation and sampling

The sample size was calculated by Statistical online sample size calculator based on the proportion of severe infection (8.5%) as one of major complication reported from Kumma et al. study in Wolaita Sodo, Ethiopia (16), using anticipated complication rate of 3.6, 95% confidence interval with alpha of 0.05 and 80% power of the study. The final sample size after adding 10% of non-response rate was 230 patients. All patients who came consecutively during the study period were included in the study.

Dependent and Independent Variables

The presence of TBS associated complications was the dependent variable and the rest including sociodemographic variables such as age, sex, marital status, average monthly income, time from first injury to hospital arrival, recent TBS visit, place of residence, and re- gion were independent variables.

Inclusion and exclusion criteria

All Musculoskeletal (MSK) trauma cases who first visited traditional bone setters before seeking orthopedic care from health facilities and presented toHUCSH were included. Patients or guardians who refused to give consent to be included in the study and those at high risk of strangulation during the follow up were excluded.

Operational definition

Complication- was labelled as "yes" or "present" when the patient report or clinically or radiologically diagnosed one of the major complications on the bone, joint, neurovascular, skin, muscle, systemic and other body part after they get treated by TBS practitioner and seek medical attention for the complaint.

Data collection

Data were collected using a structured, pre-tested questionnaire translated into the local language (Amharic) by face-to-face interviews with the patients themselves or their families, and guardians for pediatric patients. Trained BOSAD study data collectors were collecting the data and entered the BOSAD studydata collection website at bosadstudy.com which was a password-protected platform developed for this purpose.

Statistical Analysis:

The data was exported into Statistical Package for Social Sciences (SPSS) version 24.0 for cleaning and analysis. Descriptive statistics were used to summarize the data. A binary logistic regression model was employed to identify factors associated with complications. In the multivariable logistic regression model, the magnitude of the association between complications and related factors was estimated using an odds ratio with a 95% Confidence Interval (CI). Finally, the findings were described in words, tables, and figures. A p value < 0.05 was considered the cut-off point to declare a statistically significant association between independent and dependent variables.

Ethical Considerations

The study was conducted after getting ethical approval from Hawassa University, College of Medicine and Health Sciences Institutional Review Board (IRB)

office with reference number of IRB/280/12. Informed and written consent was obtained from each participant before enrolment into the study. The anonymised data was used for the intended purpose only and it wasstored in password protected server which is accessed only by the principal investigator

Results

Socio-demographic characteristics of study participants

Overall, 230 MSK trauma patients were included in the study. Most of the patients, 69.6%, lived in urban residence. Nearly one-third (29.1%) of the patients were children less than 15 years-old, with a median (interquartile range (IQR)) of 25 (12 to 40) years. Over two-thirds (63%) of the patients were from Sidama Regional State; 69.6% of them were males; and 70.8% of those in reproductive age groups were married (Table 1).

Injury and complications related characteristics of study participants

Falling down accident was the main mechanism of injury (62.2%), and upper extremity was mostly affected body part (56.5%). The majority, 88.3% of the patients, had fracture with 88.7% closed in nature, whereas the remaining 11.7% were having soft tissue injury only without fracture. Over one in ten patients (12.2%) presented to the hospital with the splint applied by TBS where the most common splint type was tight towel bandaging in 46.6% followed by bamboo in 42.4%. A considerable proportion of patients, 113 (49.1%), had topically applied herbal medication as a treatment remedy.

Over two -thirds (62.6%) of the patients had a complication at presentation to the hospital. The most common complications reported included joint stiffness (30.4%), deformity (21.7%), skin sores and maceration (13.2%), and mal-union (12.6%) (Table 2).

Moreover, 58 (25.2%) patients visited a traditional bone setter after visiting health facilities as a first en- counter. The main reasons for going back to tradition - al bone setting from the heath facilities included fami- ly or peer pressure in 24 (41.4%) patients, lack of or- ganized care in the health facilities in 15 (25.9%), lack of timely admission or long waiting list 3 (5.2%), fi-

Table 1. Socio-demographic characteristics of study participants included in the study from July 2020 to June 2021

Variables (n=230)		Frequency	Percent
Place of residence			
	Urban	160	69.6
	Rural	70	30.4
Age group in years			
	0-14	67	29.1
	15-64	152	66.1
	65 and above	11	4.8
Sex			
	Male	160	69.6
	Female	70	30.4
Region			
	Sidama	145	63.0
	Oromia	72	31.3
	SNNPR	11	4.8
	Somali	2	0.9
Marital status (n=161)			
	Single	47	29.2
	Married	114	70.8
Educational status of patients			
	No formal education	44	19.1
	Primary school	108	47.0
	Secondary school	35	15.2
	Diploma and above	43	18.7

nancial reason to be treated in a health facility 11 (19.0%), and others 5 (8.5%).

Factors associated with complications among trauma patients

In the multivariable logistic regression model, younger age less than 15 years-old (AOR 2.43, 95% CI 1.21,

Table 2. Injury and complications related characteristics of study participants from July 2020 to June 2021

Variables		Frequency	Percent
Mechanism of injury (n=230)			
	Road traffic accident	46	20.0
	Falling accident	143	62.2
	Fight/assault	34	14.8
	Others	7	3.0
Specific area involved (n=230)			
	Upper extremity	130	56.5
	Lower extremity	85	37.0
	Pelvic and hip area	15	6.5
Type of Injury (n=230)			
	Soft tissue only without fracture	27	11.7
	Closed fracture	176	76.5
	Open fracture	27	11.7
Fracture Nature (n=203)			
	Closed	180	88.7
	Open	23	11.3
Splinted at presentation (n=230)			
	Yes	28	12.2
	No	202	87.8
Herbal Medication use			
	Yes	113	49.1
	No	117	50.9
Presence of Complication at presentation			
	Yes	144	62.6
	No	86	37.4
Type of complications (n=299) [1]			
	Skin Sore and maceration	39	13.2
	Chronic Osteomyelitis and septicaemia	22	7.4
	Malunion	37	12.4
	Non union	13	4.3
	Joint Stiffness	91	30.4
	Deformity	65	21.7
	Missed compartment syndrome and Volkman's Ischemic Contracture	9	3
	Gangrene	7	2.3
	Amputation	7	2.3
	Others[2]	9	3.0

[1]There is more than one report of complication per patient, a total of 299 complications are reported from 144 patients.

[2]Includes nerve palsy, septic joint, and muscle atrophy

Table 3. Determinants of complication among study participants from July 2020 to June 2021

Variables	Complication		COR (95% CI)	AOR (95% CI)	P-value
	Yes	No			
Region					
Sidama	80	65	1.00	1.00	
Others	64	21	2.48(1.37, 4.47)	2.05(1.06, 3.40)	0.033
Time from injury to hospital arrival					
<22.5 months	49	66	1.00	1.00	
>22.5 months	95	20	6.40(3.49, 11.75)	7.40(3.86,14.20)	<0.001
Patient's age in years					
<15	47	20	1.60(0.87, 2.94)	2.43 (1.21, 4.92)	
≥15	97	66	1.00	1.00	0.013

Discussion

Our study presented the bone-setting related complications among MSK trauma patients who first visited TBS before coming to health facilities. The study showed that 63% of the trauma patients who visited TBS had complications at presentation to the hospital. This complication rate is slightly higher than the rate of complications reported fromKumma et al. done 10 years back from Wolaita Sodo, Ethiopia which was 56.91% (16), butslightly lower than Memon et al. prospective report from Pakistan which report complication rate of 79.3% (19). This shows that even though the number of orthopedic surgeons and modernhealth facilities increasing in Ethiopia, TBS prac- tice is still significantly high, and complications are being seen in the southern part of the country. The high rate of complications in our study are dueto the technique utilized by the bone setters like tight bandaging and bamboo splinting, which hinder the blood circulation and cause skin sore, maceration, gangrene, and joint stiffness with mal-or non-united fractures due to inadequate stabili- zation at the fracture.

Most reported complications from this study were joint stiffness accounting 30.4% followed by deformity (21.7%), soft tissue complications (13.2%) and malunion (12.7%). In our study, the rate of amputation after TBS practice was reported to be 2.3%. Even though the frequency of complications are different, the type of complications reported in our study are almost similar with other studies reported from different parts of resource limited countries where modern orthopedic services are less developed or inexistence (13,16,19–21). This again prove that there are a lot of similarities of technical problem from the bone setter splint which should be improved to at least decrease the frequency of preventable complications.

In contrast to prior studies entered solely on the perspective of bone setters, our investigation aimed to uncover poten- tial gaps within health facilities that might drive patients to seek treatment from traditional bone setters. Our findings revealed that 58 (25.2%) patients initially sought care from a traditional bone setter despite the availability of health facilities. The primary reasons for patients returning to TBS after visiting health facilities were diverse including 24 (41.4%) due to familial or peer pressure, 11 (19.0%) because of financial constraints associated with health fa- cility treatments, 15 (25.9%) due to perceived lack of orga- nized care within health facilities, 3 (5.2%) faced challeng- es related to timely admission or lengthy waiting lists, and 5 (8.5%) cited other reasons. We contend that the 25% of patients who initially sought care from health facilities but later returned to traditional bone setters, subsequently representing to health facilities with complications, represent missed opportunities. This underscores the pressing need for health institutions to enhance the competence of healthcare professionals in diagnosing and treating MSK injuries. Moreover, there is a crucial need to provide safe and affordable services accessible to all patients, promote community awareness about available healthcare options, and strive towards creating more favorable and organized care environments within health facilities. Addressing these issues is imperative to mitigate the trend of patients resorting to traditional bone setters despite initial contact with health facilities and subsequent complications.

In our study, we observed a significant association between younger age less than 15 years-old (AOR 2.43, 95% CI

1.21,4.92) with occurrence of complications. This pediatric population often relies on families or guardians to make treatment decisions and consequently, they may be taken to TBS without their consent about their treatment and leading to complications. This vulnerable segment of the population necessitates legal protection to mitigate the risk of complications arising from treatments decided upon without their informed decision. Safeguarding their rights in healthcare decision-making is crucial to minimize the occurrence of complications and ensure their wellbeing. Similarly, longer time between initial injury and arrival at the hospital (AOR 7.40, 95% CI 3.86, 14.20), and the region where the patients lived (AOR 2.05, 95% CI 1.06, 3.40) were significantly associated with the presence of complications. These all entail that the modern health facilities need to work towards delivering safe, affordable and accessible musculoskeletal care for the needy patients, so that the complications from TBS practice will be significantly reduced.

The limitation of this study is its nature of being facility -based where it will present the significantly injured or complicated cases and it may miss patients who perceived as they successfully get treatment from TBS and return to their activities which need community-based study to address this issue. Our study is also a single institution -based study which is difficult to generalize to the whole nation and it would have been good to make it multicenter in order to have the overall picture of the problem throughout the country. The strength of this study includes being prospective, data collected with the website developed to enhance the quality of data.

Conclusion

The magnitude of complications among MSK trauma patients who first visited TBS practice was significantly high despite the increased number of modern health facilities and orthopedic services throughout the country. The risk factors for complications were younger age, delayed presentation to the hospital, and the region where the patients lived. The Ministry of Health, Non-governmental organizations, healthcare professionals, and other stakeholders need to work hard to deliver safe, affordable, and accessible musculoskeletal care throughout the country to minimize TBS associated complications.

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Conflict of Interest

The authors declare that there is no conflict of interest about this publication.

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Original Article

Traditional Bone Setting Practice in Addis Ababa, Ethiopia: Perspectives of Traditional Bone Setters and Orthopedic Surgeons

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Abstract

Introduction: *Traditional bone setting (TBS) is extensively used throughout the world irrespective of the accessibility of modern medicine. It is a source for primary fracture care among Ethiopians although it has not been studied as much as it deserves especially from the perspective of the practitioners. The aim of this study was therefore to explore the perception of traditional bone setters and orthopedic surgeons towards TBS practice in Addis Ababa, Ethiopia.*

Method: *A qualitative descriptive study design was employed to conduct interviews. Audio recorded interview and field notes data was transcribed and then analyzed using thematic analysis.*

Result: *A total of 21 TBS practitioners and orthopedic surgeons participated in this study. The findings revealed four main themes that dealt with orthopedic surgeons' perception towards TBS practice; reasons for community preference to use TBS services; materials used, client payments, home-based services, and sources of knowledge for TBS practice and views on possible collaboration between allopathic and traditional bone setting practice.*

Conclusion: *The TBS practice is commonly used and accepted by the Ethiopian community for different reasons despite the safety concerns raised. This calls for more collaboration among the TBS practitioners and the orthopedic surgeons as well as a policy intervention to ensure that society accesses safe and effective orthopedic primary healthcare services*

Keywords*: Traditional bone setting, orthopedics, practitioners' perception, Ethiopia*

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Introduction

Literature findings depict that up to 80% of the Ethiopian population uses traditional medicine, including the services of traditional bone setters called 'Wogesha' in Amharic, for their primary healthcare needs. This has been ascribed to the cultural acceptability, the relatively low cost, and better geographical accessibility of traditional medicine (1). The traditional bone setting (TBS) practitioners have variously been defined by different authors. Ezeanya-Esiobu has defined a traditional bonesetter as "a lay practitioner of bone manipulation, well-versed—at least, according to the view of patrons and his community at large—in the medical art of restoring broken bones to full functionali- ty" (2). Another study defines a traditional boneset- ter as "a lay practitioner of joint manipulation. He or she is the 'unqualified practitioner' who takes up the practice of healing without having had any formal training in accepted medical procedures" (3). The TBS practice, which is the traditional care of musculoskeletal injury, is one of the most widely recognized forms of traditional medical practice, with an estimated 10 –40% of people using it worldwide (5). It involves the use of splints and bamboo sticks or rattan cane or palm leaf axis with cotton thread or old cloth and herbs used in theform of concoctions and incantations (4). TBS existed long before formal orthopedic careemerged; it is also a well-known procedure throughout Africa, including Ethiopia, where it provides significant primary fracture care (4).

Because traditional bonesetters are positioned strategically throughout the community, anyone in need of fracture management may be able to get assistance from them (6). Moreover, the number of

trauma patients in Ethiopia is sharply increasing due to the increase in accidents such as those related to road traffic and occupational hazards (4, 7).

In a country where there is a severe shortage of orthopedic surgeons, TBS practitioners can potentially play a critical role in expanding access to musculo - skeletal care and improving health outcomes for mor- bidity as a result of these incidents (5). This view seems to be shared by the majority of orthopedic sur- geons in one study while acknowledging problemsassociated with the TBS practice, including those related to the use of excessively tight splints (8). Sev- eral studies reported on the different problems associ- ated with TBS practitioners, such as a high proportionof amputations due to gangrene and other complica- tions as a result of tightly wrapped bamboo splints (4, 5). With the interest of enhancing access to safer and improved fracture therapy by TBS practitioners, espe- cially in developing countries, a narrowed gap be- tween traditional and allopathic practitioners is man- datory. In this case, better- prepared traditional bone setters can bridge the gap that is left by the shortage of orthopedic surgeons in developing countries especially in Africa (8).

Understanding why members of society prefer TBS, understanding the practice of TBS practitioners, and assessing potential ways for collaboration between TBS practitioners and orthopedic surgeons are thus key issues to work towards the integration of TBS practices into primary healthcare (4, 5). The aim of this study was, therefore, to explore the perception of traditional bone setters and orthopedic surgeons towards the TBS practice in Addis Ababa, Ethiopia.

Participants and Methods

A qualitative descriptive design was employed to explore the perception of traditional bone setters and orthopedic surgeons towards TBS practice in Addis Ababa, Ethiopia (1). Qualitative approaches in this study were useful in providing rich descriptions of complex perceptions and belief systems regarding traditional bone-setting practices. (1)

Study setting and study period

The data were collected from Addis Ababa which is the political and commercial capital of Ethiopia. Addis Ababa is administratively divided into eleven subcities It is also home to 12 public and more than 40 private hospitals. There are a few public and private hospitals that give orthopedic treatment in Addis Ababa including the Orthopedics Center in Tikur Anbessa Specialized Hospital. The study was conducted from April to September 2023 G.C. at different hospitals that provide orthopedic services and different parts of the city.

Study participants

A total of 21 practitioners participated in this qualitative study, including 10 traditional bone setters and 11 physicians practicing in the orthopedic surgery field. The physicians were practicing as orthopedic surgeons in the different private and public hospitals in Addis Ababa and traditional bone setters practicing in different parts of Addis Ababa. These participants were purposively selected. Snowball sampling technique was used to recruit the Traditional Bone Setters.

Data collection methods

Qualitative interviews using a semi-structured interview guide were conducted by the first author. The interviews which lasted from 25 to 90 minutes were conducted in Amharic, the official language of Ethiopia and widely used in Addis Ababa. A half-day validation workshop was conducted which included practitioners from both TBS and Orthopedic surgeons, an expert from the national medicine regulatory body, and researchers. The data collection tool has components assessing the socio-demographics, orthopedic surgeons' perceptions towards traditional bone setting practice, reasons for community preference to use TBS services, Traditional bone setters' practice, and collaboration ideas between allopathic and traditional bone setting practice.

Data analysis

Collected data from the qualitative interviews were transcribed verbatim. The textual data were then thematically analyzed (2).

Trustworthiness

The trustworthiness of the findings was enhanced by different forms of triangulation including sources, investigators, and methods. Orthopedic doctors and traditional bone setters participated as sources of data; investigators from different disciplines such as orthopedic surgery and pharmacy collaborated in this research and thus different perspectives at different stages of the research were entertained; different methods including interviews and observations were used which added to the trustworthiness. The first author who also collected the data underwent a process of reflexivity during the different research phases to enhance trustworthiness. The presentation of verbatim transcription of the study participants we believe also contributes to the trustworthiness of the findings. Finally, the preliminary findings were presented among different stakeholders including some of the study participants who were able to validate it and further provide enrich-ments.

Ethical considerations

Ethical approval were obtained from the Institutional Review Boards of the School of Pharmacy (Ref. No. ERB/SOP/461/14/2022) and the Department of Orthopedics, School of Medicine (MF/ORTH/324/2023), College of Health Sciences, Addis Ababa University. All study participants provided informed oral consent before the data collection, and they were assured that

confidentiality would be maintained and about the voluntary nature of their participation.

Results

Socio-demographic characteristics of the participants

A total of 21 practitioners participated in this qualitative study, including 10 traditional bone setters and 11 physicians practicing in the orthopedic sur- gery field. As can be seen in Table 1, an equal number of women and men traditional bone setters were interviewed with most being older than 50years of age, married, and having a high school level education.With regards to their practice, most were full-time TBS practitioners with practice du - rations of more than 10 years, average income lev- els from 1000-5000ETB, and annual client visits of100-500 (Table 2). With regards to the physicians, most were male, less than 30 years of age, and had 4 to 7 years of experience as depicted in Table 3.

Table 1: Socio-demographic characteristics ofstudy participants practicing TBS, Addis Ababa,

Ethiopia, 2023 (N=10)

Socio-demographic Characteristics		Number
Sex	Male	5
	Female	5
Age	<30 years	0
	31–49 years	3
	>50 years and above	6
Marital status	Single	0
	Married	7
	Divorced	2
Religion	Orthodox	6
	Muslim	1
	Protestant	2
Education	Illiterate	2
	High school level	4
	Post-secondary education	3

Table 2: Traditional bone setting practice related information among practitioners, Addis Ababa, Ethiopia, 2023 (N=10)

TBS practice-related information		Number
Average monthly income (ETB)	1000-5000	7
	5000-10,000	1
	10,000-15,000	2
	>15,000	0
Duration of TBS practice (years)	8-10	2
	>10	8
Number of average annual client visits	50-100	2
	100-500	6
	>1000	2

Table 3: Socio-demographic characteristics of physi-cians practicing orthopedic surgery, Addis Ababa, Ethiopia, 2023. (N=11)

Socio-demographic Characteristics		Number
Sex	Male	9
	Female	2
Age	<30 years	7
	31–49 years	4
Marital status	Single	8
	Married	3
Religion	Orthodox	8
	Muslim	1
	Protestant	2
Education	Resident	7
	Senior orthopedic surgeon	4
Year of experience	1-3 years	2
	4-7 years	6
	8-10 years	1
	>10 years	2

The findings from this study revealed four main themes that described the perceptions of TBS practi- tioners and orthopedic surgeons on TBS practice. The main themes that were identified included the follow- ing: orthopedic surgeons' perception towards the TBS practice; reasons for community preference to use TBS services; traditional bone setters' practice includ- ing the materials used, client payments, provision of home-based services and source of knowledge of TBS practitioners; and views on possible collaboration between modern and TBS practice as presented below.

Orthopedic surgeons' perceptions towards traditional bone setting practice

The orthopedic surgeon participants explained that most of the experience and knowledge regarding TBS practice came while they were on duty in different parts of the country, through actual encounters with patients and interaction with the community. Nevertheless, they also came to know about the TBS prac- tice through personal experience and through family members who visited traditional bone setters, called *Wogesha* in Amharic. The quotes below are indicative of the common use of traditional bone setting practice among these study participants' circles including about possible mishaps clients may encounter.

> *"Oh, I have relatives who are living very far away…I go on vacation with them … and I observed that they use the traditional bone setting for their health care*

needs" (Physician #4)

"Yes, there are many of them. I think there is a daughter of a family that I know closely. She is now 10 or 12 years old, and when she was a child, her arm was broken, and the traditional treatment she received was Wogesha. She was lucky and her arm was not amputated…but now her arm is bent." (Physician #5)

Some orthopedic surgeon participants reported patient complications that they encountered after being treated by the TBS practitioners, especially for certain procedures in pediatrics as depicted by the following quote.

"If the provided treatment for conditions such as fracture is not appropriate, it will cause chronic pain and swelling at the site." (Physician #5)

Some of the participants have also cited concerns about the role of the mass media; which is considered a credible source of information by society, in broadcasting 'misleading' advertisements by the traditional bone setters regarding their practice. Another concern relates to the views of influential personalities that were supportive of the TBS practice that was however not evidence-based. These two ideas are depicted by the following quotes.

"On different occasions in the last 6/7 months, a Wogesha came and advertised on television explaining it is very heal-ing." (Physician #5)
"…Because of lack of knowledge, atti-tudes from responsible bodies are also becoming a barrier in policy-making, im-plementation as well as monitoring of tra - ditional medicine especially bone setting practice… (Workshop participant #1)

Workshop participants have recommended that higher educational institution curricula in health programs be revised to be accommodative of concepts related to Ethiopian traditional medicine including TBS practice.

"…Since we have learned in the conventional education system our perception towards traditional medicine is negatively biased. If the education system could address the relevant traditional medicine aspects, it can serve as a cornerstone for future learners…" (Workshop participant # 4)

Reasons for community preference to use TBS services

The majority of the orthopedic surgeon participants indicated that the community preferred to use TBS services rather than the allopathic orthopedic treatment based on the nature of the condition to be treated, previous experience, family influence, and availability of services among others as illustrated by the following quotes.

"…What I have now become convinced of is that everyone, especially those who have had a very shocking accident and have not had to make a decision, or who have been treated by their family or themselves in the past, has the confidence to believe in traditional medicine." (Physician #1)

"The community member believes that he should go to the Wogesha, where his whole family has been treated, and that's the traditional treatment, so it's easier for an older person to go to a place that someone is used to…The current generation, instead of visiting a doctor…it's easier to believe what his best friend, a villager, and his family say." (Physician, #6)

This view regarding community acceptance is supported by the TBS practitioners who explained that the community had a positive understanding and attitude towards TBS practice which led to using their services from near and afar as depicted by the following quote.

"The people from the countryside and the city respect me and traditional bone setting practice, they come, heal, and leave." (TBS practitioner #1)

Traditional bone setters' practice
Materials used by the TBS practitioners

The TBS practitioners explained the different items and facilities used while serving their patients to keep the injured bone from further damage or to facilitate their work in the healing process such as cardboard,bamboo, abujedi, bandage, and vaseline as depicted by the quote below.

"I use tape, cardboard, Abujade (type of cloth), bandage and the most important one is bamboo. There are many different types of bandages." (TBS practitioner, #6)

The TBS practitioners further explained how they provide further recommendations and precautions to their clients as part of the treatment and appoint them for further follow-up as depicted in the following quotes.

"Nutrition has a big role in traditional bone setting healing process" (TBS practitioner #5) "… It takes from six to12 months to recover, depending on the degree of damage and the

location of the damage." (TBS practitioner #6)

Some of the physicians also reported how the TBS practitioners utilized modern technology as depicted in the following quote.

"They do x-rays, physiotherapy, they have a massage room, they have beds, they have three, four rooms, they have double access." (Physician #1)

Views on the payments for TBS services

The traditional bone setters and the physicians had different points of view on the payments paid by clients. The traditional bone setter participants believed that the payment for their services depended on the condition treated but was considered afforda- ble to the community and that they would acceptwhatever their clients considered was adequate for their services. The physician participants on the otherhand related as to how they believed thepayments asked by these TBS practitioners were high and unaffordable. These differing points are depicted by the following quotes.

"I accept whatever they have given me" (TBS practitioner #3)
"We are told that these people will come after paying a lot" (Physician #7)

Provision of home-based services

One of the peculiar natures of the TBS practice is its flexibility to provide home-based services to those patients who have limited mobility as depicted below.

'...Many people are home patients with many injuries, for example, they cannot stand up and walk, and even if they try to get in and out of the car, they will cry even if they try to move. Therefore, we treat it at home so that it doesn't get worse." (TBS practitioner #6)

Source of knowledge for traditional bone setting practice

The source of knowledge and skill for the TBS practitioners was mostly from a parent to a child but also others to which one is close through apprenticeship as described by the following quote.

"There was a woman, an older woman, I used to live with her, and I took the experience from her." (TBS practitioner #5)

The connection of traditional medicine to spiritual processes was also raised by some participants as described below although most TBS practitioners stated that TBS practice was just a practice acquired from elders and not related to any spirituality.

"I pray, and I think that God will help me" (TBS practitioner #2)

Collaboration ideas between allopathic and traditional bone-setting practice

The idea of collaboration between TBS and modern healthcare to provide better care for the community was looked upon positively by some of the partici- pants. From the TBS practitioners' side, participants cited collaboration in getting access to training to mod-ernize their practice, offer complementary services, and refer complicated cases as depicted by the follow- ing quotes.

"... I believe that a complete treatment cannot be found, because traditional medicine has its expertise and wisdom, and scientific medicine has its way." (TBS practitioner #6)
"...There are many injuries that are beyond my control; we are sending to the hospi-tal" (TBS practitioner #4)

The physician participants were mostly skeptical about the possibility of collaborations citing mostly the TBS practitioners' lack of expertise and lack of accountability as depicted below.

"I don't think it will help at all with the orthopedics…because they (TBS practitioners) can't know the insides of the whole human anatomy the same way we do…so I don't think it's going to help in any way." (Physician #1)
"...so, unless there is some accountability, some training unless they can become a legal body, it is not good to work." (Physician #7)

The perspectives of the policymakers concerning the issue of collaboration were expressed during the workshop about the strategic plan of the regulatory authority as follows.

"...As a regulatory we have developed a strategic plan for integration of the TBS and allopathic medicine to be implemented in the coming 3 years, especially in rural areas of Ethiopia..." (Workshop participant #1)

Discussion

Findings from the present study indicated the community acceptance of the TBS practice but also concerns about its safety. In addition, the findings have revealed the common materials used in the TBS and common source of knowledge which was mainly through apprenticeship with close relatives or others. With re-gards to the possibility of collaboration, positive out- looks were expressed although issues were raised onthe need for training and to ensure accountability onthe part of the TBS practitioners.

The findings from the present study indicated the acceptance of TBS practitioners among the community as described by both the TBS and orthopedic practi-

tioners. This view is supported by local studies conducted in different parts of Ethiopia among both community members and admitted patients, whereby high levels of preference were reported (3). The findings of other studies from Sudan and Nigeria support this view of community acceptance of TBS services (4-10). A review paper has reported the acknowledgment of the value of TBS practitioners by orthopedic practitioners in rural developing nations for their capacity to provide a low-cost and culturally acceptable alternative to treat common orthopedic and trauma conditions (11).

Different reasons such as family influence, cultural acceptance, affordability, availability, and flexibility to provide home-based services seem to have contributed to the community's inclination toward TBS rather than allopathic orthopedic clinics (12). The findings from a local study reported similar reasons for preferring TBS services such as lower cost, quick services, availability, and family influence (13). Findings of studies from Sudan and Nigeria similarly reported cultural beliefs, low cost, easy accessibility, quick services, attitude of health workers, delay in hospitals, fear of plaster, operation or amputation, and family and friends' influence, among reasons to patronize TBS practitioners (9, 10, 14).

The source of knowledge in TBS practice in the present study seems to be from parents to children and through apprenticeship. This finding is similar to that reported from Tanzania where the source of knowledge for TBS practice was through passage from parents to children and apprenticeship with male neighbors (8, 12). This mode of acquisition of knowledge could limit transfer or even lead to loss of this indigenous knowledge to the next generation which calls for policy intervention to preserve the beneficial aspects of TBS practice.

Findings from this study revealed the use of mostly traditional materials such as bamboo and prescribed nutrition but also make use of modern ones such as Vaseline, bandages, and even X-rays among some TBS practitioners. Studies reporting in the context of developing countries have reported the use of splints and bamboo sticks, cloth, herbal medicines, animal hide, analgesics for pain, and supplies such as disposable gloves, topical antiseptic and sterile cotton, and gauze for wound care in TBS practices (3, 8, 10, 15). The reviewed studies also revealed the use of massage as a common procedure during TBS practices (10, 15) with similar practices im- plied in the present study.

Despite the community acceptance and advantages related to TBS practice, safety concerns were raised by the allopathic professional participants including serious complications in pediatric patients. Studies have similarly reported different complications such as malunion and nonunion from lack of radiographic imaging or proper reduction, compartment syndrome and gangrene from constrictive immobilization, and infection and tetanus from lack of sterility, lack of prophylaxis, and scarification (4, 16-18). Some of these complications arising from TBS practice were apparently due to the practitioner's lack of knowledge of the risks associated with procedures and their reclusive nature (19). Another study reported how most of these complications associated with TBS practice were preventable conditions if diagnosed early (20). These issuesseem to be modifiable if the traditional and allopathic practitioners collaborate in the interest of enhancing community access to orthopedic care while minimizing harm.

Collaboration was viewed positively from the TBS practitioners' side with the interest to access training, offer complementary services, and referral of complicated cases but skeptically by orthopedic surgeons' citing the former's lack of expertise and accountability. A local study has described how training in collaboration with local leaders has led to a significant decrease in both the number of gangrenous limbs requiring amputations and the total number of amputations in a two-year prospective trial period (19). Findings from other developing countries context including Africa similarly recommend training to these TBS practitioners in the basics of orthopedic care, sterile techniques, and others that would enable access to safe primary orthopedic care to the majority of the population (11, 15, 21).

The concerns of the orthopedic surgeon participants go beyond the lack of expertise and raise the issue of accountability for the TBS practice which cannot be addressed by training alone. Literature from the developing world reveals interests and strategies to integrate these practitioners into primary healthcare similar tothat attempted with traditional birth attendants in ob- stetrics care in light of the huge patronage to the TBS practitioners on the one hand and the scarcity of orthopedic surgeons. Accordingly, a system to identify, train, certify, and regulate the TBS practice was one approach suggested to integrate these practitioners into the health system to improve their practice and ensure patient health outcomes (11, 15, 21). This approach hasbeen indicated as a strategic direction of the Ethiopian government explicitly citing registration, licensing, and integration of traditional medical practices into the healthcare system although details have not been provided (27).

These and other recommendations for integration of traditional medicine including TBS practice into the formal healthcare system require the need for a collaborative spirit and prioritize the health needs of society. They also require active interventions to bridge the mistrust that seems apparent between the TBS practitioners and the orthopedic surgeons (15, 21). Some of these interventions such as creating forums and meet-

ings can be organized by willing practitioners while a more sustainable approach would require a policy -level intervention similar to the one indicated by the workshop participant from the regulatory body. Additional research into the practice and of the different stakeholders including the TBS clients is however required to further understand the different perspectives.

Conclusion

It was apparent from the present study that the TBS practice enjoyed community acceptance, although serious safety concerns were expressed by the orthopedic surgeons. The collaborations that were hinted at by the TBS practitioners such as access to training, provision of complementary services, and referrals to the allopathic healthcare system could address some of the concerns. This in turn requires the interventions of both groups of practitioners but also of the policy makers to build trust and collaboration to better serve society. In addition, further research to explore the perspectives of the different stakeholders is recommended.

Abbreviation: TBS: Traditional bone setting

Consent for publication: Written informed consent for each key informant was taken while collecting data, identification number was not included. No videos or images specific to participants were included in the collected data.

Availability of data and materials: The raw data used for this research can be accessed upon reasonable re-quest from the corresponding author.

Competing interests: All the authors declared no competing interests.

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Authors' contributions: EKM, BMH, BLW, and MYY were involved in the conceptualization and design of the study. EKM carried out the interviews, the transcription, and coding. EKM and BMH were involved in the analysis of the interviews with BLW and MYY commenting on the analysis. EKM drafted the manuscript, and all the others revised it. All authors read and approved the final manuscript.

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Original Article

Prevalence and Associated Factors of Carpal Tunnel Syndrome Among Manual Weavers in Addis Ababa, Ethiopia: Cross-Sectional Study

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Abstract

Background: *Carpal tunnel syndrome (CTS) is a prevalent neuropathy caused by factors like thickened flexor tendon sheath, skeletal encroachment, edema, or soft tissue mass compressing the median nerve at the wrist. Manual weaving is a common method of producing traditional clothing in Ethiopia. The purpose of this study is to assess the prevalence and risk factors of carpal tunnel syndrome among manual weavers in Addis Ababa, Ethiopia.*
Methods*: A cross-sectional study was conducted. Data were collected via the open data kit (ODK) along with Kobo Toolbox server. Finally, data were analyzed using Statistical Package for Social Science (SPSS) version 25. Participants who were positive for both the Phalen's and compression tests were considered positive for carpal tunnel syndrome. The strength of association was determined using an adjusted odds ratio (AOR) with a 95% confidence interval. In the multivariable binary logistic regression, statistical significance was declared at p<0.05.*
Results: *The prevalence of carpal tunnel syndrome among manual weavers in Addis Ababa was 14.7% (95% CI; 11.5-18.4). 15.2% (95% CI; 11.9 -18.9) of the study participants were positive for Phalen's test and 19.9 % (95% CI; 16.2-24.0) of the participants were positive for the compression test. Frequency of taking a break [AOR=2.64; 95% CI; 1.06, 6.58], co-morbidities [AOR=2.76;95% CI;1.02,7.51] and alcohol history [AOR=1.97;95% CI;1.09,3.57] had statistically significant association. From the cases (n=62) most of them (90.3%) had com- plained of at least one sensory symptom.*
Conclusion*: Carpal tunnel syndrome is prevalent among manual weavers, and it is significantly associated with not taking frequent breaks during weaving, comorbidities, and alcohol consumption. Sensory symptoms (tingling, numbness, and nocturnal pain) were more common in manual weavers than motor weakness symptoms.*

Keywords*: Carpal tunnel syndrome, Compression test, Phalen's test, Symptom severity scale, Functional severity scale*
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Introduction

Carpal tunnel syndrome is well-known entrapment neuropathy, which occurs when a thickened flexor tendon sheath, skeletal encroachment, edema, or soft tissue mass compresses the median nerve at the wrist (1).

The presence of symptoms, physical findings, positive nerve conduction tests, and provocative tests such as Tinel's and Phalen's signs are all used to diagnose car-pal tunnel syndrome (3).

To establish a diagnosis of work-related carpal tunnel syndrome, it is necessary to identify the occupational activities that could have contributed to the development of the syndrome. Activities conducted by weavers include wrist extension and flexion; repeated grasping of objects involving more than two fingers, and so on. Manual weaving is a common method of producing traditional clothing in Ethiopia. Shiro-meda (Gundshmeda), Adisugebeya, and Kechenemedhani-

alem are the study areas, which are the most common places in Addis Ababa where many weavers work.

Various studies have looked at the prevalence of carpal tunnel syndrome in various occupations aroundthe world. According to Colorado State University research, the prevalence of CTS among dairy parlor workers was 16.6% (6).

According to a cross-sectional study of laboratorystaff at King Saud University Hospital in Saudi Ara- bia, the prevalence of carpal tunnel syndrome is 25.3% (5). CTS were found in 5.79% of computer users at Mosul University in Iraq. As a result, carpal tunnel syndrome is common in a variety of occupa- tions that require repetitive flexion and extension of the wrist joint. However, no published research on the prevalence of CTS among manual weavers has been conducted.

The study was the first of its kind in Ethiopia and in the Africa region, where weaving work is common. The data generated from this study could be used as a foundation for future research in similar areas. The findings of this study will also be important for ergonomists to research manual weavers to determine whether ergonomic factors play a role in the development of CTS.
The aim of this study was to investigate the prevalence and risk factors of carpal tunnel syndrome among manual weavers in Addis Ababa, Ethiopia.

Methods and Materials

Study area and study period

This study was carried out from November 13, 2021, to January 7, 2022, in Addis Ababa City, where clus-tered weaving activities were done. Shiromeda, Adisu Gebeya, and Kechene Medhane Alem are the top areas where weavers are found in a clustered manner. Addis Ababa is the capital and largest city of Ethio- pia.

There are 57 enterprises in ShiroMeda(Gundshmeda), which contain an average of 1400 manual weavers. There are 13 enterprises in the Ad- disu Gebeya area where, on average, 260 manual weavers were found, and around the Kechene Medha-nialem, there are 12 enterprises in which an average of 240 manual weavers were included.

Study design and participants

A cross-sectional study design was conducted among manual weavers who were registered by the Addis Ababa city administration as enterprises and fulfilled the eligibility criteria.

Eligibility Criteria

We included manual weavers who have worked for at least 12 months as manual weavers. Weavers utilizing modern and advanced automatic machines were excluded. Weavers who have trauma or have a history of trauma recently at the shoulder and/or neck and/or arm and/or forearm were also excluded from this study.

Sample size determination

The sample size was computed based on a single proportion population formula with a prevalence of 50%. Because there is no previous similar study conducted in Ethiopia, taking the margin of error of 5%. The researcher took a 10% non -respondent rate which is 38.4 and the total sample size was 423.

Sampling procedure

There are three sites in Addis Ababa where manual weaving enterprises were found: Shiromeda (Gundshmeda), AddisuGebeya, and Kechenemedhanialem (Figure 1). The sample size was allocated proportionally to the three sites based on the total number of manual weavers. The names of weavers in each enterprise were registered and coded based on alphabetical order. Then, the participants were selected using a simple random technique by using alphabetical order-based codes as a sampling frame. Computer-generated random numbers were used to select the participants. The total number of manual weavers who had been registered was 1900.

Study variables

The dependent variable for this study was developing carpal tunnel syndrome. The independent variables were socio -demographic factors (gender, age, marital status, and educational status) and clinical and work-related factors (weaving work experience, frequency of taking breaks, mostly used hands, body mass index, comorbidities, alcohol history, and smoking history).

Operational definitions

Carpal tunnel syndrome: defined as the presence of pain at the wrist joint, hand, or forearm, in addition to paresthesia that worsens at night and is positive for Phalen's test and compression test.

Paresthesia: is defined as the presence of numbness and tingling at the radial side of the palm and 3 or 4 radial side fingers.

Data collection tools and procedure

Data were collected using a structured questionnaire by trained health professionals. Three trained data collectors were involved. The questionnaire had three parts. The first part had basic socio-demographic information; the second part had information about factors related to CTS; and the third part had a physical examination sheet. On the physical examination sheet, provocative tests were included to diagnose carpal

tunnel syndrome clinically. A combination of Phalen'stest and the compression test increases the reliability ofthe data. Because when we combine these provocative tests, we can get 92% of specificity and sensitivity (33). The severity scaling was performed using the Boston carpal tunnel syndrome questionnaire (BCTQ) (11).

Data presentation and analysis

The data was collected and entered using Open Data Kit (ODK) version 2021.2.4 software along with the **Kobo Toolbox** server to store the collected data and exported into SPSS version 25 for statistical analysis. Descriptive statistics like mean, standard deviation, median, interquartile range, and percentage were exe- cuted based on the nature of the data after checking the normal distribution. The data was presented with narra-tion, tabulation, and a graphical presentation.

The association between independent variables and CTS was determined using binary logistic regression. The "Hosmer and Lemeshow" test was done to test model fitness. First a bivariable analysis was performedon each of the selected indicators for the data-set. Then, any variable of $p<0.25$ was entered into multivariable analysis to identify variables that had a statistically significant association with CTS ($p<0.05$). The strength of the association was determined by computing the crude odds ratio (COR) and adjusted odds ratio (AOR) with a 95% confidence interval.

Data quality control

To ensure the quality of the data, pre-testing of the questionnaire was conducted among 13 respondents, which was equivalent to 5% of the total sample size. The data was collected by a data collector who has good skill in performing a physical examination. The Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) was used, which is a globally accepted stand- ard tool to diagnose carpal tunnel syndrome. Appropri- ate training was given to the data collectors by a senior orthopedist. To diagnose carpal tunnel syndrome and to

avoid false positive reports, a combination of at least two provocative tests was conducted in addition to signs and symptoms. To manage the data properly, the researcher used ODK for collecting and exporting data to SPSS for data analysis.

Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committee (REC) of the School of Medicine, College of Medicine and Health Sciences, Addis Ababa University. Before collecting the data, informed con-sent was obtained from each study participant. Poten-tial identifiers were not described in the questionnaire to ascertain confidentiality and the data collected was placed in a secured place. The information collected from the study participants was kept confidential and used solely for research purposes.

Results

Socio-demographic characteristics of study partici-pants

In this study, a total of 422 manual weavers participat-ed, resulting in a response rate of 99.7%. The median (IQR) age of the study participants was 30.1 (8) years. As shown in Table 1, the participants ranged in age from 20 to 64 years old. Most of the participants, 150 (35.5%), were in the age category of 26–30 years. Males represent 79.6% of the study participants. The majority (87.7%) of the study participants in this study were married. Regarding their educational status, 43 (10.2%) of the study participants had no formal educa- tion, while the remaining 89.8% had completed prima- ry school or above.

Table 1: Socio-demographic characteristics of manual weavers working in Addis Ababa , 2022.

Variables	Categories	Frequency	Percentage %
Sex	Male	336	79.6
	Female	86	20.4
Age	20-25	78	18.5
	26-30	150	35.6
	31-35	96	22.8
	36-40	55	13.0
	41-45	24	5.7
	46-50	13	3.1
	>50	6	1.4
Marital status	Currently married	370	87.7
	Currently unmarried	52	12.32
Educational status	No formal education	43	10.2
	1^0 Education	192	45.5
	2^0 Education	149	35.3
	College or above	38	9.0

Clinical and work-related characteristics of study participants

The weaving work experience of study participants ranged from 2 to 46 years. The median (IQR) of wav-ing work experience was 10 (6) years. As shown in Table 2, more than half (57.1%) of the respondents had

weaving work experience of <10 years. Out of the total study participants, 353 (79.6%) take breaks only at lunch, while 86 (20.4%) of the subjects take breaks every four hours. The majority of manual weavers (95%) were right-handed, with only 5% being left-handed. Regarding their clinical history, 7.1% of the participants had comorbid diseases, 42.7% drank alco-hol, and 2.1% were smokers. Almost all of the partici-pants (98.3%) were in the normal BMI range.

Table 2: Clinical and work -related characteristics of manual weavers who work in Addis Ababa.

Variables	Categories	Frequency	Percentag
Weaving work experience (in years)	<10 years	241	57.1
	10-20 years	150	35.5
	>20 years	31	7.3
Frequency of taking break	Only at lunch	336	79.6
	Every 4 hours	86	20.4
Mostly used hand	Right	401	95
	Left	21	5
BMI	Underweight	6	1.4
	Normal	413	98.3
	Overweight	1	0.2
Comorbidity	Yes	30	7.1
	No	392	92.9
Alcohol	Yes	180	42.7
	No	242	57.3
Smoking	Yes	9	2.1
	No	413	(97.9)

Prevalence of carpal tunnel syndrome

The prevalence of CTS among manual weavers in Addis Ababa was 14.7% (95% CI: 11.5–18.4). Among the participants included in this study, those who were positive for Phalen's test and compression test were considered to have CTS. Of the total respondents, 15.2% (95% CI: 11.9–18.9) of them were positive for Phalen's test, and 19.9% (95% CI: 16.2-24.0) of the participants were positive for the compression test (Table 3).

The prevalence of CTS demonstrated a variation in sex, age, and other predictor variables. It was higher among females (16.3%) than males (14.3%). Similarly, the prevalence was higher in the age categories of 36–40 years (3.8%) and married (14%). From the 401 right -handed study participants, 56 (13.9%) were positive for CTS. Out of the 62 CTS -positive subjects, 58 (93.5%) took a break only at lunchtime. Similarly, CTS was found in 28% of those with comorbid conditions and 21.74% of those who drank alcohol. From the study participants who had more than 20 years of weaving work experience (n = 31), 7 (22.6%) were positive for CTS. Whereas only 21.9% of individuals with 10–20 years of experience and 9.84% of those with <10 years of experience, respectively, were posi- tive for CTS (Table 2). As indicated in Figure 2, from the total respondents, those with weaving experience of 10–20 years account for 7.1%.

Table 3 : Prevalence of carpal tunnel syndrome among manual weavers.

Variables	Category	Frequency	%	Prevalence	95% CI
Phalen's Test	Positive	64	15.2	15.2%	11.9-18.9
	Negative	358	84.8		
Compression Test	Positive	84	19.9	19.9%	16.2-24.0
	Negative	338	80.1		
Carpal Tunnel Syndrome	Positive	62	14.7	14.7%	11.5-18.4
	Negative	360	85.3		

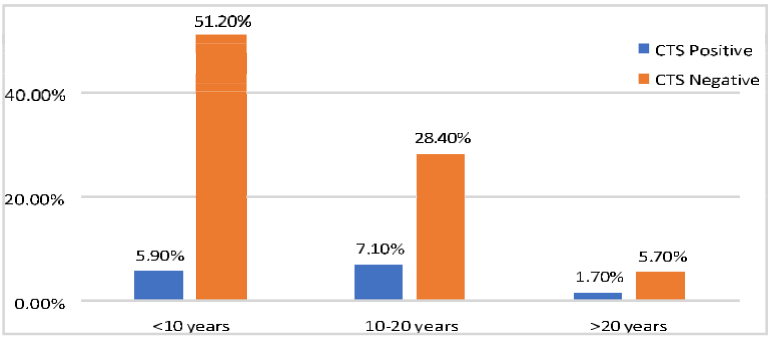

Figure 2: Carpal tunnel syndrome based on the different period of weaving work experience among manual weavers in Addis Ababa, 2022.

Symptom and functional severity scale of carpal tunnel syndrome

The symptom severity scale (SSC) ranged from a minimum of 11 to a maximum of 25. The functionality severity scale ranged from 8 to 16. The mean (SD) of SSC and FSC was 17.77 (3.84) and 8.98 (1.85), respectively (Table 4).

Among the carpal positive study participants (n = 62), 56 (90.3%) had nocturnal pain, 34 (54.8%) woke up at least once during the night due to the pain, 25 (40.3%) had hand or wrist pain during the daytime, 51 (82.3%) had numbness in the hand, 50 (80.6%) had a tingling sensation in their hand, 35 (56.5%) had weakness in their hand or wrist, and 12 (19.4%) had difficulty grasping.

The three categories (mild, moderate, and severe) ofCTS symptoms were based on the SSS and FSS. Indi- viduals suspected of having mild, moderate, and se-vere CTS symptoms were in the 50^{th} percentile, in the 50- 75^{th} percentile, and above the 75^{th} percentile, re- spectively. This classification was the same for FSS
5. Based on this classification, as shown in Figure 3, out of the CTS-positive subjects (n = 62), 26 (41.9%) had mild symptoms, 34 (54.8%) had moderate symptoms, and 2 (3.2%) had severe CTS symptoms. Similarly, 39 (62.9%) had mild functional difficulty, 22 (35.5%) had moderate difficulty in function, and 1 (1.6%) had severe functional difficulty.

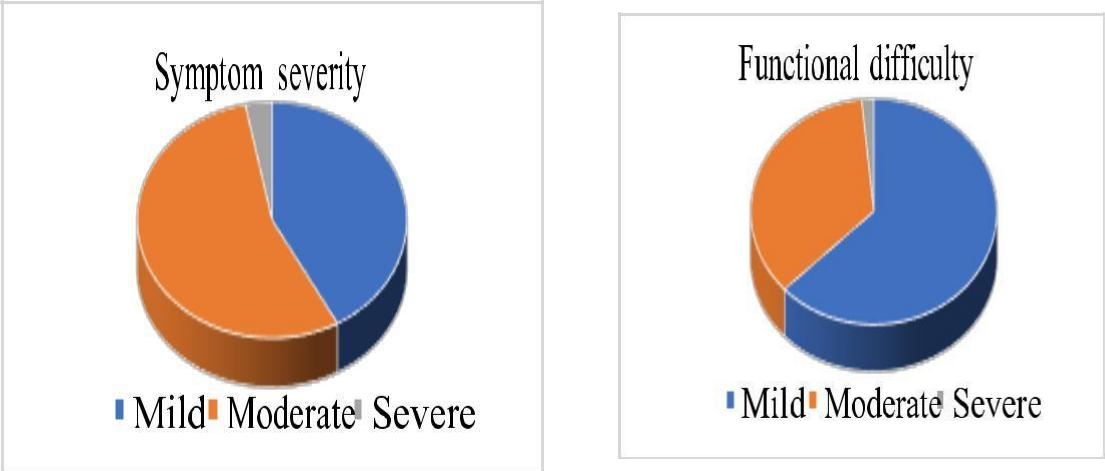

Figure 3: Distribution of Symptom Severity Scale and Functional Severity Scale Categories.

A comparison of the mean SSS and FSS of CTS-positive study participants using the different predictors showed that the mean SSS was not statistically different between males and females. While the mean FSS of females (9.93±2.9) was significantly higher than males (8.71±1.3), which showed that females had more functional difficulty than males due to CTS, After checking the assumptions, a one- way ANOVA was conducted to compare the mean SSS and FSS between the different categories of weaving work experience.

Study participants who had more than 20 years of experience had a statistically significant mean SSS difference with those participants with less than 10 years of experience (mean difference = 2.71, p-value = 0.031).

But the mean FSS difference between the two groups was statistically insignificant. Moreover, subjects who consume alcohol (18.81±3.6) had a statistically higher SSS than those who don't consume alcohol (16.05±3.7).

Table 4: Symptom severity scaling (SSS) and functional severity scaling (FSS) among CTS positive manual weav-ers in Addis Ababa

Variable	Category	SSS mean (SD)	t-value/ F-value	p-value	FSS mean (SD)	t-value/F-value	p-value
Sex	Male	17.52(3.7)	0.961	0.341	8.71(1.3)	-2.24	0.029
	Female	18.64(4.5)			9.93(2.9)		*
Work Experi-	<10 year	16.15(2.5)	4.45	0.031*	8.11(0.6)	2.27	0.105
ence	10-20 year	17.41(3.0)			8.23(1.0)		
	>20 year	18.86(4.1)			8.48(2.2)		
Handedness	Right	17.7(3.8)	-0.48	0.630	8.91(1.7)	-0.950	0.346
	Left	18.5(4.2)			9.67(3.1)		
Alcohol History	Yes	18.81(3.6)	2.60	0.012*	9.08(1.6)	-0.490	0.623
	No	16.05(3.7)			8.85(2.1)		
Comorbidity	Yes	19.29(3.4)	1.12	0.273	9.05(1.9)	0.841	0.404
	No	17.58(3.9)			8.43(0.5)		
Frequency	Only at lunch	18.29(5.6)	0.371	0.712	9.14(2.3)	0.239	0.812
Of Breaking	Every 4 hours	17.71(3.6)			8.96(1.8)		
time							

* Significant at p-value <0.05

Factors associated with carpal tunnel syndrome

Mostly used hand, frequency of break time, educational status, and history of alcohol and co morbidity were taken as candidate variables for multivariable logistic regression at a p-value ≤ 0.25. The output from multivariable binary logistic regression showed waving work experience, co morbidity, less frequent break time, and alcohol were associated with carpal tunnel syndrome after adjustment to confounding variables.

Study participants with more than 20 years of weav-ing work experience had 3.89 times higher odds of having carpal tunnel syndrome (AOR = 3.89, 95% CI, 1.28–11.76, p = 0.016) than those with less than 10 years of experience, provided that the other varia-bles were kept constant. Similarly, the odds of having carpal tunnel syndrome among participants with 10– 20 years of weaving work experience were 2.69 (AOR = 2.69; 95% CI: 1.36–5.34, p = 0.004) times higher than those with less than 10 years' experience.

Keeping the other variables constant, participants who reported taking a break only at lunch were 2.64 times more likely to have CTS than those who took abreak every four hours (OR: 2.64; 95% CI: 1.06– 6.58, p = 0.038). The odds of CTS in current alcohol users were 1.97 times higher than those who did not drink alcohol (AOR: 1.97, 95%CI: 1.09 –3.57, P = 0.025). Moreover, study participants who had comor- bid conditions had 2.76 times higher odds of having CTS than those without any comorbid diseases (AOR, 2.76, 95% CI, 1.02-7.51) (Table 5)

Discussion

This study tried to assess the prevalence of carpal tunnel syndrome (CTS) and its associated factors among 422 manual weavers using an interviewer-administered questionnaire. A physical examination was also done to perform Phalen's and compression tests. The prevalence of CTS among manual weavers was 14.7% (95% CI, 11.5%–18.4%). The result of the current study was comparable to a study carried out in Kuwait among office workers (18.7%) and Iran (19.4%) among carpet weavers. The prevalence inthis study was lower than in other studies conductedin Turkey (21.2%) (17), India (21.5%) (39), Saudi Arabia (25.3%) (5), and Iraq (36.2%) (1). In contrast, it was higher than the study conducted in China among office workers (9.6%) (40) and in the USA (8.7%; 41) among poultry processing workers. Our finding was also higher than other studies conducted in Sweden (14.4%) and Japan (4.7%) among the general population.

The possible explanation for the discrepancy in prevalence could be the difference in the study population. The Japanese study was conducted among the general population, which might reduce the prevalence. Whereas the study in Iraq was among computer users who were susceptible to CTS due to the repetitive wrist and hand movement nature of their work. An- other possible reason for the discrepancy could be the method of assessment used to diagnose CTS. In the present study, CTS was diagnosed with clinical assessment and physical examination (Phalen's test and compression test). While the Iraqi and Turkish studies use nerve compression tests in addition to clinical assessment, which might increase the diagnosis of asymptomatic CTS,

Table 5: Bivariable and multivariable logistic regression analysis of carpal tunnel syndrome with its predictor vari-able among manual weavers working in Addis Ababa, 2022.

Variables	Category	Carpal Tunnel syndrome		COR (95% CI)	AOR (95% CI)
		Yes (%)	No (%)		
Sex	Female	14(3.32)	72(17.1)	1	1
	Male	48(11.4)	288(68.2)	0.86(0.45-1.64)	0.66(0.31-1.42)
Marital Status	Unmarried	3(0.71)	49(11.6)	1	1
	Married	59(13.98)	311(73.69)	3.09(0.94-10.27)	2.67(0.77-9.34)
Weaving work Experience	<10 years	25(5.9)	216(51.2)	1	1
	10-20 years	30(7.1)	120(28.4)	2.16(1.22-3.84) **	2.69(1.36-5.34) **
	>20 years	7(1.7)	24(5.7)	2.52(0.99-6.44) *	3.89(1.28-11.76) *
Mostly used hand	Left	6(1.4)	15(3.6)	1	1
	Right	56(13.3)	345(81.8)	2.46(0.92-6.62)	2.4(0.83-6.97)
Frequency of break per day	Every 4 hours	7(1.7)	79(18.7)	1	1
	Only at lunch	55(13.0)	281(66.6)	2.21(0.97-5.04) *	2.64(1.06-6.58) *
Educational Status	No formal education	6(1.42)	37(8.77)	1	1
	1^0 educations	37(8.77)	155(36.73)	1.47(0.58-3.75)	2.27(0.78-6.65)
	2^0 educations	16(3.79)	133(31.5)	0.74(0.27-2.03)	0.82(0.27-2.46)
	College and above	3(0.71)	35(8.29)	0.53(0.12-2.28)	1.08(0.21-5.56)
Alcohol History	No	26(6.2)	216(51.2)	1	1
	Yes	36(8.5)	144(34.1)	2.08(1.20-3.59) ***	1.97(1.09-3.57)*
Comorbidity	No	55(13)	337(79.9)	1	1
	Yes	7(1.7)	23(5.5)	1.87(0.76-4.55) *	2.76(1.02-7.51) *

*** significant at p-value <0.001 ** significant at p-value <0.01 * significant at p-value <0.05
Good of fitness test (Hosmer and Lemeshow test) p-value = 0.069

The current study revealed that the prevalence of CTS recorded among females (16.2%) was higher than males (14.3%). This finding agreed with the studies done in USA (7), Saudi Arabia (5), Iraq (1), and China (40), which report a higher rate of CTS in females than males. The possible reason for the higher rate of CTS infemales could be due to the smaller tunnel size andad- ditional daily work at home.

The prevalence of CTS in this study increased as the age increased; the rates also increased, with the highest prevalence in the age group of more than 45 years. This finding was in line with studies done in India (39) and Sweden (7).

Our study showed that the mean difference of SSS in relation to sex among CTS-positive participants had no statistically significant difference (t-value = 0.961; P-value = 0.0.34). This was in contradiction with the study conducted in Saudi Arabia (5), which found a significantly elevated SSS in females compared to males. However, contrary to the Saudi Arabian study, female individuals in this study had a statistically higher mean FSS than male participants (t-value = -2.24; P-value = 0.029). Therefore, females had higher difficulty of function. This might be since females do a lot of activities at home that require repetitive hand flexion and extension at the wrist joint. This may worsen FSS.

In this study, the mean difference of SSS in relation to weaving work experience in the three categories (<10, 10-20, and >20 years) was statistically significant (t = 4.45; p = 0.031), which is against a study conducted in Saudi Arabia (5), which states that the mean difference of SSS is not significant in relation to work experience. But like the Saudi Arabian study, the mean difference of FSS related to work experience was not statistically significant (t = 2.27; p = 0.105).

The mean difference of both SSS and FSS in relation to comorbidity, handedness, and frequency of taking a break was not statistically significant, with a P-value of 0.63, 0.27, and 0.71, respectively, for SSS and 0.34,

This study implied that among the carpal-positive study participants, 82.3% had numbness in the hand, 90.3% had nocturnal pain, and 80.6% had a tingling sensation in the hand. This was higher than the Saudi Arabian and Indian studies, which showed 61.4% and 30% numbness, 66.7% and 10% nocturnal pain, and 70.2% and 10% tingling, respectively. This finding was also higher than the Chinese (40) study, which discovered 60% numbness and32% tingling. Among our CTS-positive participants, 19.4% had difficulty grasping, 40.3% had hand or wrist pain during the day, and 56.5% had weakness in theirhand or wrist. This contrasted with the Saudi Arabianstudy, which reported 31.6% difficulty grasping, 82.5% ofhand or wrist pain during the daytime, and 73.7% of weakness in the hand.

Weaving work experience and CTS were found to have a strong association in this study. Participants with 10–20 years of weaving work experience had 2.69 times higher odds of having CTS than those with 1–10 years of work experience. Participants with more than 20 years of weaving work experience had a 3.89 times higher risk than those with less than 10 years of weaving work experience. A cross-sectional study conducted in Iran among female carpet weavers reported similar findings (20). Which suggested that developing CTS is highly associated with weaving experience and active working time per day? In this study, estimating the association between CTS and active working time per day was difficult because almost all the study participants work 8 hours per day and 6 days a week.

According to this study, participants who reported only taking a break at lunch were 2.64 times more likely to have CTS than those who took a break every four hours. A study done among computer users in China (40) was comparable with our findings. It reports that working without a break was found to be associated with an increased prevalence of CTS.

According to our findings, the risk of CTS was 1.97 times higher in alcoholics than in non-drinkers. Similarly, a cross-sectional study conducted in France (42) and India (39) reported higher odds of CTS among alcoholics than their corresponding subjects.
According to our findings, having comorbidities (diabetes, rheumatoid arthritis, and goiter) raises the inci- dence of CTS by 2.76 times. A cross-sectional study of office employees in Kuwait accentuates our findings, re- vealing that participants with two comorbidities had an odds ratio of 3.3, while those with three comorbidities hadan odds ratio of 14.9, according to the study (5).

Many earlier studies have revealed an association between DM and CTS (29, 30). Even though this study found an association between CTS and comorbidities (DM, RA,and goiter) in general, it did not establish a specific asso-ciation between CTS and DM. This is due to the fact that we only had 6 (1.42%) known DM participants in this study, making statistical analysis challenging. Similarly, numerous prior investigations found an association between RA and goiter (21, 23–25, 33–35). It was also difficult to determine if there was any associa- tion or not, for the same reasons as DM.

Even though overweight and CTS had a strong association in prior studies (21, 26, 27), there was no such association in this study. This could be due to the respondents' socioeconomic position. Since obesity is more common in those with higher socio-economic levels, our participants were by default low-income. Because the participants in this study were manual hand weavers, they were classified as small business-es by the Addis Ababa city authority. These chances were provided for people who could not run their own business due to a lack of funds. As a result, mostof the participants (413) (98.3%) have a normal BMI (18.5- 24). Similarly, the Chinese (40) study stated that BMI was not a significant predictor of CTS.

The present study failed to show a significant association between smoking and educational status with CTS. This was since the number of observations for smoking was not sufficient to fit into an analytical analysis. This was contrary to the studies done in China (40), the UK (23), and India (39), which found a higher risk of CTS among smokers and a lower risk of CTS among those with higher educational levels.

Conclusion

The findings of this study implied that a high prevalence of clinically confirmed CTS was seen among manual weavers in Addis Ababa. The prevalence was higher among females than males. Those participants who do not take a break frequently show higher odds of CTS than those who take breaks frequently. Participants who had been working as manual weavers for a long time had higher odds of having CTS. Drinking alcohol and comorbidities (DM, RA, and goiter) were also highly associated with CTS.

Sensory symptoms (tingling, numbness, and nocturnal pain) were more common than symptoms of motor weakness. Sensory symptoms are more common among females than males in those participants with many years of experience than in those with fewyears of work experience. Drinking alcohol was alsoa risk for developing sensory symptoms.

Unlike other studies, this study showed that handedness, smoking, age, and educational status had no significant association with developing CTS or both sensory and functional symptoms.

Recommendation

Since this study was done in the worksite, it did not include serious cases in which workers were unable to weave owing to severe CTS. As a result, further community-based studies should be conducted. Health education should be given for manual weavers

to take at least two breaks per day and to avoid drinking alcohol. It is better to conduct a periodic screening regularly to diagnose CTS early and to minimize functional disabilities.

List of abbreviations

AOR: Adjusted odds ratio, BMI: Body mass index,CTS: carpal tunnel syndrome, COR: Crude odds ratio, DM: Diabetic Mellitus, IQR: interquartile range. ODK: open data kit, RA: Rheumatoid arthritis, SPSS: statisti- cal package for social science, SSS: symptom severity scaling, FSS: functional severity scaling.

Consent for publication

Not applicable

Availability of data and materials

The data sets generated and /or analyzed during the current study are not publicly available due to preserving participant anonymity but are available from the corresponding author on reasonable request.

Competing interests

All authors assert that they have no competing interests.

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Authors' contributions

Hailemariam. Z designed the study, was involved in supervising data collection, analysis, and interpretation of the result, and drafted the paper, and participated in preparing all versions of the manuscript. Mekbeb. A, Biruk. L, Elsa. D and Solomon. M assisted in the design and the proposal development, monitored data collection, assisted during analysis, and revised subsequent drafts of the paper. All authors read and approved the final manuscript.

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Original Article

Accuracy of Predicting Implant Head Size by Digital Templating with and without Radiographic Marker in Hip Hemiarthroplasty: A One Year Retrospective Record Review

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Abstract

Background *Preoperative templating has paramount importance for both Total Hip Arthroplasty and hemiarthroplasty. The objective of this study was to assess accuracy of predicting implant head size by digital templating with and without an external radiographic marker in hip hemi-arthroplasty.*

Methods: *A retrospective record review was conducted**.** Two blinded observers used digital software (Radiant Dicom viewer) to template the femur head size of 35 individuals who had undergone hip hemi-arthroplasty in Tikur Anbessa Specialized Hospital (TASH) from September 2022 to September 2023 using two different meth- ods, i.e., external radiographic marker and fixed magnification factor. The templated head size values were then compared to the head size of actual implants used intra-operatively to assess the accuracy of each method. Co- hen's kappa value was used to calculate inter-observer variability.*

Result: *The accuracy of predicting implant head size in hip hemi-arthroplasty using both methods was similar with a mean relative error of method 1 (2.8 & 3.1% for observers A & B, respectively) and method 2 (3.3 & 3.4%for observers A & B, respectively), p-value for both observers A & B is 0.46 & 0.59, respectively with 95% CI. Inter-observer agreement for both method 1 & 2 was excellent when a precision scale of 1 size was used with a kappa value of 0.84 and 0.93 respectively.*

Conclusion*: Digital templating of hip hemiarthroplasty using a fixed magnification factor is as accurate as the radiographic marker method in predicting implant head size with excellent Inter-observer reliability.*

Keywords*: Hemiarthroplasty, templating, femur head size, external radiographic marker, fixed magnification factor*

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Introduction

Hip fractures are the most common ones among fragility fractures. Approximately 2 million people sustain hip fractures yearly and femur neck fracture accounts for 50% [1]. By the year 2050, it is ex-pected that the incidence will be doubled [2]. Among patients with hip fractures, 75% are women [3].

Arthroplasty is the mainstay of treatment for older individuals with a displaced femoral neck fracture. For several reasons, Total Hip Arthroplasty (THA) is the main treatment choice for older, active patients (less than 75 years of age) [4][5]. Hemiarthroplasty (HA) is reserved for elderly fragile patients and those with higher dislocation risk. However, in countries like Ethiopia most patients are managed with HA since the practice of THA is not well expanded. A variety of HA implant options are available, such as fixed and modular neck, unipolar and bipolar head, and cemented and uncemented stem. The current choice of implant is cemented modular bipolar HA [6] [7].

There have been many reports on pre-operative digital templating in THA. It helps the surgeon predict the proper implant size and levels of bone resection so that, it decreases surgical time and complications of both intraoperative and postoperative procedures [8][9]. Ithas also been recently shown to be a helpful tool in

hip HA preoperative planning.[10]

Although intraoperative direct measurement of the native femur head dictates the final femur head size, estimating the possible size preoperatively will help the surgeon check the availability of the size in the operation theatre stoke. The discrepancy between the femoral head size and acetabulum has been identified as a contributing factor to accelerated acetabular erosionand protrusion, which may increase the likelihood of requiring revision surgery. [11]. Various reports showed that a size difference between the native and prosthetic femur head size beyond 1.5 to 3.2 mm will result in significant acetabular erosion [12][13][14].

There are several methods for determining the magnification factor (MF) while templating. The pervious studies showed that, digital templating using a set MF has better or equal accuracy to the external radiographic marker method (ERM) [15][16]. The lower accuracy of ERM method may be due to technical difficulty in finding the center of Greater Trochanter (GT), particularly in obese patients which in turn affects the accuracy of this technique. According to study conducted in the united kingdom, there is an average 6.8% error in accuracy regarding femoral head size due to the position of ERM [17].

Though previous study showed that the ERM technique is inferior, it is still used as the mainstay of templating technique in TASH. Furthermore, this method incurs additional costs and radiation exposure by increasing the number as well as the filed of X-ray in order to incorporate the marker over the GT. This study assessed the predictive accuracy of digital templating for femur head size in hip HA with and without a radiographic marker.

Methodology

Materials and Method

A retrospective study was conducted in all patients who had undergone hip HA for the indication of femurneck fracture at TASH from Sept 2022 to Sept 2023 and fulfilled the eligibility criteria. Patients witha Adequate preoperative pelvic AP x-ray with ERM placed over the GT and documented actual implant head size in the medical chart were included in this study. Patients with contralateral hip HA were exclud- ed from the study. Adequacy of the pelvic x-ray was assessed using the following parameters: well cen- tered, no significant rotation of the pelvis, and thelesser trochanter of the uninjured femur shouldn't be seen in full profile. Data were collected using a check- list which consisted of sociodemographic factors (age and sex), implant related factors (size and type of im- plant), and templated values. Age, sex, size, and typeof implant used were retrieved from their respective medical record.

Preoperative templating of femur head size:

The radiant Dicom viewer was used to template the femur head size from the uninjured side of the hip. Templating was done by two observers (A & B) who were blinded to the size of definitive implant used and each other's measurements. The widest diameter of the femur head from the uninjured hip was measuredto determine the femur head size. Then the direct X- ray measurement was calibrated using 2 differentmethods; Method 1 – external radiographic marker & method 2 - fixed magnification factor. (figures 1 & 2)

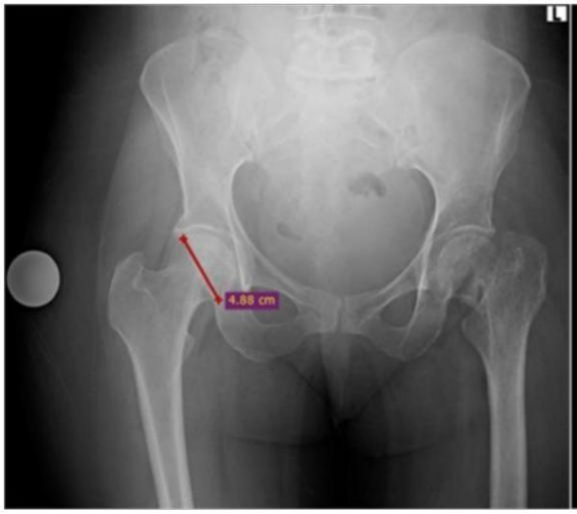

Fig. 1 direct X-ray measurement of femur head

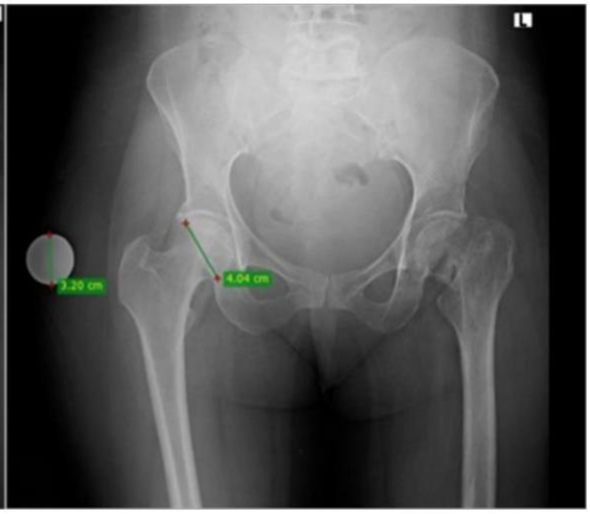

Fig.2 calibrated femur head size

The magnification factor of our digital X-ray was determined from 15 pilot pelvic AP X-rays with a 32mm sphere over the GT. Each radiograph magnification factor was obtained using the following formula and the mean magnification factor was calculated to be118%.

MF = Actual sphere size x 100
Templated sphere size

The femur head size was calculated using a set MF of 118 by the following formula:

Direct x-ray measurement femur head x 100 Fixe magnification factor (118)

eg. Femur head size calculation for the x-ray on fig. 1 will be, $4.88/118 \times 100 = 4.13$CM.

Data processing and analysis:
Once the data ware collected and checked for completeness, analyses were done using IBM SPSSversion 29 software. The template and actual implant head sizes were compared and thedifference was computed.

The accuracy of each technique was expressed using percentages. Mean relative error for both methods & observers was calculated & compared using an independent student t-test. Cohen's kappa value (k) was used to assess inter-observer reliability.

Result
One hundred and two 102 hip hemiarthroplasties were done for an indication of femur neck fracture at TASH from September 2022 to September 2023. Outof these participants, 35 (12 males and 23 females) met the eligibility criteria. The average age was 67 (50-95 years). 8 patients underwent cemented HA and the remaining 27 were uncemented. In terms of implants 7 bipolar and 28 unipolar heads wereused. The average implant head size we used was 42mm in females & 47mm in males soft tissue and joint spac-es.
Fig. 3 & 4: show age and sex frequency distribution

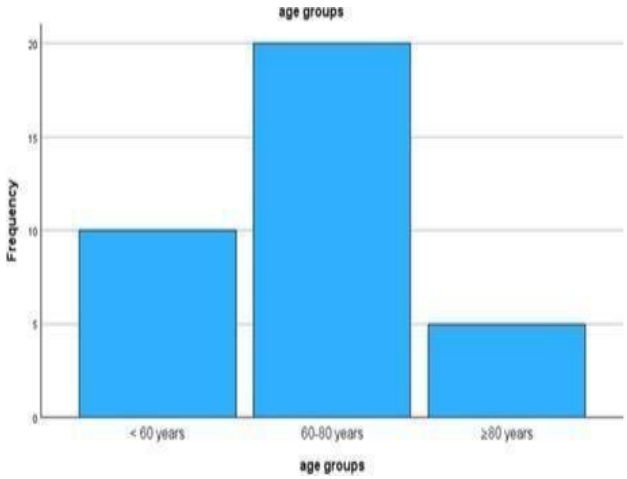

Fig.3: age frequency distribution

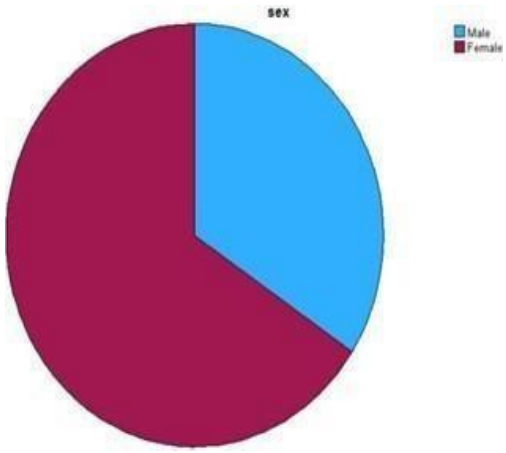

Fig.4: sex frequency distribution

Accuracy:
Observer A predicted the exact femur head size in 11 hips (31%) & 8 hips (23%) using method 1 & 2 respectively. The accuracy increased to 85% (30 hips) & 80% (28 hips) when the precision level was increased to within 2mm. Observer B predicted the exact femurhead size in 9 hips (26%) & 7hips (20%) using meth- ods 1 & 2 respectively. When the precision level is increased to within 2mm, femoral head size was pre- dicted correctly in 27 hips (77%) using both tech- niques. (table1)

The mean relative error of method 1 was (2.8 & 3.1% for observers A & B, respectively) lower than method 2 (3.3 & 3.4% for observers A & B, respectively) however it was not sta- tistically significant (p- value for both ob- servers A & B was 0.46 & 0.59 with 95% CI). (table 2)

Inter-observers agreement:
Kappa value for the exact measurement agreement using method 1 & 2 was 0.36 and 0.52 respectively. When the precision scale of 1 size (1mm) was used, kappa value increased to 0.84 and 0.93 for method 1 & 2, respectively showing excellent inter-observer agreement.

Table 1: The difference between templated & actual head size of both observers using the two methods. A1 (observer A with method 1), A2 (observer A with method 2), B1 (observer B with method 1), B2 (observer B with method 2)

Difference between template & actual head size	**No. of hips**			
	A1	A2	B1	B2
-4	1	1	0	1
-3	2	5	6	5
-2	5	2	3	5
-1	3	10	6	9
0	11	8	9	7
1	8	3	7	5
2	3	5	2	1
3	2	1	2	2
4	0	0	0	0
Exact agreement	11/35	8/35	9/35	7/35
	31%	23%	25%	20%
-1+1 agreement	22/35	21/35	22/35	21/35
	63%	60%	63%	60%
-2+2 agreement	30/35	28/35	27/35	27/35
	85%	80%	77%	77%

Table 2: Mean relative error of both methods by both observer. A1 (observer A with method 1), A2 (observer A with method 2), B1 (observer B with method 1), B2 (observer B with method 2)

	A1	**A2**	**B1**	**B2**
Mean relative error in percentage	2.8 (SD 2.6; 0-9.1)	3.3 (SD 2.7; 0-9.1)	3.1 (SD 2.6; 0-7.6)	3.4 (SD 2.7; 0-9.1)

Discussion

Determination of the radiograph magnification is critical for proper templating. Various methods such as distance method, external radiographic marker, and fixed magnification factor availableto determine magnification.

A study conducted to assess the comparison of systems for calibration when templating for total hip replacement with digital radiography showed that a set magnification factor was as accurate as the distance method and significantly more accurate than using ERM in digital templating of THA [15].

Another study on pre-operative digital templating in cemented hip hemiarthroplasty for neck of femur fractures evaluated the accuracy of digital templating using the distance method in 40 patients who had cemented hip HA by comparing templated implant sizes to actual implant sizes. They were able to template the implant head size and stem size correctly within two head sizes in 81% and 89%, respectively [10].

Additionally, a study on digital templating in hip replacement with and without radiological markers attempted to evaluate the precision of digital templating in hip replacement (both HA and THA). Using radiographic marker and distance technique, they templated the implant head size of 22 post-operative radiographs and compared the result to the known size listed in the medical records. The accuracy was found to

be comparable, with mean absolute measurement errors for the radiological marker and the distance technique being 2.8% and 2.6%, respectively (p = 0.75) [18].

Another study conducted on digital templating without a calibration marker in predicting implant size for hip hemiarthroplasty has shown that femoral head size and offset can be properly predicted using digital templating with a set magnification factor of 120%. Fifty preoperative radiographs of patients underwent hip HA were templated using digital software by two blinded observers, whothen compared the outcome to the actual implant size. The accuracy was found to be 90% (n=45) for predicting the offset and head size within 2 mm with substantial to excellent inter-observers agreement [16].

In our study, both observers predicted the femoral head size in 80% (n=28) and 77% (n=27) of cases using a fixed magnification factor of 118%, which is lower thana study reported by Mina Derias et al [16]. This may bedue to the software which we use for templating the radiographs. We used Radiant Dicom viewer in all cases, not a specific digital software designed for that particular implant. Additionally, we were not sure that whether the radiographers filmed the pelvic X-ray from a fixed distance which might also affect the magnification factor.

Our study also showed that the accuracy of predicting implant head size in hip HA using both methods, i.e., external radiographic marker and fixed magnification factor is similar with a mean relative error of method 1 (2.8 & 3.1% for observers A & B, respectively) and method 2 (3.3 & 3.4% for observers A & B, respective- ly), the p-value for both observers A & B was 0.46 & 0.59 with 95% CI). Interobservers agreement for both methods 1 & 2 is excellent when a precision scale of 1 size is used with kappa values of 0.84 and 0.93, respec- tively.

Conclusion

Digital templating of hip HA using a fixed magnification factor is as accurate as the radiographic marker method in predicting implant head size with excellent interobservers reliability. The study also conclude that 15-20% of the femur heads cannot be predicted within 2mm by any of the methods.

So, digital templating of the femur head using a set magnification factor can be used as an alternative effective and reliable method for ERM method. It is better to have all sizes of HA implant in the operation theatre stoke. Radiologists should also take adequate pelvic AP X-ray from a fixed distance. Researchers need to conduct further studies with a larger sample size, and a prospective study is also recommendedfor better accuracy assessment.

Limitations of the study

The primary limitations of this research are the limited sample size and the retrospective nature of the study methodology. The accuracy of each method could have been better assessed had we compared the templated result with the native femur head size rather than the size of implant used.

Acknowledgment

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Ethical consideration

Data collection was done after obtaining ethical approval by the institution review board of Addis Ababa University. Patients' medical data were kept confidential throughout the project.

Consent to publish

Participants consent for publication is not applica- ble.

Authors contribution

Study conception and design: Natnael Shewatatek (NS), Misgana Temesgen (MT), Biruk Lambisso (BL); data collection: NS; formal analysis and interpretation of results: NS, Tadiwos Niguss (TN); draft manuscript preparations; NS, TN. All authors reviewed the results and approved the final version of manuscript.

Conflict of interest

The authors report no conflicts of interest in thiswork.

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Original Article

Correlation of Tibial Nail Length with Olecranon to Fifth Metacarpal Head Measure- ment : A Facility Based Cross-Sectional Study

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Abstract

Background: *The gold standard of care for a tibial shaft fracture is an intramedullary nail. When selecting the correct nail size, it is crucial to assess the length of the tibial bone before surgery. This study aimed to evaluate the feasibility of using the length of the olecranon to the fifth metacarpal head as an alternative method for determining the appropriate length of a tibial nail in situations where measurements using the contralateral tibia are not possible.*

Method: *A Cross-sectional study was conducted at Tikur Anbesa Specialized Hospital, involving 150 volunteers aged 18 or older attending the orthopedics outpatient department as patient's attendant. Two observers conducted measurements using a tape meter. The length of the tibial nail was estimated by measuring the distance from the tibial tuberosity to the medial malleolus (TMD). Forearm measurement was obtained from the tip of the olecranon to the tip of the fifth metacarpal head, with the wrist in a neutral position and the hand clenched (OMD). Pearson's correlation test was used to assess the correlation between the two measurements. Hierarchical regression analysis was conducted to examine the impact of age, gender, and BMI on these measure- ments and their associations.*

Result: *A significant positive correlation between TMD and OMD was observed (Pearson correlation coefficient of (r) 0.927 ($p < 0.001$). The mean OMD measurement was 34.19 cm, while the TMD measurement was 34.1 cm. A hierarchical regression analysis revealed age, gender and BMI did not have statistically significant influence on these measurements and their correlation.*

Conclusion: *The study suggests that tibial nail length can be estimated using forearm measurement in situa- tions where contralateral tibia measurement is not possible.*

Keywords*: Tibial Nail Length, Olecranon to metacarpal head, Forearm, correlation*

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Introduction

Fracture of the tibia shaft are the most commonly occurring long bone fractures in in both developed and developing countries [1, 2]. According to research conducted at the Tikur Anbessa specialized Hospital has revealed that tibia fracture accounts for 15.4% of all fractures reported at the hospital [3]. The intramedullary nail is the standard of treatment for majority of diaphyseal tibial bone fractures, which gives a stable construct with minimal soft tissue damage, and important for early mobilization [4, 5].

It is essential to estimate tibial nail length preoperatively for satisfactory outcomes. It helps to prepare the correct nail size range preoperatively, avoid unnecessary delay in the operating room and avoid revision surgeries. Using a shorter nail may lead to malreduction, short working length and implant failure. Similarly, the removal of a short nail can pose challenges if it is buried too deeply. A longer nail may cause fracture site distraction, impingement of the patellar tendon, and penetration of the nail to the ankle joint [6]. Tibial nail length measurement can be assessed both before the surgery and during the surgery. Intraoperative estimation is the most precise method; however, it may lead to extended surgical durations and heightened radiation exposure. The intraoperative methods include two guide wires -technique, the nail-against-limb technique, and using a radiographic ruler [6-8]. The preoperative radiological techniques outlined include the krammer splint technique, scanograms, spotograms, templating, and direct measurements obtained from radiographs of the contralateral limb [9, 10]. There are different anthro-

pometric methods to measure preoperatively [11-13]. This encompasses measurements from olecranon to fifth metacarpal head, medial knee joint line to ankle joint line, medial knee joint line to medial malleolus, tibial tuberosity to the ankle joint, tibial tuberosity to medial malleolus and body height. The tibial-tubercular-medial malleolus distance (TMD) has proven to be a simple, inexpensive, and accurate method for the preoperative evaluation of the tibial nail length. Most of the above methods necessitate an intact contralateral tibia for measurements, making them unsuitable for cases of bilateral tibia fracture [9-14]. This study aims to determine whether olecranon to the fifth metacarpal head (O -MH) length can serveas a reliable alternative method to measure nail lengthof tibia in cases when indirect measurements using the contralateral tibia are not feasible.

Methods and Materials

This is a hospital-based descriptive cross-sectional study conducted from June 2023 to July 2023 at TASH. After department level ethical clearance were obtained, a simple random sampling technique was employed to select 150 healthy volunteers (patient attendants) who were 18 years or older and had visited TASH orthopedics outpatient department during the study period.
Sample size is determined using single population proportion formula:

$$\frac{n=(P)(1-p)(Z\alpha/2)^2}{d^2}$$

Where n= Total number of participants who participated in the study

P = prevalence of tibia fracture 10% in research conducted in Tikur Anbessa Speciallized Hospital[1].

Z= at 95% confidence interval is 1.96 d= margin of error which is taken as 5%

The calculated result is **138**. By adding 10% non-response rate, the total sample size becomes **150**. People who had previous tibial shaft fracture, forearm fracture, metacarpal bone fracture, congenital or traumatic limb deformity, limb amputation and age less than 18 years old were excluded from the study.
Age, sex and Body Mass Index of all the patients were recorded using a standardized questionnaire. Two observers independently conducted measurements using a tape meter, and the average of their recorded values were determined. The length of the tibial nail was estimated by measuring the distance from the most prominent point of tibial tuberosity to the most prominent point of the medial malleolus (TMD), as depicted in Figure 1. Forearm measurement was ob-tained from the tip of the olecranon to the tip of the fifth metacarpal head, with the wrist in a neutral position and the hand clenched (OMD), as depicted in Figure 2.

Figure 1 OMD measurement

Figure 2 TMD measurement

Results

The result of the study showed the following. All the data were normally distributed. Among the 150 volunteers involved in the study, 81 (56%) were males and 69 (46%) were females. More than 70% of participantsare between age of 20-40 years. The average BMI was 23.4kg/m^2 .

The mean TMD length was 34.1 cm and the mean OMD were 34.19 cm, the results are summarized in table 2. Liner scatter plot of TMD and OMD observed as seen in figure 4. The result showed a significant positive correlation between TMD and OMD, as evidenced by a Pearson correlation coefficient of (r) 0.927 ($p < 0.001$).

A hierarchical regression analysis was conducted to examine the impact of age, gender and Body Mass Index on these measurements and their associations, as summarized in table 3.

The results of this analysis revealed none of these variables exerted a statistically significant influence on these measurements and their correlation.

Table 1: Mean measurements of height, weight and BMI

Variables	Mean	Std, Deviation
Height in meters	1.65	.088
Wight in kilo gram	64.04	12.4
BMI	23.44	4.05

Table 2: Descriptive TMD and OMD measurements

Variables	OMD in cm	TMD in cm
Mean	34.19	34.1
Minimum	27.5	27.5
Maximum	38.7	39
Std. Deviation	2.17	2.19

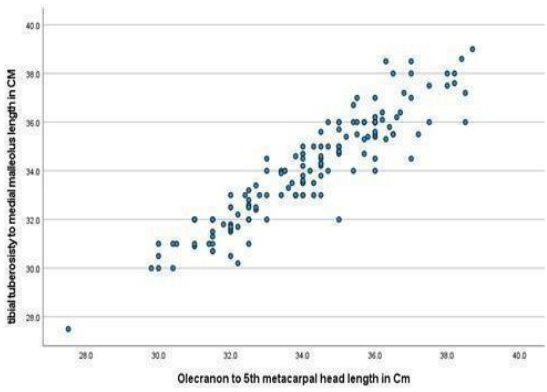

Figure 4 Liner scatter plot

Discussion

Our study's descriptive analysis showed that mean TMD measurement was 34.19 cm, while the meanOMD was approximately 34.1 cm. In contrast, a prior study conducted by Blair S. at Doncaster Royal Infir- mary using similar forearm referencing technique re- ported slightly different values, with mean TMD 34.2 cm and OMD 35.2 cm. In his paper no case was the TMD longer than the OMD. However, in our study,we observed a difference; the average TMD measure- ment was longer than OMD compare to his paper[15]. Our study revealed a significant positive correlation between TMD and OMD, as evidenced by a Pearson correlation coefficient (r) of 0.927 (P< 0.001). This strong correlation suggests that OMD is a relia- ble alternative measurement for estimating tibial nail length, especially when TMD measurement not feasi-ble or accurate. The result also indicated that age, gen-der and Body Mass Index have no statistically signifi-cant effect on these measurements and association.This finding aligns with previous research and further supports the use of OMD as a valuable preoperative measurement. In A. Hegde et al.'s study (2019), they found a strong correlation between TMD and OMD through Pearson's correlation test (r = 0.966). Similar to our study, they also discovered that age, gender,and Body Mass Index did not have a significant im- pact on these measurements and their correlation. Re- search conducted in Khartoum, Sudan, by Hassan El- bahri (2021) revealed that the statistical analysis indicates a significant positive correlation between OMD and TMD (with a significance level of less than 0.01),which is consistent with the findings in our study [16].

Conclusion and Recommendation

In conclusion, this study provides valuable insightsinto tibial nail length estimation and highlights theutility of OMD as an alternative measurement in case where TMD measurement may be challenging. This study also demonstrated its reliability across different genders, age groups, and BMI categories. Additional - ly, the strong correlation between TMD and OMD reaffirms the potential of OMD as a reliable preopera- tive measurement. This research contributes to the optimization of tibial nail length estimation and may ultimately lead to improved surgical outcomes and reduced intraoperative complications.

Building upon these findings, we recommend further investigations with larger and more diverse samples to validate the robustness of OMD as a reliable measure-ment for the tibial nail length estimation. Moreover, additional studies could explore the correlation of OMD measurement and tibial nail length measure-ment in a patient with tibial shaft fracture in a clinical setting.

Limitation and strength

The limitation of our study is the homogenous sample of volunteers from a single hospital. The strength of

Table 3: Hierarchical Regression analysis

Model	t	Sig.
(Constant)	1.960	.052
Olecranon to 5th metacarpal head length in Cm	30.100	<.001
(Constant)	1.331	.185
Olecranon to 5th metacarpal head length in Cm	22.710	<.001
Age	-.794	.429
Gender	.502	.616
BMI	-1.519	.131

our research in contrast to earlier studies, our re-search has larger sample size 150 volunteers.

Ethical considerations
Before conducting data collection, approval was obtained from Addis Ababa University and informed consent was taken from all the participants. The confidentiality of patient's medical information was maintained throughout the project.

Conflict of interest
The authors report no conflicts of interest in this work.

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Original Article

Comparison of Radiological and Clinical Outcome of Unstable Intertrochanteric Fracture Treated with Dynamic Condylar Screw and Proximal Femoral Nail Antirotation: A Facility Based Retrospective Study

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Abstract

Introduction *Extra-medullary and intramedullary implants are options for treatment, although consensus is lacking concerning the outcomes. This study compared clinical and radiological results of unstable intertrochanteric fractures treated by either proximal femoral nail anti-rotation (PFNA) or dynamic condylar screw (DCS) system.*

Methods *This was an eighteen months retrospective comparative study (January 2022 to June 2023) where all the operated unstable intertrochanteric fractures from Tikur Anbessa Specialized Hospital (TASH) between January 2022 and June 2023 were reviewed. Data was analyzed with SPSS version 26 and results were summarized by text and table, with statistical significance set at p <0.05. Comparison of blood loss, duration of surgery, injury to the time of surgery, postoperative hospital stay, time of full weight bearing, radiologic union time, and quality of reduction, complications, and Harris hip score was between PFNA and DCS groups.*

Results: *A total of 51 patients were included in the study, 31 (60.8%) in PFNA and 20(39.2%) in DCS group. PFNA group had statically significant superior outcome difference for the amount of blood loss and Harris hip score with p-values of 0.017 and 0.001 respectively. While, age, sex, location, comorbidity, injury at the time of surgery, duration of hospital stay, duration of follow-up, radiologic union time, quality of reduction, and complica-tions were not significantly different between the two groups.*

Conclusion *proximal femoral nail anti-rotation system has better functional outcomes and less intraoperative blood loss than dynamic condylar screws in the treatment of unstable intertrochanteric fractures.*

Keywords*: unstable intertrochanteric fracture, dynamic condylar screw, proximal femoral nail anti-rotation, varus collapse*

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Introduction

Unstable intertrochanteric fracture characterized by comminution of the posteromedial cortex, a thin lateral wall, displaced lesser trochanterfracture,subtrochanteric extension, and reverse obliquity fractures (1).

Surgical management with stable fixation and early mobilization using extramedullary or intramedullary devices is the gold standard treatment of intertrochanteric fractures (2). However, controversy over the choice of various implants continues as intramedullary and extramedullary devices with significant price differences and conflicting outcome reports designed for the treatment of unstable intertrochanteric fractures (2–5). In developed countries, the intra-medullary device is the gold standard treatment choice (5, 6). However, in low-income countries using affordable extramedullary devices with comparable outcomes is an option (7, 8).

Several factors influence the outcome of intertrochanteric fracture treatment such as the age of the patient, the patient's general health, the time from fracture to treatment, and the stability of fixation (7). Regardless of treatment choice, there remains a 20% to 30% mortality risk in the first year following fracture, with males having a higher mortality rate compared to females (9, 10). Operative complications include varus collapse, implant failure, nonunion, and infection which leads to revision surgery (1, 2,10).

To our knowledge, there is no data showing treatment modality and outcome of unstable intertrochanteric fractures in sub-Saharan countries. The study aims to assess differences in Harris Hip Score, varus collapse, fixation failure, and blood loss, among patients with unstable inter-trochanteric fracture treated with Dynamic condylar screw (DCS) and proximal femoral nail anti -rotation (PFNA). Therefore, knowing the outcome of DCS and PFNA in the treatment of unstable fractures helps to choose the proper implant with a good outcome and a reasonable cost.

Material and Methods

Study setting, study design and study period

A retrospective study encompassed all patients aged 18 to 80 years who underwent PFNA and DCS fixa- tion for unstable intertrochanteric fracture at a single tertiary institution in Addis Ababa, Tikur Anbessa Specialized Hospital (TASH) between January 2022 and June 2023 was conducted. TASH is the biggest referral hospital in the country, where orthopedic service has one of the highest volume. Orthopedic department has a separate trauma and pediatrics unit with sub-specialty training, where two-third of the admissions are trauma patients.

Source population

The source of population is all intertrochanteric patients who visited TASH during study period.

Study Participants

All patients who fulfilled the eligibility criteria within the study period were selected.

Dependent and Independent Variables: sociodemographic variables such as age, sex, clinical, radiologic characteristics, and type of implant used were independent variables, whereas varus collapse, amount of blood loss, fixation failure and Modified Harris Hip Score were dependent variables.

Eligibility Criteria

Inclusion criteria were the presence of completed patients' data, and a minimum of six-month follow-up. In contrast, patients with pathologic fractures, patients who didn't answer phone call complete data were ex- cluded.

Operative technique: Preoperatively, patients underwent anteroposterior and lateral hip X-rays, deep venous thrombosis screened, and received prophylaxis. Surgeries were performed by orthopedic trauma specialists or fellows. Patients were positioned supine on a traction or standard table, closed reduction was tried; open approaches were used if needed. Intraoperative fluoroscopy verified reduction, PFNA is preferably used**.** The quality of reduction was evaluated using the Baumgartner reduction quality criteria in immediate postoperative x-rays.

Good reduction: when alignment is normal or slightly valgus neck shaft angle and less than 20º angulation on lateral view and displacement less than 4mm on both views.

Acceptable reduction: is when only one criterion is met

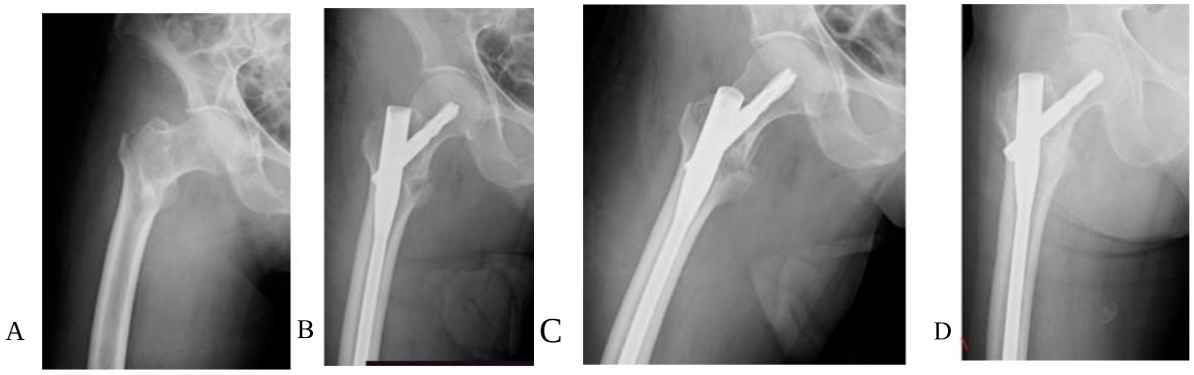

Figure 1: A) 68-year old female patient with a right unstable intertrochanteric fracture B, C) immediate postoperative AP/Lateral x-rays show good reduction. D) At 8-month follow-up

Postoperative clinical and radiological assessment at 2, 6, and 12 weeks, six months and one year were collect - ed. Full weight-bearing was allowed upon evidence of clinical and radiological union. Complications were treated accordingly upon presentation

Fixation failure was defined as a helical blade and screw pull-out, cut through or out, and nail or plate breakage.

Varus collapse change in neck-shaft angle at six months >10° from immediate post-operative radiography. In this study, a complication is defined as varus collapse, fixation failure, or non-union within 18 months of postoperative follow-up evidenced by radiography.

Modified Harris hip score is a functional assessment tool consisting of eight questions categorized into three: pain, function, and level of activity. Scores are added together to make a maximum possible score of 91, which is multiplied by a factor of 1.1 to derive a final Harris hip score (HSS) out of 100 (12).

Data Collection and Analysis

Data were collected by trained resident and cross checked by the principal investigator with Excel sheet, which was exported into a statistical package for the social sciences (SPSS) version 26 for data cleaning and analysis. The result was summarized by using texts, tables, and figures. The data was presented with mean and median for continuousand percentage for categorical variables. Age, amount of blood loss, duration of surgery, injury to the time of surgery, postoperative hospital stay, time of full weight bearing, and radiologic union time were tested using student's t-tests to compare the PFNA and DCS groups. To compare the groups with categorical data Chi-square tests were performed and statistically significant was declared when the P-value was <0.05.

Ethical Consideration: The study was conducted after getting ethical approval from Addis Ababa University College of Health Sciences with institutional review board number 004/24/Ortho.

Result:

A total of sixty-nine patients with unstable intertrochanteric fracture fixed with either PFNA or DCS were selected the study period. Among these, 51 patientswho fulfill the inclusion criteria were included in the analysis. Thirty-one patients treated with PFNA for the remaining 20 DCS were used. Eleven patients with incomplete data, six patients who died, and one pathologic fracture were excluded.

The distribution of age, sex, location, comorbidity, injury to time of surgery, duration of hospital stay, and duration of follow-up was not significantly different between the two groups **.** Fall from standing height is the commonest mechanism of injury for both groups. There are a total of 18(35.3%) complications where varus collapse was found the highest 14(77.7%) inboth groups (Figure. 2, *Table 1).*

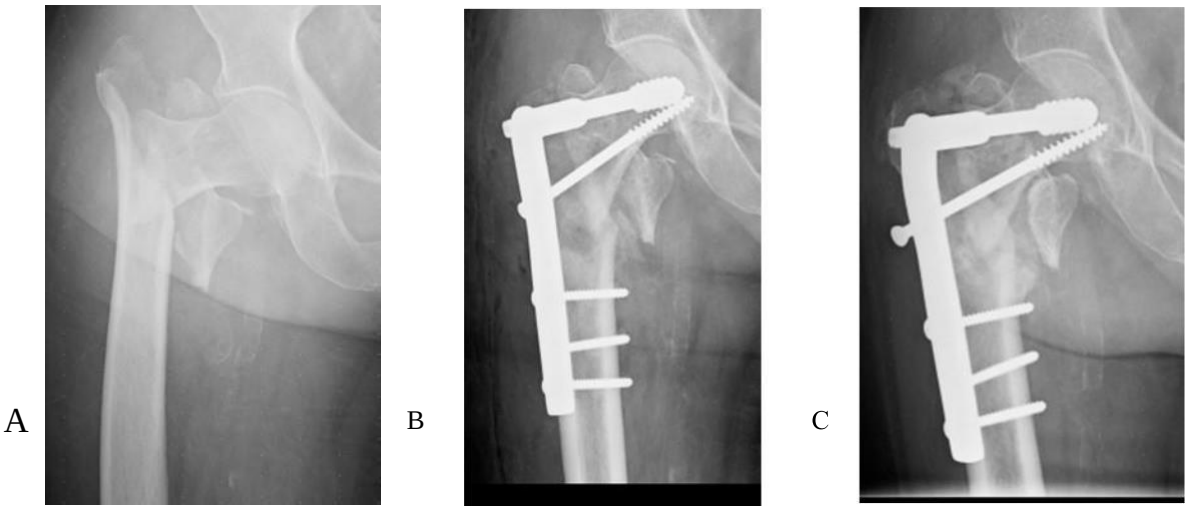

Figure 2: A) 74-year old female patient with a right unstable intertrochanteric fracture B) immediate post-operative x-rays show poor reduction, C) Varus collapse at 3-month follow-up

Table 1: Sociodemographic, clinical and radiologic distribution, TASH, 2022-23

Variables		No. (%)		
		PFNA group	DCS group	Total
Age(years)	≤50	15(48.4)	10(50)	25(49)
	>50	16(51.6)	10(50)	26(51)
Sex	Male	20(64.5)	11(55)	31(60.8)
	Female	11 (35.5)	9(45)	20(39.2)
Location	Addis Ababa	15(48.4)	7(35)	22(43.1)
	outside Addis Ababa	16(51.6)	13(65)	29(56.9)
Comorbidity	None	23(74.2)	15(75)	38(74.5)
	Had comorbidity	8(25.8)	5(25)	13(25.5)
Mechanism of injury	RTA	4(12.9)	3(15)	7(13.7)
	Fall-height	7(22.6)	0	7(13.7)
	Fall-standing height	13(41.9)	13(60)	26(51)
	Bullet	7(22.6)	4(25)	11(21.6)
Injury to surgery (days)	Mean, Median	19.2, 19	22.5, 23	
Need of transfusion		3(9.7)	5(25)	8(15.7)
Post-operative hospital stay (day)	Mean	10.2	4	
	Median	3	3	
Average duration of follow up (month)	Min. 6 to max. 18	12	7.7	
Types of complications	Varus collapse	6(33.3)	8(44.4)	14(77.7)
	Fixation failure	2(11.1)	0	2(11.1)
	Infection	1(5.6)	0	1(5.6)
	Non union	0	1(5.6)	1(5.6)

In regard to duration of surgery, and time of full weight bearing, the PFNA group was seen to have better values but not statically significant. The amount of blood loss was found statically significant in PFNA group (P=0.01), Table 2.

Table 2 : Comparison of the groups of intra-operative variables, radiologic and clinical variables, TASH, 2022-23

Variables	PFNA	DCS	P value
Age (year)	52.4	50.8	0.62
Duration of surgery(in minutes)	79.8	110.8	0.08
Amount of blood loss(ml)	378.1	665.6	0.01
Injury time to surgery(day)	19.2	22.5	0.18
Post-operative hospital stay(day)	10.2	4.0	0.97
Time of full weight bearing	3.0	3.7	0.69
HHS	84.9	70.9	0.73
Radiologic union time	3.0	3.4	0.42

Concerning Harris hip score, we found a statically significant relationship (p=0.001) with the PFNA group, ac-counting for 20 (64.5%) excellent scores (table 3).

Table 3 : Comparison of categorical variables and groups, TASH, 2022-23

Variables		PFNA n (%)	DCS n (%)	Chi-square	P-value
Quality of reduction	Good	18(58.1)	10(50	0.54	0.764
	Acceptable	9(29.0)	6(30)		
	Poor	4(12.9)	4(20)		
Complications	Yes	9(29.0)	9(45.0)	1.36	0.244
	No	22(71.0)	11(55.0)		
HHS	Excellent(90-100)	20(64.5)	1(5.0)	20.32	0.001
	Good(80-89)	5(16.1)	6(30.0)		
	Fair(70-79)	1(3.2)	4(20.0)		
	Poor(60-69)	2(6.5)	6(30.0)		
	Under poor(<60)	3(9.7)	3(15.0)		

Discussion

Due to improvements in life expectancy and population size, the number of hip fractures has been projected to rise from 1.7 million in 1990 to 6.26 mil-lion by the year 2050(13). DHS is considered the gold standard option of treatment for stable-type fractures. The optimal internal fixation device for the repair of unstable intertrochanteric fractures remains a matter of controversy (8, 14–16).

In our study, the amount of blood loss in PFNA group is significantly lower than DCS group. However, this is due to all DCS fixations being done open while the majority of PFNA groups are reduced closed. This result is consistent with a retro - spective comparison study done in 91 patients to determine the clinical and radiological results who are treated with PFN, DHS, or proximal femoral locking compression plate (PF-LCP) for unstable intertrochanteric femoral fracture. This study shows perioperative operating time, blood replacement amounts and hospitalization period is statically significant in PFN group than DHS and PF-LCP group (5). Similarly, a randomized control trial done by Baumgartner comparing extramedullary and intramedullary devices on 131 patient's shows 44% less blood loss in the intramedullary device group (17). However, a prospective randomized controlled trial done by Leyi to compare perioperative blood loss between extramedullary and intramedullary devices found a significantly lower blood loss in the extramedullary group (18).

We found HHS in the PFNA group is higher than DCS group which was supported by a meta-analysis of 18 randomized controlled trials (RCTs), 2414 patients, conducted to evaluate functional scores, surgical outcomes, and adverse events in adult patients receiving intramedullary fixation more effective and safer in terms of blood loss, operative time, length of incision, hospital stay, and implant failure than extramedullary fixation (2). However, another meta-analysis done on 8 randomized controlled trials comparing PFN and DHS in the treatment of trochanteric fractures showed no significant difference in blood loss, blood transfusion, mortality, and reoperation between the two implants even though the cost of intramedullary is higher than DHS(19). Similarly, a randomized prospective study comparing fixation using a DHS (343 patients) or intramedullary nail(341 patients) for all intertrochanteric and sub-trochanteric fractures showed no long-term differ- ences in outcome at three and 12-month follow-up, with improved early pain on mobilization scores in the intramedullary group. Maintenance of a good reduction and prevention of collapse offers optimum function (20).

Contrary to our finding, a prospective randomized multicenter study compared the clinical and radiographic outcomes of 204 patients treated with extramedullary hip screw and intramedullary device for unstable intertrochanteric hip fracture, radiographic parameters favored the intramedullary treatment arm, which had less femoral neck shortening (21). This is in line with a randomized clinical trial study by Ali Andalib (22) and a meta-analysis comparing the relative advantages of intramedullary nail and extramedullary fixation in unstable intertrochanteric fractures which shows PFNA group had a better union time (23). However, a comparison of the dynamic hip screw and proximal femoral nailing techniques in stable intertrochanteric fractures (24) and systematic review and meta-analysis compared extramedullary fixation and intramedullary fixation for intertrochan-

teric fracture showed no difference in union time (25).

Our study had certain limitations: being a retrospective study in nature, a relatively small number of patients, a single-center study, and a short follow-up period. The strength of the study is to our knowledge it is the first study in Africa to compare the outcome of DCS and PFNA fixation for unstable intertrochanteric fractures and the result is practice changing.

Conclusion

This study supports proximal femoral nail anti -rotation system (PFNA) has a superior outcome than the dy-namic condylar screw concerning HHS and theamount of blood loss. DCS should not be the first choice of treatment because of the high rates of varus collapse.

Recommendations

Further randomized control trials on the outcome of PFNA and DCS fixations is recommended.
Consider manufacturing orthopedic implants locally to reduce the cost and improve the availability.

Abbreviations and Acronym

AAU Addis Ababa University
DCS Dynamic Condylar screw
DHS Dynamic hip screw
HHS Harris Hip Score
PFNA Proximal Femoral Nail Antirotation
TASH Tikur Anbessa Specialized Hospital

Acknowledgment

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Original Article

Patient-Reported Outcomes of Operatively Treated Ankle Fractures and Complication Rate in Resource-Limited Setting: A Four-years Retrospective Study

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Abstract

Background*: Ankle fractures are the second most common lower limb fracture after hip fractures, accounting for 10% of all fractures. It is a common injury, with a global incidence of 187/100,000 inhabitants per year. It is the 5th most common fracture in patients who visited Tikur Anbessa Specialized Hospital. The purpose of this study was to evaluate functional and Health Related Quality of Life (HRQL) outcomes after surgically treated ankle frac-tures and to detect some of their predictors as well as complication rates.*

Methods *: This retrospective record review was conducted among ankle fracture patients treated with open reduc-tion and internal fixation (ORIF) between January 2018 and January 2022, at Tikur Anbessa Specialized Hospital. Patients' responses were recorded with a structured questionnaire including the Olerud Molander Ankle Score (OMAS) via phone interviews. The collected data was entered, and analyzed using SPSS Version 26. The Chi- square test was conducted to assess the strength of association between the functional outcome of surgically treat- ed ankle fractures and independent variables.*

Results*: Out of the 75 patients with ankle fractures treated with open reduction and internal fixation (ORIF), 61 patients met the inclusion criteria. Among these, males accounted for 55.7% (34), while females comprised 44.3% (27) of the total cases. The prevalence of comorbidities was 24.6% (15 out of 61), with diabetes being the most common, followed by hypertension and asthma The complication rate was 52.5 %, with residual ankle pain as most common type of complication. The mean value of OMAS and American Orthopedics Foot and Ankle Society-ankle hindfoot score (AOFAS) ware 70.43 and 72.96, respectively. A strong association was found between OMAS score and timing of surgery and age.*

Conclusion*: Despite surgical treatment being the primary approach for managing unstable ankle fractures, pa-tients often experience functional impairment. The complication rate following ankle fracture open reduction and internal fixation was found to be high. As an outcome of patients aged 60 and above treated operatively is signifi-cantly associated with lower OMAS and AOFAS scores.*

Keywords*: Patient Reported Outcome Measurement, Olerud Molander Ankle Score, Operatively Treated Ankle Fractures, Ethiopia*

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Introduction

Ankle fractures are the second most common low-er limb fracture after hip fractures, Ankle fractures are a common injury, with a global incidence of 187/100,000 inhabitants per year (1).

The literature on the treatment of ankle fractures is scarce with heterogeneous case series reportingthe outcome of a various management strategies, using different outcome assessment methods (2, 25).

The incidence of ankle fracture in the 2016–2019 period in the United States was 14.1 per 10,000 patient-years, of which 3.3 required surgery. Complication rates were high, with approximately 10% of patients requiring sec- ondary surgery. Residual pain was the main complica- tion and affected nearly a third of all patients (3).

The incidence of ankle fractures has been increasing according to population studies done in the US. Re-search done at Moi Teaching and Referral Hospital notedpatients presenting with unfavorable ankle fracture out-

comes during follow-up in routine outpatient orthopedic clinic (4).

The highest frequency of fractures in patients who visited Tikur Anbessa Specialized Hospital occurred in the femur 32 (15.8%); followed by tibio-fibular 29 (14.4%) and humerus 26 (12.9%). Isolated patellar fracture occurred in 22 (10%) patients; Ankle fractures accounted for 9 (4.5%) patients; Pelvic fracture was seen in 6 (3%) patients (17).

In a multicenter study done in china the incidence rate of infection after ORIF of a closed ankle fracture was found out to be 3.7%, with 2.57% for superficial and 1.12% for deep SSI (7).

Surgical management of ankle fractures has been extensively studied in literature (26) but studies investigating validated clinical results are lacking and controversial. The purpose of this study was to evaluate functional and Health Related Quality of Life (HRQL) outcomes after surgically treated ankle fractures and to detect some of their predictors as well as complication rates following ankle ORIF.

Methods

Study design

A retrospective record review was conducted from March 1 to August 30, 2023, in Tikur Anbessa Specialized Hospital.

Study setting

Tikur Anbessa Specialized Hospital is the largest referral hospital in Ethiopia with 700 plus active beds, located in the capital city of Ethiopia, Addis Ababa. The Department of Orthopedics and Trauma Surgery is one of the main departments in Black Lion Hospital. It has 75 active beds.

Source participants

All ankle fracture patients managed operatively at Tikur Anbessa Specialized Hospital from January 2018 to January 2022 which fulfills the inclusion criteria.

Eligibility criteria

Patients with follow up less than 1 year, patients having associated injuries and pediatric patients with age ≤16 years were excluded. All patients who were treated within the study period and fulfilled the eligibility criteria were included.

Study variables

Patient age, sex, type of fracture, time of surgery, comorbidities, smoking and alcoholic habit are independent variables whereas measures of treatment outcome in ankle fractures American Orthopedic Foot and Ankle Society (AOFAS) & Olerud-Molander Ankle Score (OMAS) scores and complication ratewere the dependent variables in this study.

Operational definitions

Surgical Site infection (SSI) - is defined as patients having a surgical wound with discharge or erythema around the wound up to 1 year of follow-up.

Early Surgery – is an operative procedure conduct-ed within 1 week of injury.

Data collection

Three orthopedic residents were designated to be data collectors after necessary training was given. Data was collected from the Operating Room logbook, patient cards, computer follow-up records, and X-rays of patients. Patients were interviewed via phone calls and questionnaires were filled out.

The ankle-specific outcome score was devised by Olerud and Molander Score (OMAS) is a well-established self-reported questionnaire, which is considered functionally oriented and is a valid ankle-specific outcome scoring system According to Olerud and Molander score, 0–30, 31–60, 61–90, and 91–100 is considered 'poor,' 'fair,' 'good,' and 'excellent' functional outcome, respectively (15).

Table 1: Olerud and Molander ankle outcome score

Parameters	Degree	Score (100 max)
Pain	None	25
	While walking on an uneven surface	20
	While walking on an even surface	10
	While walking indoors	5
	Constant and Severe	0
Stiffness	None	10
	Present	0
Swelling	None	10
	Only evenings	5
Stair climbing	Constant	0
	No problem	10
	Impaired	5
	Impossible	0
Running	Possible	5
	Impossible	0
Jumping	Possible	5
	Impossible	0
Squatting	No problem	5

	Impossible	0
Supports	None	10
	Straps Used	5
	Stick or crutch	0
	Same as before the in-	20
Work and	jury	
activities of	Loss of tempo	15
daily of	Change to a simple job	10
daily living		
	Severely impaired work	0
	capacity	

Data Management and Quality Control
Data quality was ensured by continuous evaluation

and tallying of the collected data were carried out by the principal investigators. Data were analyzed using

the computerized statistical program SPSS version 26 then frequencies were calculated for descriptive analysis of socio-demographic variables. Mean value of OMAS comparative association between each risk factor and functional outcome analyzed. Results are described using tables, pie charts, and bar graphs.

Ethical considerations
Ethical clearance was obtained from the research and ethical review committee of Tikur Anbessa Specialized Hospital, Addis Ababa University College of Health Science. All the collected data were kept confidential.

Results
Sociodemographic characteristics
A total of 75 patients with ankle fractures were operated on in the Tikur Anbessa Specialized Hospital Orthopedic department in those 4 years of period of which 61 patients fulfilled the inclusion criteria and were evaluated. From these 55.7% (34) were males and the remaining 44.3% (27) were accounted by females. The mean age of patients in the study was
41.4 and 63.9 % (39/61) reside in Addis Ababa.

Of those 61 patients 39 (63.9%) were treated with

lateral malleolar plate and medial malleolar screw. The secondly used instrument is the medial malleolar screw alone which was used in 5 (8.2%) patients. Lateral malleolar plating alone, external fixator with delayed ORIF, medial malleolar K-wire, and lateral malleolar rush pin are used in the remaining patients. The prevalence of comorbidities is 24.6% (15/61)and from this most of them are diabetic 16.4 % (10/61) followed by HTN and asthmatic. Twopatients were alcoholic and there were 4 Smokers.

Characteristics of Ankle Fracture Fall-down accidents are the most common cause
(50.8%) of ankle fractures. Even though most of the patients were from Addis Ababa, 57.4% came to the hospital after a day. 26.2% of them presented after

one week of injury. The right side of the ankle is involved in 60.5 % of the cases. And open fracture accounts for 27.9% of the cases.

Table 2 : Characteristics of ankle fracture

Mechanism of injury		Frequency	Percent
	Falling Down Incident	31	50.8
	Road Traffic Accident	27	44.3
	Fighting Injury	1	1.6
	Sport injury	2	3.3
Time of presentation	Within a day	9	14.8
	Within a week	35	57.4
	Within 3 weeks	16	26.2
	After 3 weeks	1	1.6
The side of the limb involved	Right	40	65.6
	Left	21	34.4
	Total	61	100
Status of fracture	Open	17	27.9
	Closed	44	72.1
	Total	61	100

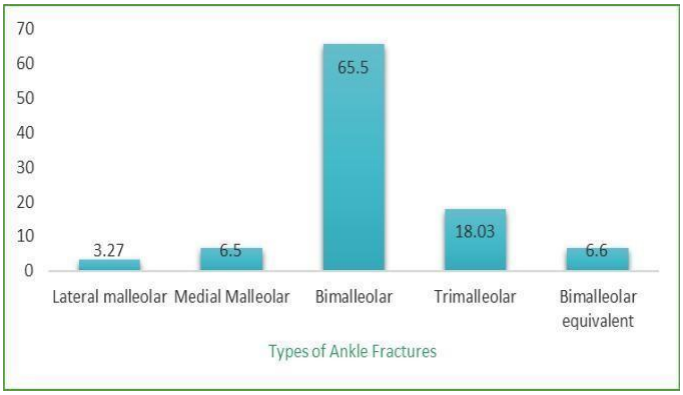

Figure 2 : Types of ankle fracture with frequency

Complications following Ankle Fracture ORIF
From all evaluated patients the complication rate was 52.5 % and the most common type of complication encountered is residual ankle pain (34.4%). Other complications observed are ankle swelling, joint stiffness, and chronic wounds in order of descending frequency.

Table 3: Prevalence of complications after operative management of Ankle fractures at Tikur Ambessa Specialized Hospital from March 1 to August 30,2023.

		Frequen cy	Percent
Re-operation	Yes	9	14.8
	No	49	85.2
	Total	58	100
Chronic ankle swelling	Yes	15	24.6
	No	46	75.4
Joint stiffness	Yes	15	24.6
	No	46	75.4
Surgical site Infection	Yes	5	8.12
	No	56	91.88
	Total	61	100
Chronic Pain	Yes	21	34.4
	No	40	65.6
Chronic Wound	Yes	13	21.3
	No	48	78.7
	Total	61	100

Patient Reported outcomes

63.8% (30/47) of the results achieved a good score measured by the OMAS scoring system. Around 27.7% (13/47) of the results garnered an excellent score. And 8.5% (4/47) of the results obtained a poor score.

The mean value of the OMAS score is 70.43 with a minimum of 35 and a maximum of 100. In the group of age ≥ 60 years median OMAS score is 50 (mean, 52.14; range,40-75), and in the age group of < 60 years median OMAS score is 72.78 (Mean, 72.78; Range, 35-100).

The Chi-square test was conducted to assess the strength of association between the functional outcome of surgically treated ankle fractures and independent variables such as delay in surgery, age, gender, type of fracture, presence of diabetes, and smoking habits, as elucidated in Table 7. The obtained p-value of > 0.05, along with a 95% confidence interval, indicates that there is no statistically significant association between the outcome and the independent variables .

Table 4 Relationship between OMAS and independent variables (n = 61)

Association	P-value
OMAS vs Gender	0.695
OMAS vs Age (below and above 60)	0.001
OMAS vs Fracture type	0.188
OMAS vs Smoking Habit	0.509
OMAS vs DM	0.926
OMAS vs Delay in surgery (within a week)	0.046

AOFAS ankle hind foot score was assessed for 27 patients in which the mean AOFAS score was 72.96 (Range 45-90). The mean AOFAS value is lower in age groups of ≥ 60 years which is 66% when compared to age groups less than 60 years with a mean AOFAS value of 75 %.

Discussion

Operative treatment for ankle fractures restores sufficient stability to allow full mobility at the ankle joint (8, 10).

Makwana et al. compared ORIF cases with conservatively treated ankle fractures and concluded that ORIF treatment has a higher functional outcome score and a significantly better range of movement of the ankle (14).

Outcomes of ankle fractures are assessed by different clinical scores and patient-reported outcomes. We have used the most widely used AOFAS ankle hindfoot and OMAS scoring methods from clinical and PROM scores respectively.

Functional outcomes of patients treated with ankle fractures treated with ORIF at Tikur Anbessa Specialized Hospital were assessed using OMAS and the result shows with overall mean of 70.43. The mean OMAS for males is 71.92 and for females 68.57 it is somewhatcomparable with results from St. Paul Hospital which was 76.79 and 75.65 for males and females respectively (12). And is less when compared with male and female OMAS score which is 80.5 and 72.1 respectively on NH Shah et al. (15). This may be because in NH Shah et al. the OMAS score was assessed at 5th year follow-up and, in our research, the mean duration of follow up was 36.4 months with minimum 12 and maximum of 60 months.

There is a significant association between age ≥60 years old and Lower Olerud Molander Ankle Score (OMAS) with a P-value of 0.001 with a confidence interval of 95 %. It is the same as the study done by Chong et al. the association of age ≥60 postoperative OMAS was strong with a P value of < .001 (13).

Some patients with ankle fractures treated with ORIFhave some sort of complications. The complication rate of 52.5% in this study with the most common types be- ing residual ankle pain, swelling, and chronic wounds.

The reoperation rate is 14.8% the most common reason for re-operation was an infected surgical wound followed by an infected implant and implant removal for the reason of chronic pain same as a study done by D'Almeida VR et al (14). The reoper- ation rate in this study is comparable to a studydonein US by MF Vanderkarr et al. in which the re- operation rate is 10.3 % in which the identified caus-es are infection and revision surgery (4). In the studydone in Madrid Spain by Macera A et al., the overall complications rate was 36.0%; werepresented by infection (4.7%) impaired wound healing (3.2%),and of majorly of residual pain (16).

In this study patients with low OMAS scores have a strong association with delay in surgery with a P-value of 0.046 and it is supported by the research done in the Netherlands which says that delay in surgery is associated with a significant rise in infec- tious wound complications, which significantly low- ers outcome and patient satisfaction. These fractures should preferably be treated within the first day (15, 20). Even though there is no significant association between syndesmotic injury, being diabetic and al-coholic are associated with lower health-related Quality of Life (HRQL) same as in a study done by Kelemework AD et al. (12).

The rate of surgical site infection (SSI) following ankle fracture ORIF in Tikur Anbessa Specialized Hospital is 14.8% (9/61). This is higher when com-pared with other studies which is reported as 3.7% by R Sun et al. in China in 2017 and 4.7 % by Mac-era A. et al. in 2018 (7) (16). One study retrospec-tively reviewed 50 consecutive patients who under-went ORIF for ankle fracture. Surgical Site Infection was present in 24% of the patients (19). A meta-analysis done in China in 2018 suggests that higher BMI, ASA≥3, diabetes, alcohol abuse, open fracture, subluxation/dislocation, incision cleanness grade 2–4, high-energy injury mechanism, chronic heart dis-ease, history of allergy, and use of antibiotic proph-laxis were significant risk factors for SSI after surgi-cal treatment of ankle fracture (21,23).

Kang *et al* found out that Open fractures (OR = 4.220) showed the highest risk for developing SSI, followed by the male sex, an increasing number of comorbidities, a history of dementia, a history of myocardial infarction, and an increasing age. Seasons also seem to be related to SSI; the summer season showed the highest risk for SSI after ankle fracture surgery (22). Wound debridement within the first 72 hours, early definitive fixation, and definitive fixation within the first two weeks were the main contributors to the reduction of infection rates. Poor reduction and mal-union were associated with higher rates of delayed infection and poor functional outcomes (24). However, there are no associated factors found with SSI in this study.

Smaller sample size used in the study and lower level of evidence study design (retrospective record review) are limitations of the study.

Conclusion

Even though the surgical treatment of ankle fracture results in good postoperative functional outcomes, restores ankle function, and allows good mobility of the ankle joint, still some patients experience few re-strictions in functional activities of after one year of post-surgical treatment. There is a significant associa- tion between lower OMAS score and late surgery and age ≥ 60 years old.

The SSI is higher further studies are needed for confir-mation with a higher number of patients involved and associated factors should be analyzed we should be careful with the prevention of SSI. We recommend future studies based on factors associated with SSI in patients with ankle fractures. As an outcome of patients aged 60 and above treated operatively is significantly associated with lower OMAS and AOFAS scores this should be compared with patients treated nonopera-tively to decide on options of management.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this research. The research was conducted with full objectivity and without any competing financial, personal, or other interests that could influence the integrity of the findings or conclu-sions.

Acknowledgment

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Original Article

Determinants of Early Complications in Femur Neck Fractures Following Operative Management in a Resource Limited Setting : A Facility Based Retrospective Study

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Abstract

Introduction: *The main goal of treating femoral neck fractures in young patients and non-displaced fractures in the elderly is preserving the femoral head while reducing complications. The aim of the study was to assess factors determining early complications after fixation of femur neck fracture.*

Methods and Materials: *This was a three-years retrospective study conducted at tertiary at Tikur Anbessa Specialized Hospital were reviewed. Data was analysed using SPSS version 29 and results were summarized by text and table. Bivariate and multivariate analysis were used to assess the association between explanatory and out- come variables. Factors with P-value <0.05 in the multivariate analysis were considered to have statistically sig- nificant association with outcome.*

Results: *A total of 78 patients were included where 57 (73%) patients were male and mean age was 37 years. The average time from injury to surgery was 17.8 days; more than two third of patients were operated on after 07 days of the injury. Sixty-seven (85.9%) were displaced and 9 were classified as Pauwels type III (angle >70°). There were 22(28.2%) non-acceptable fracture reductions according to Garden alignment index. Twenty-nine (37.2%) patients had developed complications where fixation failure was commonest occurring in 20(25.4%) followed by non-union 6(7.7%) and AVN 3(3.8%). From the multivariate analysis, patients who had unacceptable garden alignment index were significantly associated with early complications (AOR - 27.43; 95%CI 5.62-133.95, p<0.001), while the presence of revision was marginally associated with early complications (AOR- 21.7, 95% CI 0.69-1000, p= 0.079).* ***Conclusion:*** *In fixation of femur neck fracture, achieving anatomic reduction, assessed via the immediate postop-erative Gardenalignment index, predominantly influences early complications. Time from injury to surgerydoesn't significantly impact early outcomes, suggesting operability beyond 7 days in resource-limited settings.*

Keywords*: Risk factors, Femur neck fracture, Early complications, Garden Alignment index, Ethiopia*
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Introduction

The main goal of treating femoral neck fractures in young patients and non-displaced fractures in elderly is preserving the femoral head while reducing complications (1,2). A surgically treated femoral neck fracture typically undergoes healing within three to five months (3). However, Complication rates such as early fixation loss, non-union, and avascular necrosis (AVN) of the femoral head, range from 10% to 45% (4,5). Thirty-three percent of patients undergoing internal fixation require reoperation, while one in seven necessitate conversion to total hip replacement (THR) (6). Patient physiology, fracture specifics, fixation quality, and rehabilitation influence healing. Delays > 24 hours in fixation, and comorbidities (smoking, alcohol, renal issues) predict potential fixation failure (7). Similarly, Displaced fracture, unacceptable reduction, high Pauwels angle, and posterior cortex comminution are risk factors for non-union and implant failure (8,9).

According to Upadhyay A et al randomized controltrial done on displaced fractures, the efficacy of internal fixation within one week of injury is consistent (8).

Internal fixation within 6 hours post-injury shows lower rates of non-union and avascular necrosis (AVN) compared to fixation between 6 to 24 hours and beyond 24 hours. However, discrepancies exist regarding the optimal timing for operative intervention to prevent non-union (9, 10).
Intervention after one week of injury interferes with anatomic reduction due to fibrosis formation around the fracture and proximal migration of the distal fragment that necessitate open procedures (8). In low and middle-income countries (LMIC), there is a delay in presentation to healthcare facilities and delivery of treatment which is true for femur neck fracture fixation as well (10).

To our knowledge, in LMIC, there is no data on the outcomes of femur neck fixation and determinants of early complications. This study primary aim is to identify the factors influencing early complications within 6 months of fixation mainly fixation failureand AVN, and non-union.

Methods and Materials
Study Setting, Design and Period
This is a retrospective study done at a tertiary institution in Addis Ababa, Tikur Anbessa Specialized Hospital (TASH) between January 2020 and December 2022. The Department of Orthopedics at TASH was established in 1987. It has 75 beds in the adult and paediatric orthopedic wards where trauma patients account 61.5% of admissions.

Study participants
All patient who underwent femur neck fracture fixation during the study period was included in the study. **Study Variables**
The outcome of femur neck fracture fixation like implant failure, non-union and AVN were dependant variables while the rest including socio-demographic variables such as age, sex, clinical and radiologic characteristics were independent variables.

Inclusion and exclusion criteria
Patients with a complete medical record, and with a minimum of six-month follow-up were included In the study. Patients with bullet injuries, pathologic fractures, and incomplete data were excluded.

Operational definition and technique Preoperatively, patients underwent antero-posterior and lateral hip X-rays, deep venous thrombosis screen- ing done for patients who come after 48 hours of inju- ry, and received prophylaxis. Surgeries were per- formed by orthopedic trauma specialists or fellows. Patients were positioned supine on a traction or stand- ard table, attempting closed reduction; open approach- es were used if needed. Intraoperative fluoroscopy verified reduction, employing either three parallel can - nulated hip screws or dynamic hip screws for fixation.

The quality of reduction was evaluated using the Garden Alignment Index (GAI) in immediate postoperative x-rays. Acceptable alignment ranged between 155 to 180 degrees, measured as the angle of the compression trabeculae concerning the medial femoral shaft on anteroposterior and lateral views (**Fig 1**)

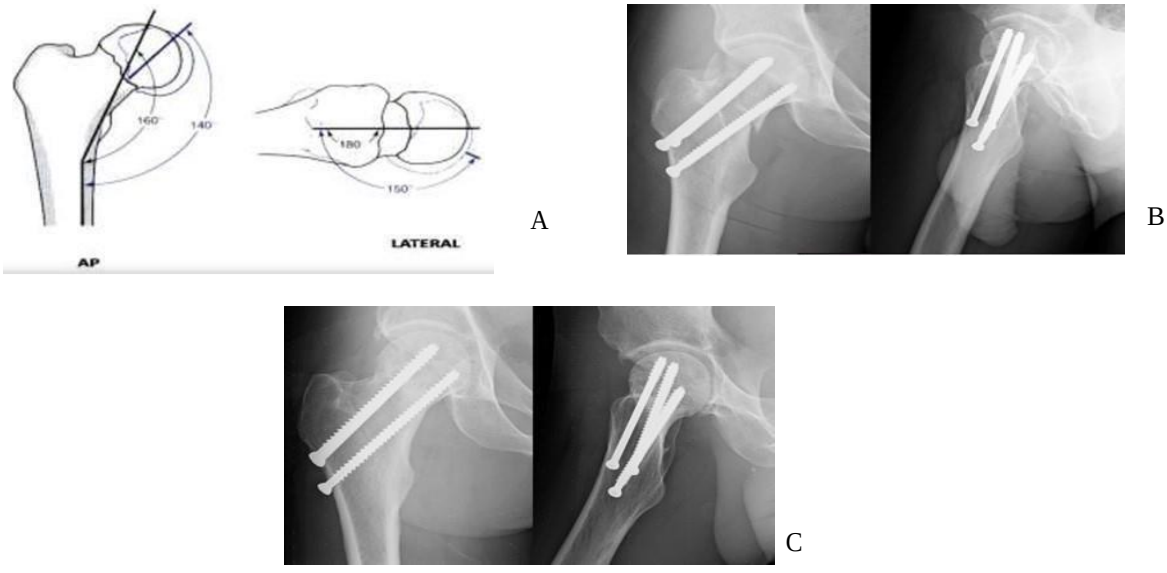

Fig. 1 a) Garden Alignment Index Measurement b) Postoperative AP and lateral radiography with acceptable GAI. Surgery was done 21 days after injury c) AP/Latera radiography at 2 years

Postoperatively, patients were followed at 2, 6, and 12 weeks; then biannually with physical examinations and radiology. Weight-bearing is allowed at 12 weeks or upon evidence of clinical and radiological union. Complications were managed promptly.

Fixation failure was defined as osteofixation loss and fracture displacement within 6 months of surgery via radiography.
Non-union was defined as persistent pain and radiolucent line at 6 months post-fixation.
AVN defined as femoral head collapse post-fracture healing on X-ray. Because of short follow up period and magnetic resonance imaging (MRI) there may be missed cases.
Early complication is defined as the presence of fixation failure, AVN, and/or non-union within 6 months of postoperative follow-up.

Data collection and Analysis
The data was collected with Excel which was exported into SPSS version 29 for data cleaning and analysis. The result was summarized by using texts, tables, and figures. The data was presented with mean and median for continuous and proportion for categorical variables. Bivariate and multivariate analysis was used to assess the association between explanatory and outcome variables which is early complications within 6 months of the operation and statistically significant was declared when the P-value was <0.05 in the multivariate analysis.

Ethical Consideration
The study was conducted after getting Ethical approval from Addis Ababa University College of Health Sciences with institutional review board number AAUMF 03-008.

Result
Sociodemographic characteristics of patients. A total of 357 femur neck fracture patients' data was recorded from January 2020 to December 2022 where 104 patients underwent femur neck fixation. Seventy-eight patients with femur neck fractures were included in our study. The excluded patients included those with incomplete data (13), bullet injury (9), young age less than 18 years (3), one pathologic fracture, and patients underwent replacement surgery.

Fifty-seven (73%) patients were male and the mean age at the time of surgery was 37 (18 -75) while the median age was 35 years. Road traffic accident (RTA) was the commonest mechanism of injury for 31(39.7%) patients, followed by fall from height in 24 (30.7%). Only 7(9%) patients had comorbidity where smoking was commonest 3(3.8%). Thirteen (17%) patients had associated other musculoskeletal injuries

The average time from injury to the date of surgery was 17.8 (1 - 126) days; whereas the median time of injury to surgery was 13.5. One patient operated at126day of injury. More than two-thirds of patients were operated after 07 days of the injury.

Among the 78 femur neck fractures, 67 (85.9%) were displaced and 9 were classified as modified Pauwels type III (angle >70°).

Closed reduction was successful for 48(61.5%) fractures where cannulated hip screw was used for 67 (85.9%) fractures fixation. There were 22(28.2%) non -acceptable fracture reductions according to Garden alignment index. Immediate post-operative revision surgery was performed for 7(9%) patients for indication of unacceptable reduction, and screw penetrations (**Table 1**).

Six month's Outcome data
Twenty-nine (37.2%) patients had developed complications where fixation failure was commonest occurring in 20(25.4%) followed by non-union 6(7.7%) and AVN 3(3.8%) (**Table 1**).

Displaced fractures, modified Pauwels type III, unacceptable garden alignment index, and need for immediate postoperative revision were found to be determinants for the development of early complications on the bivariate analysis (**Table 2**).

Among 67 patients with displaced fractures, 28(41.8%) developed complications. Based on the modi- fied Pauwels classification, 9 were type III where 6 (67.7%) developed complications.

Of the 22 (28.2%) patients with unacceptable reduction, 20(90.1%) of them developed complications. Closed reduction is successful for 48 of these 15 developed complication and 30 patients under went open reduction of these 14 developed complications (**Table 2**).

Table 1. Sociodemographic and radiologic status of femur neck fracture patients

Variables		Frequency No. (%)
Age(years)	≤40	48 (61.5)
	>40	30(38.5)
Sex	Male	57(73)
	Female	21 (27)
Location	AA(Addis Ababa)	33(43.3)
	OAA(outside Addis Ababa)	45(57.7)
Comorbidity	None	71(91)
	Had comorbidity	7(9)
Mechanism of injury	RTA	31(39.7)
	Fall-height	24(30.7)
	Fall-standing	23(29.6)
Injury to surgery time(days)	≤ 7 days	23(29.5)
(Average 17.8)	>7 days	55(70.5)
Garden (n= 79)	Non-displaced (I&II)	11(14.1)
	Displaced (III & IV)	67(85.9)
Pauwels (Original)*	I & II (<50 º)	23 (29.5)
	III (>50 º)	55 (70.5)
Pauwels (modified)**	I & II (<70 º)	69(88.5)
	III (≥70º)	9(11.5)
Fixation methods	CHS	67(85.9)
	DHS	11(14.1)
Garden alignment index	Acceptable	56(71.8)
	Non-acceptable	22(28.2)
Use of fully threaded	Used	44(65.2)
screws	Not used	23(34.8)
Presence of complications	Yes	29 (37.2)
	No	49(62.8)
Types of complications	Fixation Failure	20(25.4)
	Non-union	6(7.7)
	AVN	3(3.8)

**Represented the Pauwels classification where Pauwels type III is the angle measurement greater than 50 degrees.*

*** Represented the Pauwels classification where Pauwels type III is the angle measurement greater than 70 degrees.*

Table 2. Showing the association between sociodemographic status and complications

Variables		Complications No. (%)		P-value
		No	Yes	
Age	≤40	34 (70.8)	14 (29.2)	0.064
	>40	15 (50)	15 (50)	
Sex	Male	38 (66.7)	19 (33.3)	0.843
	Female	11 (52.4)	10 (47.6)	
Location	AA	23 (69.7)	10(30.3)	0.282
	OAA	26 (57.8)	19 (42.2)	
Comorbidity	None	46 (64.8)	25 (35.2)	0.252
	Had	3 (42.9)	4 (57.1)	
Mechanism of injury	RTA	21 (70)	9 (30)	0.408
	Fall from height	16 (64)	9 (36)	
	Fall from ground	12 (52.2)	11 (47.8)	
Injury to time of surgery	≤ 7 days	17(73.9)	6(26.1)	0.19
	7 days	32(58.2)	23(41.8)	
Garden type	Non-displaced	10 (90.9)	1 (9.1)	0.038
	Displaced	39 (58.2)	28 (41.8)	
Pauwels type (Original)	I&III (<50 º)	18 (78.3)	5 (21.7)	0.068
	III >50 º	31 (56.4)	24 (43.6)	
Pauwels type (modified)	I&II (<70 º)	46 (66.7)	23 (33.3)	0.052
	III (≥70º)	3 (33.3)	6 (66.7)	
Reduction method	Closed	33 (68.8)	15 (31.2)	0.17
	Open	16 (53.3)	14 (46.7)	
Garden alignment index	Acceptable	47 (83.9)	9 (16.1)	0.001
	Nonacceptable	2 (9.1)	20 (90.9)	
Revision	Yes	1 (14.3)	6 (85.7)	0.005
	No	48 (67.6)	23 (32.4)	
Use of fully threaded	Yes	27 (62.8)	16 (37.2)	0.878
	No	14 (60.9)	9 (39.1)	

From the multivariate analysis, patients who had unacceptable garden alignment index was significantly associated with early complications (AOR -27.43; 95%CI 5.62-133.95, p<0.001). But the presence of revision was modestly associated with early complications (AOR 21.7; 0.69-1000, p=0.079 (**Table 3)**

Discussion

In our study, 37.2% patients developed overall early complications. This is comparable with study done by Duckworth 32% (7), Stappaerts in Belgium 32.5% (11). We found that non-acceptable Garden alignment index is statically significant risk factor for early complications whereas, immediate post-operative revision surgery is modest risk factor. Similar to our finding, early complications observed in femur neck fixations with non-acceptable Garden alignment index (11–13). Previous studies in the literature shows anatomic reduction and stable fixation prevent bad results in femur neck fracture fixation (14–16)

In our series median time of surgery was 13.5 days; as the patients present delayed and limited resources for timely treatment. We didn't found any association between time of surgery and early complica-tions. This result is supported by multicentre study done in Malaysia on outcome of femur neck fixation in young patients shows 50% complications; AVN (32%), non-union(11%) and infection 4.3% where; time of surgery had not association with complica-tions(14). Due to short follow up period unlike other studies (2, 17) the percentage of AVN in our study is low. Another meta-analysis done on effect of timing of internal fixation of intra-capsular femur neck fix-ation on late development of AVN & non -union failed to show any association (18). In contrary to this fixation within 6 hours of injury shows less non-union and AVN compared to 6 to 24 and after 24 hours (19).

We have found a significantly higher complication (28.2%, P=0.038) in displaced fractures compared to non-displaced fractures, similar to the study by Roger Erivan et al HR = 2.77 (95%CI: 1.09–7.02), p = 0.025 (20) and Yang et al OR=2.93 (95%CI: 1.08-7.96), P=0.035 (21). Another study done in Norway by Hoelsbrekken et al shows 26.8 % fixation failure, non-union, and AVN rate in displaced fractures, while it is 10.3 % in non-displaced (22).

Table. 3 Bivariate and Multivariate modelling showing the association between explanatory and outcome variables (early complications)

Variables	Bivariate Analysis		Multivariate analysis	
	OR (95% CI)	P-value	AOR (95%CI)	P value
Age (Ref: ≤ 40)	2.06(0.79-5.39)	0.14	2.36 (0.53-10.46)	0.257
> 40				
Time to Surgery (Ref: ≤ 7 days)	3.17(.95-10.57)	0.06	1.36 (0.24-7.66)	0.727
>7 days				
Garden Type (Ref: I&II)	595(0.72-49.31)	0.10	5.14 (0.35-75.74)	0.233
III&IV				
Pauwels Type (Ref: I&II)	2.86(0.7-11.71)	0.15	1.39 (0.12-16.93)	0.794
III				
Reduction Method (Ref: Closed)	2.06(0.79-5.39)	0.14	1.41 (0.29-7.00)	0.671
Open				
Garden alignment index (Ref: Acceptable)	44.33(10.37-189.48)		27.43 (5.62-133.95)	<.001
Non-acceptable		<0.001		
Revision (Reference -No)	15.3(1.73-135.25)			0.079
Yes				
		0.014	21.7(0.69-1000)	

However, a result of logistic regression analysis could not find the presence of displacement as a factor predicting the complication comparable to a study by Ramadanov et al (23).

It is indicated that age is a predictive factor for femoral head necrosis (23, 24). However, we could not find any significant difference in age between the patients with complications such as fixation failure, non-union, and femoral head necrosis and those without compli-cations. This is in line with a study by Yang et al which shows age has no association with non-union (21).

Pauwels' original thesis suggested, that the more verti-cal the Pauwels angle is, the higher the incidence of non- union (25). However, the findings in the study of Parker and Dynan, which was conducted among 335 patients, failed to find any correlation between the Pauwels angle and non-union in both displaced and undisplaced fractures (26). In our series, there is ahigher tendency of early complications in Pauwels type III fractures with an angle greater than 70 de- grees.

Conclusion

Our study shows that unacceptable Garden alignment index and immediate post-operative revision surgery were the main risk factors for early complications.

Recommendations

Based on our findings, we recommend anatomic reduction irrespective of the time of injury to surgery is a key consideration during femur neck fracture fixation. Further study on late complication with long term follow up and comparative outcome study on early and late femur neck fracture fixation.

Conflict of Interest

There is no conflict of interest to declare.

Abbreviations and Acronym

AA Addis Ababa
AAU Addis Ababa University
AVN Avascular Necrosis
DHS Dynamic hip screw
LMIC Low and Middle Income Country
OAA Outside Addis Ababa
RTA Road Traffic Accident
TASH Tikur Anbessa Specialized Hospital

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Original Article

Patient Self-reported Functional Outcomes after Total Hip Arthroplasty: Insights from a Tertiary Hospital in Ethiopia

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Abstract

Background: *Total hip arthroplasty (THA) is one of the most frequently performed procedures in orthopedic surgery where both the acetabular and femoral parts are replaced with a prosthesis. It is most often performed to relieve pain and restore function in patients with severe traumatic or non-traumatic hip pathologies.*

Objectives: *The primary objective was to investigate the functional outcomes of total hip arthroplasty with a minimum follow-up of one year after the procedure.*

Methods: *The modified Harris Hip Score (mHHS), Oxford Hip Score (OHS), EQ-5D and the Standard Version of the Short Form (SF) 36 outcome measures were used. Patients who underwent total hip arthroplasty from September 2017 to July 2023 were included. The functional outcomes of hip arthroplasty were expressed as frequency distribution, mean, and Median (IQR) depending on the nature of the variable. SPSS software version 27 was used for analysis. A p-value less than 0.05 was considered significant.*

Results*: This study included a total of 63 patients with an average follow-up of 45 months (3.75 years). There were more male patients (47, 74.6%). The mean age at the time of surgery was 48.6 years. The most common indication for THA was advanced osteoarthritis (40 patients, 63.5%). There was one case of dislocation and one revision due to infection.Mean scores of mHHS, OHS, and SF- 36 were 89.7, 43, and 88.9, respectively which indicates satisfactory joint functional outcome and a good quality of life.*

Conclusion*: Total hip arthroplasty is an effective treatment option for people with severe hip pain and disability at Tikur Anbessa Specialized Hospital with satisfactory outcomes. Proper documentation of outcome measures including preoperatively and on follow-up at 3 months, 6 months, 1 year, 2 years, 5 years, and 10 years is recommended to scale up and include the service to other hospitals to make it available for timely service.*

Keywords*: Total hip arthroplasty, Functional outcome, Harris hip score, THA, Hip surgery*

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Introduction

Total hip arthroplasty (THA) is one of the most frequently performed procedures in orthopedic surgery. It involves femoral and acetabular components made from various materials, with a multitude of available designs (1). It is most often performed to alleviate pain and restore function for patients with extensive hip joint damage caused by conditionssuch as osteoarthritis, rheumatoid arthritis, avascu- lar necrosis, traumatic arthritis, certain hip fractures,or benign and malignant bone tumors. This proce- dure has the potential to substantially improve qual- ity of life (1,2). Advancements in joint replacement surgical techniques and technology have greatly enhancedthe effectiveness of total hip replacement (3).

Unlike developed nations where the benefits of THA are enjoyed, developing nations like Ethiopialag in adequately providing it (4), leading to pro- longed waiting times and complications for thepatient (5). A literature review conducted in sub– Saharan Africa shows that the outcomes of THA are not well studied (6).

Typically, functional outcomes of THA are assessed using the modified Harris Hip Score (mHHS), short form (SF)-36 (7), Oxford Hip Score (OHS), and EQ-5D, which are influenced bypatient characteristics (8). The large majority of patients who undergo the operation experience improved quality of life (9). The improvement in quality of life after orthopedic interventions is as-

sessed using outcome measures (10). The quality of life after total hip arthroplasty reported in a study conducted by Wiklund I and Romanus B showedthat it is comparable with that of a healthy referencegroup of similar age and sex distribution (11).

In a study in the US, 85% of THA patients were well functioning well at 20 years (12). Another study reported an average HHS of 89.4 at follow-up (13). In the Swedish hip arthroplasty registry of 1996, arthritis (OA, post-traumatic, and rheumatoid) and avascular necrosis (AVN) accounted for over 95% of THR indications (14).

Due to improvements in health services, the life expectancy of the Ethiopian population has increased from 39.9 years in 1960 to 64 and 67 years for males and females, respectively in 2016 (15). According to the World Health Organization, the life expectancyat birth in Ethiopia has increased to 67.81 years as of 2023 (15). As most indications for THA are age-related, the demand for THA is expected to increase. Studies have shown that THR is a viable, safe, and effective option in Ethiopia (4).

Tikur Anbessa Specialized Hospital has been providing THA services since 2017 with its own THA surgical set. However, the functional outcomes of these procedures have not been studied yet. Therefore, this study aimed to evaluate the patient self-reported functional outcome of THA at Tikur Anbessa Specialized Hospital.

Patients and Methods

Study Setting and Period

Tikur Anbessa Specialized Hospital (TASH) is a public hospital located in Addis Ababa, Ethiopia.The orthopedic department was established in 1987 and has 75 beds in the adult and pediatric orthopedic wards.

Total hip arthroplasty (THA) surgery was first performed at TASH in 2005 by expatriates using donated implants. In 2017, TASH acquired its own set of THA implants and began performing the surgery independently.

The study was conducted between July 30, 2023, and September 30, 2023. All patients who underwent total hip arthroplasty from 2017 to July 2022 were included in the study.

Study Design

An observational retrospective cohort design was used.

Selection of Study Participants

All patients who underwent total hip arthroplasty at TASH were considered the source population. The study participants were patients who underwent THA at TASH during the period of September 2017 and June 2022 and those who fulfilled the eligibility criteria.

Eligibility criteria

Patients for whom total hip arthroplasty was doneand who have a minimum of one-year follow-up were included in the study. Patients who did not give consent, who were seriously ill to give the required information, patients with psychiatric conditions, and those who have physical disability that limits movement were excluded from the study

Data Collection Procedure:

The patient list was compiled from operating theater logbooks. Socio-demographic, disease conditionsand treatment-related data were collected from pa- tient charts and directly from patients via phone interviews. A chart abstraction tool that consisted of socio-demographic characteristics, disease conditions, and treatment was used to collect data from patient charts. Data collection from patients was conducted through phone interviews (16) to complete the outcome-measuring tools mentioned above. The questionnaire was developed using KoboToolbox, a free and open-source software platform for data collection and management. It was adapted from the EtJoint registry, an ongoing joint registry process. It consisted of four parts: sociodemographic characteristics, disease condition, treatment condition, and outcome measuring tool questions. The questionnaire was initially prepared in English and then translated into Amharic. Verbal consent was obtained before data collection via phone call and recorded in KoboToolbox.

Data Processing and analysis

The collected data were extracted from KoboToolbox and imported into IBM SPSS Statistics version 27 for analysis. The data were then cleaned, transformed, and made ready for analysis.

The Shapiro-Wilk normality test was used to check for skewness in the descriptive variables since our sample size is small. A p-value less than 0.05 was considered significant.

Skewed variables were described using robust descriptive statistics such as the median with interquartile range (IQR) that accounted for outliers and non-normality. In contrast, normally distributed variables were described using the mean and standard deviation.

Ethical considerations

This retrospective study analyzed existing data collected from surgical logbooks, medical records, and phone interviews. It did not influence patient treatment and any potential risks to patient safety were considered minimal. Due to the anonymous nature of the data and logistical challenges associated with

contacting individuals from a historical record, obtaining written informed consent was deemed impractical. The study received a waiver of written informed consent from the department's ethicalreview committee. Data privacy and confidentiali-ty were ensured through anonymous data record-ing, analysis, and manuscript writing. Participants were informed about the study through phone calls.

Results

Background characteristics

This study included a total of 63 patients with an average follow-up of 45 months (3.75 years), ranging from 12.7 months (1 year) to 71.7 months (6 years). There were more male patients (47, 74.6%) than females (16, 25.4%). The mean age at the time of surgery was 48.6 years (ranging from, 24 to 78 years), and the majority (42, 66.7%) were between the ages of 50 and 59. The median BMI was 22.8 with an interquartile range of 4.075 (Table 1).

Comorbidities: The most common medical comorbidities were hypertension (12 patients, 19%) and diabetes mellitus (7 patients, 11.1%). One patient was HIV positive and had started antiretroviral therapy (ART) before the procedure. The indication for implantation in this particular patient was a femoral neck fracture.

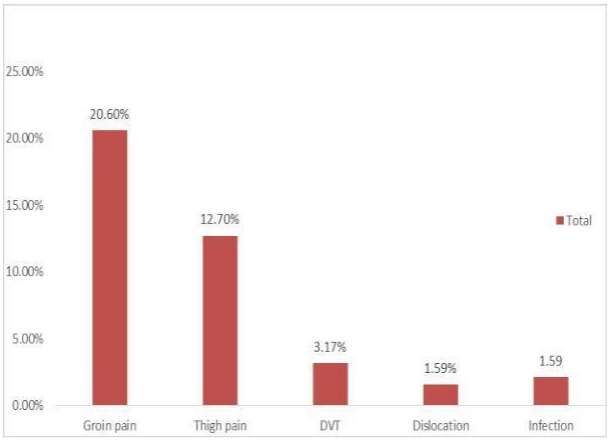
	N	%
Age category		
24-29	3	4.8
30-39	6	9.5
40-49	12	19
50-59	42	66.7
Patient origin (residency)		
Addis Ababa	41	65.1
Oromia Region	13	20.6
Amhara Region	4	6.3
SNNPR	3	4.8
Gambella	2	3.2
Comorbidities		
Hypertension	12	19
Diabetes Mellitus	7	11.1
HIV	1	1.5
Indications for THA		
Osteoarthritis	40	63
Avascular Necrosis	7	11
Previous Tuberculosis	6	10
Femoral Neck Fracture	5	10
Dysplasia	3	5
Ankylosing Spondylitis	1	2

SNNPR: Southern Nations Nationalities Peoples' Region
THA: Total Hip Arthroplasty

Table 1 : Background characteristics of study participants

Forty-one (65.1%) patients were from the capital city, Addis Ababa, while 13 (20.6%) were from the Oromia Region. The remaining patients were from the Amhara Region (4 patients, 6.3%), Southern Nations Nationalities Peoples' Region (3 patients, 4.8%), and Gambella Region (2 patients, 3.2%). The average waiting timefor surgery after the decision was made and the patient was booked for THA was 4.54 years, with a range of 0 to 10 years.

Indications: The most common indications for THA are depicted in Table 1. Bilateral total hip arthroplasty (THAs) accounted for 19% (n=12) of all THAs, while



right- and left-sided THAs accounted for 46.0% (n=29) and 34.9% (n=22), respectively.

Figure 5: Complications

Outcome: The modified Harris Hip Score was skewed with a median of 93.4 (IQR= 14), and a mean of 89.7. The Oxford Hip Score had a median of 45 (IQR=7) and a mean of 43.

The average SF-36 score was 88.9, with domain average scores as follows: general health (90.0), physical functioning (88.9), role physical (90.1), bodily pain (88.7), vitality (79.1), social functioning (87.7), role emotional (90.0), and mental health (92.0). The data were skewed, with a median SF-36 score of 93.3 and domain median scores as follows: general health (95), physical functioning (90), role physical (100), bodily pain (90), vitality (80), social functioning (100), role emotional (100), and mental health (100).

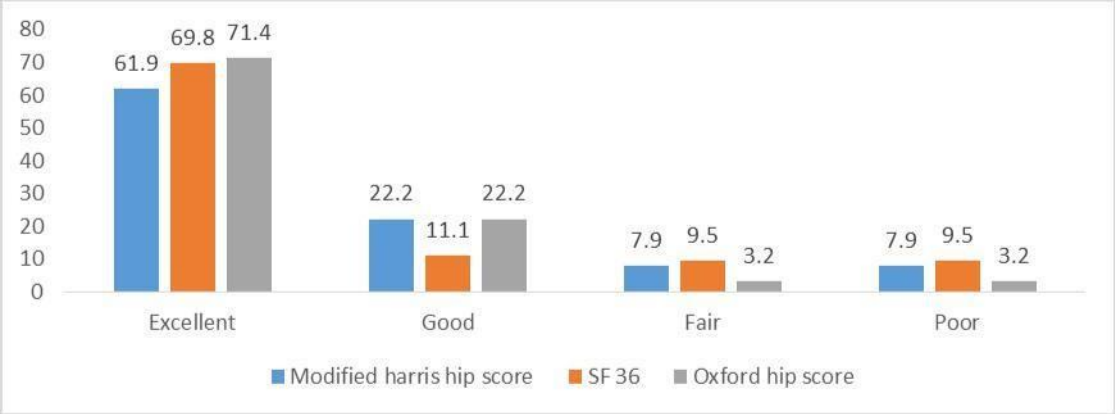


Figure 6: Percentage of cases in each outcome measure by category. The numbers are in percent. Excellent (>90%), good (80-89%), fair (70-79%) poor (<70%).
NB. Oxford Hip Score is converted to 100% for the purpose of comparison with other outcome measures.

EQ-5D result: 27 (42.9%) of patients responded 11111, which is the best possible health state on the EQ-5D. EQ VAS measure of overall self-rated health status was skewed with a median of 85, which is high; interquartile range of 17 indicates a wide range of self-rated health scores (Table 2 and Figure 7).

Table 2: Self-reported functionality

Levels	**Dimensions**				
	Mobility n (%)	Self-care n (%)	Usual activity n (%)	Pain/discomfort n (%)	Anxiety/ depression n (%)
Level 1 (No problems)	50(79.37)	51(80.95)	40(63.49)	34(53.97)	56(88.89)
Level 2 (Slight problems)	7(11.11)	11(17.46)	22(34.92)	20(31.75)	7(11.11)
Level 3 (Moderate problems)	5(7.94)	1(1.59)	0	8(12.7)	2(3.17)
Level 4 (Severe problems)	1(1.5%)	0	1(1.59)	1(1.59)	0
Level 5 (Extreme problems /unable to do)	0	0	0	0	0
Total	63(100)	63(100)	63(100)	63(100)	63(100)

Most patients in the study (53 patients, 84.1%) were able to walk without a walking aid. The remaining patients (9 patients, 14.3%) used a walking aid, but did not need help from others to walk.

The most commonly used implant sizes were 32 mm-3.5 head, 52mm acetabulum shell, and number 9 stem diameter.

Discussion

Research on the outcomes and number of total joint replacements (TJRs) performed in sub-Saharan Africa (SSA) is limited (18). One study (19) reported a 3% dislocation rate in a series of 300 total hip replacements, while another study conducted in Ethiopia by reported 4% total hip replacement (THR) prostheses dislocated due to a fall accident (11). One was reduced closed, without surgery, and the other required surgical reduction due to delayed presentation (4). In our study, there was one case of dislocation was treated with closed reduction as it presented acutely. An article from Kenya reported a superficial infection of 2% and a deep infection rate of 1% (20), which is comparable to a deep infection rate of 1.6% in our study. Another study done in Ethiopia has also found a similar infection rate as our study (11).

In our study, the major indication for total hip arthroplasty was osteoarthritis accounting for 63% (n=40) of cases. Similarly, Gokcen EC and Wamisho BL reported osteoarthritis as the majorindication in 44% of cases (4).. Another study by found osteoarthritis to be the primary diagnoses (94.8%) (17). In contrast, the Malawi hip registry report showed the primary diagnosis to be AVN, accounting for 48.6%.

Arthroplasty outcomes in sub-Saharan Africa are underreported, but available literature suggests that arthroplasty can be successful in this region (18,20). Among African reports, one study found the mean and median mHHS of 86.6 and 88 in South Africa (17). Similarly, Gokcen EC and Wamisho BL found an average mHHS at follow-up at Cure Hospital, Ethiopia to be 88.7, which is comparable to our finding of mHHS 89.7 (4). We found a mean OHS of 43, showing a slight improvement from the report by Gokcen EC and Wamisho BL (4).

The EQ-5D results suggest that a significant proportion of patients (42.9%) reported full health after THA, indicating that THA can be a very effective treatment for people with severe hip pain and disability.

The SF-36 results with an average score of 88.9 which is in the upper range of good, suggest that patients who underwent THA experienced signifi- cant improvements in their quality of life post- surgery.

Overall, all outcome measures show a significant improvement in health state, demonstrating that total hip arthroplasty is safe and effective.

Limitations

One of the limitations of this study is that it has a small sample size. Study participants may be prone to recall bias.

Conclusion

Total hip replacement (THR) surgery is an effective treatment option for individuals experiencing severe hip pain and disability at Tikur Anbessa Specialized Hospital, yielding satisfactory outcomes. Proper documentation of outcome measures including preoperatively and on follow-up at 3 months, 6 months, 1 year, 2 years, 5 years, and 10 years is recommended to scale up and include the service to other hospitals to make it available for timely service. Initiating a national hip registry for patient complete data follow-up is also recommended.

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Systematic Review

Functional Outcome Difference in Adult Patients With Distal Radius Fractures Treated with External Fixation Versus Closed Reduction and Casting: A Systematic Review

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Abstract

Introduction: *Distal radius fracture is one of the most common fractures treated by orthopedic surgeons. There are multiple alternatives for treating these fractures, such as operative fixation, and casting. Each treatment option has its own advantages and disadvantages, but the main goal is to help patients return to their preinjury level of function. The objective of this study was to review the literature to determine which treatment modality provides the best functional outcome for patients with distal radius fractures.*

Search methods: *Investigators searched COCHRANE, PUBMED, and EMBASE for randomized, and quasi-randomized control trials comparing closed reduction and external fixation, with closed reduction and casting. They evaluated patient-reported functional outcomes. Studies in languages other than English, prospective studies without randomization, and studies lacking assessment of patient-reported functional outcome measures were excluded*

Results- *Seven randomized control trials involving 869 patients with both intra-articular and extra-articular distal radius fractures were included. Patients' age ranged from 16 to 80 years. The studies showed considerable variations in the type of injury, treatment protocol, and outcome measurement tools. Three studies showed that operative treatment of distal radius fractures was beneficial, while two trials suggested that the choice between the two modalities should be made on an individual basis based on the benefits and potential complications. One study concluded that operative treatment of distal radius fractures is harmful to patients' function. The studies had some methodological weaknesses.*

Conclusion –*Based on the results of this study, there is no enough strong evidence in the literature to determine a difference in patient-reported functional outcomes among adult patients with distal radius fractures treated with external fixation versus closed reduction and casting. It is challenging to make recommendations on which treatment modality leads to better functional outcomes.*

Keywords- *distal radius, functional outcomes, external fixation, closed reduction casting*

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Introduction

Distal radius fractures are common fractures treated by orthopedic surgeons worldwide, accounting for 16% of all fractures. They have a bimodal distribu- tion caused by high-energy injuries in the young and falls in the elderly population, which is increasing dueto a rise in life expectancy of active elderly popu- lation with osteoporosis (1,2). Distal radius fractures include those within 3cm of the wrist joint. In adults older than 50 years old, they are the second most common fracture patterns next to hip fragility frac- tures (3). Additional risk factors include female sex, decreased bone density, and smoking (4). Despitetheir high prevalence, there is a lack of clear diag- nostic and treatment protocol, resulting in frequently missed injuries, longstanding wrist pain, and disabil- ity (5).

The most common fracture pattern in the elderly is Colle's fracture which is a metaphyseal bone injury over the cortico-cancelous bone junction. It is characterized by dorsal angulation, radial tilt, radial translation, and metaphyseal impaction. Intra-articular fractures mostly occur in young adults with

high energy injuries with reticular displacement, and impaction (6). Patients sustain a spectrum of soft tissue injuries with a reported incidence of more than 30% in those recovering from distal radius fractures or surgery which causes persistent disability (7).

In the literatures, there are twenty classification systems for adult distal radial fractures with different inter-, and intra-observer reliability. The complexity of choosing the appropriate classification systems also stems from different definitions of acceptable reduction with various treatment modalities. In addition to this, there is no consensus on the most favorable treatment option for different varieties of distal radius fractures in adults (8). Variations exist due to various bone quality, differences in age of the patient, degree of soft tissue injury, and patient expectations for the future use of their hands (9,10). Treatment modalities vary from closed reduction with casting to surgical fixation methods including k-wire fixation, external fixations, various types of plate fixations,and intra-medullary rods (11). The current working agreement is to treat extra-articular distal radial fractures with closed reduction and casting, as it is less invasive and cheaper with a subsequent displacement ranging from 43-60% worse for older patients (12, 13). However, there is no evidence suggesting less invasive treatments will give patients acceptable functional outcomes with fewer complications (14). Orthopedic surgeons aim to achieve less than 5 de- grees of radial inclination, restore radial height within 2-3mm of normal, neutral volar tilt, and less than 1 mm of articular surface step-off (15).

Outcomes after treatment were historically measured using physician-reported measures, including the degree of motion in the joints and imaging parameters, which were determined to be less important in understanding the overall patient satisfaction with the treatment and the overall functional status of the patients. Patient-reported outcomes are the standard for any follow-up of a certain treatment modality. Studies suggest that during the early post-treatment phase, patients focus on getting proper pain control, and in the long term focus on returning to work and the abil-ity to do daily life activities (16).

The overall goal of treating these fractures is restoring the patient's pre-injury level of performance. The success of treatment modality is assessed using different outcome measuring tools. There are two types of functional outcome measures: performance-based outcome measures and patient-reported outcome measures. The rationale for conducting this review is to understand the evidence in the literature on the difference in patient-reported outcomes following treatment of distal radius fractures with two of the treatment options: external fixation and closed reduction casting. After analyzing the data, the authorshope to gain knowledge and provide suggestions on which treatment modality provides better functional outcomes. Commonly used tools for evaluation include questionnaires such as the Disabilities of the Arm, Shoulder and Hand Questionnaire (DASH), short form health survey (SF-36), and patient-rated wrist evaluation (PRWE) (17,18).

The objective of this study was to assess which group of patient populations are better treated with external fixation compared to casting by comparing the functional outcomes and complication rates of patients with in the two groups.

Methods

2.1 Searching strategy

Randomized controlled trials and quasi-randomized trials comparing functional outcomes of adult patients with any type of distal radius fractures treated with operative fixation, including external fixation with closed reduction, and casting for distal radius fractures of various severity and causes of injury were reviewed in this study. The following eligibility criteria were used for inclusion of published articles. The study needs to be randomized control trial comparing two treatment modalities, written in the English language, the full document must be available for review without any specification to the year of study and number of study participant**s**, and the studies must have at least 6 months of follow-up.

Literature searches were made in the online databases such as COCHRANE, EMBASE, and MEDLINE. Reference lists of index articles were also searched for additional information in Research-Gate, Science-Direct, and Google Scholar. The search strategy employed the use of key MeSH (medical subject headings) for every database, and articles with titles that corresponded to the study criteria were collected using the ZOTERO application, with the Google Chrome ex tension, for a repeat view by the coauthors.

2.2. Selection of studies

The titles and abstracts of retrieved studies have been reviewed for relevance, and the full-text versions of potentially relevant articles were then analyzed according to the inclusion criteria. We looked for additional references in the reference lists of all included studies. This review included English-language literatures, Trials comparing external fixation alone or with addi-tional pin augmentation, and non-operative treatments, with additional treatment arms such as open reduction internal fixation, were included. Studies without ran-domization, and studies lacking assessment of patient - reported functional outcome measures were excluded. The quality of the studies was appraised through Cochrane risk-of-bias (RoB 2) tool. Digital object identifiers (DOIs) were commonly used to search for original articles, and those studies whose full manu-scripts were not available were excluded from the re-view. The researchers did not attempt to contact au-

thors to obtain new information or confirm published data. This review does not have an assigned registration or protocol number. Conference proceedings, textbooks, and guidelines were excluded from this review.

The primary outcome of the study is patients who have painless wrist motion with acceptable patient- reported functional outcomes. Functional outcome measures studied include the Musculoskeletal Func- tion Assessment (MFA) instrument, *Jebsen- Taylor* Hand *Function* Test (JTHFT), and Michigan Hand Score (MHS). Pain assessment scales, range of motion measurements with a goniometer, dynamome- ter measurement of grip strength, and a combination assessment of patient-reported and physician-assessed outcome scores like the Mayo Wrist Score were also included **.** Data was extracted to a Microsoft Excel sheet by the Authors.

Results

All the included studies were written in the English language and spanned 32 years, with the earliest study in 1990 (19) and the latest study done in 2021 (20)**.** The total number of patients included was 896**.** In those studies where sex distribution wasdescribed,there was a female predominance with the highest covering 90% of the participants (21). The youngest patient age stated is 16 years (23). Tworeasons men- tioned as causes for injury were accidental falls and high-energy road traffic injuries. There was no de- scription of the cause of injury for patients in two of the studies (19,20). Five of the studies were exclusive for extra-articular distal radius fractures (20,21,22,23,24), and one study had both intra and extra-articular fractures (19). Only three had a clear description of the radiologic parameters of fracture displacement for inclusion in the study.

Two of the studies had multiple arm trials including open reduction internal fixation with external fixation and casting (24). Three different methods of operative fixation - open reduction internal fixation, closed reduction pinning, and closed reduction external fixation were compared with casting (20). The other studies only included closed reduction with cast and external fixation. Methods of fixation were uniform across studies with all studies involving spanning external fixators, but there was a significant disparity in the type of external fixation device they used. The AO, Hoffman, Orthofix, Ace Colles, and Roger-Andersson were mentioned to be used in the stated studies.

There is a significant variation in the outcome measuring tools used by the studies (23) used a baseline functional assessment for all patients past skeletal maturity immediately upon arrival after an acute trauma using score MFA score and SF -36 questionnaires. The MFA scale is a self-reported health instrument designed to evaluate the status of patients with musculoskeletal extremity disorders (26). The short form has a longer functional index with 34 sections,and the bother index with 12 questions regarding how the loss of function has bothered patients in a wide range of disabilities with four subscales in- cluding upper and lower extremity dysfunctions, problems with daily activities, and mental and emo-tional problems (27). The SF-36 is a multi-scale with 8 sections addressing issues of limitations in physical and social activities, body pain, and mentalhealth (28).

In three trials, patients' ability to perform daily activities like opening door knobs, turning, and using keys, as well as carrying objects was used to evaluate the extent of functional recovery after treatment (19,21,25). Sarmiento's modification of Gratland and Werley's score was also mentioned as a measure of functional outcome. It is a combination of patient and clinician reported outcomes, including range of motion, residual deformity, grip strength, nerve injury, finger stiffness, severity of arthritis, and subjective evaluation of the patients (22). The MHS is one of the most common patient-reported outcome measurement tools for pain, satisfaction with hand function, motion, strength, and aesthetics with proven reliability and validity (20,30,31). Pa- tients' subjective assessment of residual wrist de- formity and wrist function at the end of the follow- up period was also used as an outcome measure- ment tool (24). Patient satisfaction with the function of their wrist after treatment was classified in tofour groups: poor, fair, good, and excellent without detailing what each group represents.

There is a discrepancy in the clinical or radiologic criteria used to treat fractures, and different exclusion criteria were used. These trials are analyzed based on the quality of their study designs and the risk of bias. All of the studies had improper blinding of assessors towards the patients' treatment assignment. The lack of blinding could lead to detection (measurement) bias, where assessors may be biased while checking outcome measures such as joint range of motion and grip strength. However, the nature of treatments can make it difficult toblind assessors effectively. Patients may have visi- ble implants, radiologic evidence of their treat- ment, and surgical incisions that reveal the type of treatment they received. Even if patients arrive with their surgical sites covered, assessors would need to remove the coverings for a proper evaluation.

Blinding of investigators towards allocation of patients to treatment groups is a vital part of conducting trials as prior knowledge can lead investigators to consider prognostic factors in the decision- making, potentially introducing selection bias. Two studies mentioned the importance of blinded sur-

geons and assessors during the initial allocation of patients, a factor not addressed in other studies (20,23). Another important factor that will help minimize selection bias is ensuring baseline characteristics of patients are similar. Factors such as age, gender, fracture patterns, and mode of injury are listed in the studies included as being similar across treatment groups in the included studies. Blinding patients is also vital in randomized trials as patients' knowledge of other treatment options may create decreased enthusiasm and performance which in turn might negatively affect the outcome. Blinding is mentioned in the methodology of only some of the trials (20,23).

Results with no statistical significance are equally mentioned with all the significant findings in all studies included, which minimizes reporting bias where researchers are inclined to report statistically significance results and omit those that did not have strong evidence. Avoiding a reporting bias enables the review to reach to proper conclusion backed by the evidence provided. Intention to treat analysis is the concept of analyzing patients in the group they are initially assigned to, irrespective of the fact that they might receive different treatment at the discretion of the treating surgeon. The pur- pose of this analysis is to minimize the bias in de- termining the effectiveness of a certain treatment modality. Intention-to-treat as a guide to analysis was used in the two of the trials (20,23).

In one of the studies 37 patients all above the age of 60 years were randomized (19). Radiographic comparison of the residual displacement between external fixation, and cast treatment groups were similar with no significant variation. In addition, the final functional outcomes after a total of fifteen months of follow up were similar. Accordingly due to the failure to achieve a significantly better result useof an external fixator was discouraged for pa-tients above 60 years of age with distal radius frac-tures. Another study randomized 113 skeletally mature patients with distal radius fracture from 16 to 75 years of age, without specification for the cause of trauma (23). After following the patients for two years, they had similar pain and upper ex-tremity function among patients treated with cast and external fixation. In the first year postop, the function was closer to the normal, or uninjuredside. Grip, pinch strength, and range of motion also showed similar patterns up to 2 years post injury. Radiological assessment revealed that the external fixation group had better restoration of distal radius length, and palmar tilt but these results did notreach statistical significance. They concluded that anatomical reduction is possible to be achieved with either of the treatment modalities, andpatientswho are treated have better function in the end, which did not prove to be a statisticallysignificant difference.

A third trial followed 90 patients, with an average age of 39 years, for four years; 70% of the causes of injury were road traffic injuries (24). A statistically significant difference in grip strength was observed among the cast immobilization groups. Patients in the external fixation group showed better radiologic restoration of dorsal tilt and radial height. Amongthe three arms the least articular step -off was in the open reduction and internal fixation group, followed by external fixation. The functional outcomes were better with external fixation compared to open reduction internal fixation and cast immobilization, though this difference was statistically insignificant. The authors concluded that operative treatment of distal radius fractures is better for maintaining the reduction and recovering the articular anatomy with the least risk of arthritis. Therefore, it is the preferred choice of treatment for displaced and comminuted intra-articular distal radius fractures.

A trial that enrolled 32 patients aged between 55 and 80 years with unstable intra-articular distal radius fractures, followed them for one year. The results showed significantly better radio-carpal angle and radial inclination in the external fixation group, and better finger grip in the cast treatment group, although this difference was not statistically significant (21). The mean range of wrist flexion was also better in the external fixation group. Both groups reported similar levels of pain, with residual radiocarpal pain present in both groups at one year. Other patient-reported functional outcomes showed no difference between the two groups throughout the one-year follow-up period. The authors concluded that the patient's activity level before the injury should be considered when deciding on the modality of treatment, as those patients with limited function may be satisfied with just cast immobilization.

A 2003 trial involving 125 patients ranging from 16 to 75 years of age with extra-articular distal radius fractures has the longest follow-up of seven years in this review (25). Anatomically, there was significantly better radial length and angulations in pa-tients treated with external fixation. However, re- sults at one year and at the 7^{th}- year follow-up showed similar wrist range of motion and grip strength compared to the opposite side, with an equal functional outcome. The authors concluded that there were better radiologic and anatomic out- comes in patients treated with an external fixator compared to closed reduction and casting which wasnot significant after 7 years.

The most common complications among patients treated with an external fixator were pin site infection, superficial nerve injuries, Dupuytren's contracture, and pin site pain reaching up to 20% in one

study (19). Cast treatment had complications including joint stiffness, tendon rupture, and carpal tunnel syndrome. The complication mentioned as the most significant determinant of long-term outcome was reflex sympathetic dystrophy (21,23). There was no correlation between the final anatomic reduction after treatment and the risk of developing reflex sympathetic dystrophy, nor was there a correlation between the risk of developing carpal tunnel compression and the initial or post-treatment degree of fracture displacement according to (22).

Discussion

There is a great diversity among the trials included in this review on demographic factors and mode of inju-ry.The age of participants ranged from 16 to 80 years. High-energy injuries from road traffic acci - dents, which are likely to cause more severe fracture patterns and more severe associated soft tissue inju- ries were also studied with low-energy fractures sec- ondary to accidental falls within the same trial. The study periods ranged from 1990-2021, which might impact treatment outcomes across decades due to advancement of surgical procedures, implants, and patient optimizationin recent years which might cause diversity in the expected patient outcomes. Thestudy areas have more diversity spanning three conti-nents: Europe, North America, Asia, and New Zea- land.

Most of the studies included both intra -articular and extra-articular fractures. Although only a fraction of the trials included future risk of wrist joint arthritis which is likely to be affected by the involvement of the joint surface, the functional outcomes of patients may be influenced by the severity of initial injury. There was lack of clear classifications for mode of injury, that resulted in poor understanding of the best treatment for patients with low -energy distal radius fractures from accidental falls. The patient groups included in the majority of the studies lacked exclusivity for age or severity of injury, which would directly affect the choice of treatment. Only one study analyzed the outcome of treatment for distal radius fractures in line with daily activities requiring proper hand functions including holding keys, opening taps, and carrying goods that are easier to replicate among wider population groups.

Conclusion

By conducting this review, the authors aimed to determine if there is a difference in functional outcomes among adult patients with distal radius fractures treated with external fixator and casting. Differences in functional outcomes should be studied to understand the effect of our treatment on the long-term functionality of patients. The evidence and suggestions at hand from different trials is not strong enough to conclude which treatment modality offers better short and long-term functional outcomes.

There is currently no strong evidence to support which surgical treatment modality for distal radius fractures offers the best outcome. There is no clear definition of age group and radiologic parameters that physicians can use to choose between treatment with external fixation and casting as treatment options. Patients with varying expectations, different use of their hands, and different activity levels should be approached differently and with an understanding of advantages and disadvantages of each treatment alternative. There is lack of protocols in the literature on how to properly follow and rehabilitate patients with distal radius fractures after treatment. Therefore, the authors suggest that there is a need for a high-quality randomized con- trolled trials that encompass various treatment mo- dalities for distal radius fractures, taking into ac- count variables such as modes of injury, age, and degree of displacement.

Limitation of the review

There is a potential for missing trials, both published and unpublished. We only have two studies with long-term follow-up, spanning 4, and 7 years (24,25). Only two studies had strong evidence backed by adequate blinding, and randomization resulting in less bias (20,23).

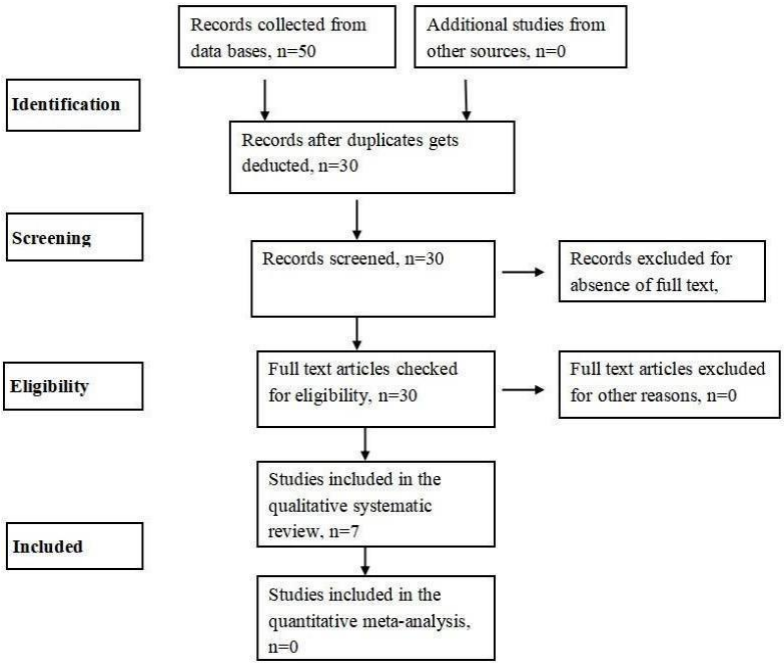

Fig-1-Preferred Reporting Items for Systemic Reviews and Meta-analysis (PRISMA) flow diagram describing the method of selecting trials

Table 1- Descriptions of basic demographic characters of studies included

Study ID	Year of publication	Study area	Number of patients	Age of patients	Length of follow up (in months)
Horne et al	1990	New Zeeland	37	Above 60	15
Kreder et al	2006	Canada	113	16-75	24
Kapoor et al	2000	India	90	average age 39	48
Hegeman et al	2004	Netherlands	32	55-80	12
Young et al	2003	United kingdom	125	16-75	84
Roumen et al	1991	Netherlands	101	Above 55	6 and half
Yoon et al	2021	US, Canada, Singapore	296	Above 60	12

Table 2– Summary of important characteristics of the studies included

Study ID	Fracture patterns included	Mode of injury	Exclusion criteria	Outcome measure used	Complication	Conclusion
Horne et al	displacement decided by the physician	not stated	None stated	wrist range of motion, grip strength, pain, limitation of mobility	radial nerve irritation, and pin site problems	no difference in anatomic end results, and functional outcomes
Kreder et al	Displaced fracture with metaphyseal comminution	29% high energy injuries	comminution, dorsal tilt >10 degrees, joint gap, prior trauma, congenital anomaly, delay more than a week, mental incompetence, open fractures	SF-36, MFA questioners, Jebsen Taylor test, grip strength, lateral pinch strength, and a sensorymotor exam	Pin site infection, reflex sympathetic dystrophy	Trend towards better function with fixation, evidence not statistically significant
Kapoor et al	intra articular distal radius fractures	70% road traffic injuries	None stated	wrist range of motion, Grip strength	carpal tunnel syndrome, finger stiffness, pin track infection, reflex sympathetic dystrophy	operative treatment has better functional outcome for intra articular fractures, external fixation is preferred for comminuted fracture types
Hegeman et al	Unstable distal radius intraarticular fractures	Accidental fall	Previous fracture, unable to perform functional evaluation	wrist range of motion, grip strength, Gartland, and Werley score, Goris criteria	reflex sympathetic dystrophy, dupuytren contracture	Functional outcome is good in the studied age regardless of modality
Young et al	dorsally angulated with more than 10-degree angule, and 2mm radial shortening	89% accidental fall, 11% road traffic injuries	bilateral fractures, ipsilateral limb injuries, unable to comprehend	wrist range of motion, grip strength,Gartland, and Werley score	reflex sympathetic dystrophy, pin site scar, wrist pain, extensor policies longus tendon rupture	radiographic results of treatment with external fixator are significantly better but long term follow up did not show any difference
Roumen et al	Displaced colles' fractures	Accidental fall	None stated	grip strength	reflex sympathetic dystrophy, carpal tunnel syndrome, stenosing synovitis, wrist pain, extensor policis longus rupture	external fixation has no indication for elderly patients with redisplased distal radius fractures, severity of soft tissue injury determines the outcome
Yoon et al	extra articular distal radius fractures	not stated	bilateral fractures, open fractures, previous fractures	pain, grip strength, Michigan hand assessment, wrist range of motion, esthetics	pin site, and surgical site infections	Regardless of treatment options patients have similar outcome in the long run, choice depend on the recovery process

Table 3- Summary of analysis of quality of studies

	Allocation concealment	**Blinding assessors**	**Blinding patients**	**Intension to treat analysis**	**Baseline character similarity**	**Inclusion/ Exclusion criteria**	**Loss to Follow up**
Horne et al	none stated	none	none	none stated	no mention	not clearly stated	22%
kreder et al	used Computer generated envelopes	Final assessors were not blinded	Blinded to their group	All results analyzed according-ly	similar in age, gender, and cause of injury	Excluded for severity of injury, language barrier, and inability to participate	25%
kapoor et al	none stated	none stated	none stated	none stated	age, sex, and initial deformity	none	Full follow up
hegeman et al	not stated	not stated	not stated	not mentioned	cause of fall ,age, sex, pre-injury status, fracture pattern	prior fractures ,inability to perform functional evaluation	not stated
young et al	envelope allocation	not stated	not stated	not mentioned	not clearly stated	additional injury, bilateral fracture, inability to comprehend	32%
roumen et al	not mentioned	not mentioned	not mentioned	not mentioned	mode of injury and age distribution	not mentioned	20%
yoon et al	computerized	surgeons and assessors were not completey blinded	partially blind and were informed of other options sometimes	mentioned as primary method of analysis	similar except volar tilt, and age.	open fracture, bilateral fracture, prior same wrist surgery	4%

Table 4. summary of conclusion drawn from studies

Study ID	Horne et al	Kreder et al	Kapoor et al	Hege-man et al	Young et al	Roumen et al	Yoon et al
Clear inclusion, and exclusion	none stated	yes	Not stated	yes	yes	Not clearly stated	yes
Clearly defined outcome measures	Both anatomic, and functional outcomes stated	Clearly stated primary, and secondary outcomes	yes	yes	yes	yes	yes
Conclusion	External fixation for distal radius treatment is likely to be harmful	External fixator for distal radius fractures is likely to be beneficial	Operative treatment of displaced comminuted intra articular fracture is beneficial for functional outcome	Choosing between treatment options is a tradeoff between harm and benefit	External fixator has neutral long term functional outcome	External fixation is unlikely to be beneficial to elderly patients with redisplacement	Operative treatment is likely to be beneficial to patients who require quicker recovery

Table 5: Patient rehabilitation Protocols

Study ID	Rehabilitation protocol described
Horne et al	mobilization after 5 weeks, physical therapy if there is wrist, or hand stiffness
Kreder et al	mobilization after 6-8 weeks
Kapoor et al	writing, and eating allowed immediately , mobilization after 6-7weeks, active hand, elbow, and shoulder motion, and strength training after
Hegeman et al	Mobilization after 6 weeks, and sent to physical therapy afterwards
Young et al	external fixation group start wrist range of motion at 3 weeks, full mobilization at 6 weeks for both groups
Roumen et al	mobilization after 5 weeks
Yoon et al	used institution based rehabilitation protocol

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A.O.
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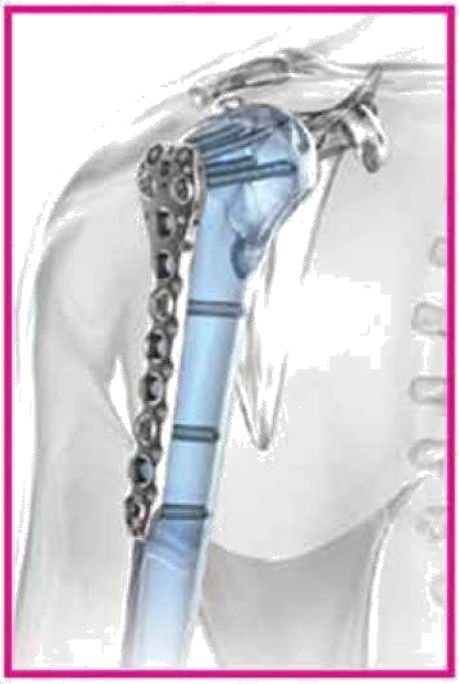

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