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Surgical management of lower extremity fractures in Sub-saharan Africa: A systematic review of post-operative quality of life and functional outcomes

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Abstract
Background: Lower extremity fractures are a major cause of morbidity in Sub-Saharan Africa, often resulting from road traffic accidents and delayed surgical care. Evidence on long-term post-operative quality of life (QoL), functional recovery, and psychosocial outcomes is limited, hindering rehabilitation efforts and socioeconomic support.
Purpose: To evaluate post-operative QoL and functional outcomes following surgical management of lower extremity fractures in Sub-Saharan Africa.
Methods: A systematic review was conducted per PRISMA-2020 guidelines. PubMed, Embase, Cochrane, Web of Science, African Index of Medicine, African Journal of Medicine, and Global Health Journal were searched for English- and French-language studies (2000-2025) reporting QoL after surgical management of lower extremity fractures in Sub-Saharan Africa. Screening was done via Rayyan, with data extracted on health-related QoL (HRQoL), functional recovery, psychosocial outcomes, and complications. Risk of bias was assessed using MINORS criteria.
Results: Thirty-seven studies (n = 3,780 patients; 3,784 fractures) met inclusion criteria. Road traffic accidents were the most common cause (n = 2,199), and femoral (n = 1,875) and tibial (n = 1,793) fractures predominated. Intramedullary nailing was the most frequent intervention, associated with faster functional recovery, earlier union, and improved short-term HRQoL compared to external fixation or conservative management. Seventeen studies reported HRQoL outcomes, 27 assessed functional recovery, and 8 evaluated psychosocial outcomes. Postoperative infection and nonunion were reported in 7 and 10 studies, respectively. While short-term outcomes were generally favorable, long-term results showed persistent pain, functional limitations, diminished QoL, high infection risk in severe open fractures, and psychosocial burdens including financial strain and caregiver impact.
Conclusion: Surgical management yields high union rates and favorable early functional outcomes, especially with intramedullary nailing. However, long-term QoL is constrained by infections, persistent pain, and socioeconomic challenges. Expanding timely surgical access, modern fixation techniques, infection prevention, rehabilitation, and psychosocial support is critical to optimize sustained outcomes in Sub-Saharan Africa.
Study Design: Level IV, systematic review of II-IV studies

Keywords: Orthopedic trauma, surgery, Africa

Introduction

The trauma epidemic in Sub-Saharan Africa (SSA) is one of the most critical and under recognized public health crises. Motor vehicle accidents driver of life-altering injuries that profoundly affect individuals, families, and communities [68]. These injuries contribute significantly to the region's increasing burden of trauma, a neglected health crisis further exacerbated by poverty and limited healthcare infrastructure. The disability burden associated with such injuries is profound, leading to significant economic and societal consequences. Long-term injury-related disability frequently prevents individuals from returning to work or school, reinforcing cycles of poverty and social vulnerability [51].

Orthopedic trauma care in SSA faces immense challenges, as the demand for surgical intervention far exceeds available resources. The region suffers from a critical shortage of orthopedic specialists, with fewer than one surgeon per million people compared to an average of five per 100,000 in high-income countries[61]. As a result, many injury-related deaths occur in low- and middle-income countries, where preventive efforts are minimal, and

healthcare systems are least equipped to handle the burden. This cycle of injury, disability, and lack of access to care perpetuates economic hardship and hinders social mobility [26]. Even when surgical intervention is available, rehabilitation services remain scarce, limiting the potential for full recovery.

Lower extremity fractures are among the most common and debilitating injuries resulting from road traffic crashes in SSA [56]. These fractures cause significant physical impairment, limiting an individual's ability to work, attend school, and maintain an independent quality of life [42]. In resource-limited settings, timely surgical intervention is often unavailable, and even when surgery is accessible, rehabilitation services are scarce. Many patients face long-term disability, impacting their physical, psychological, and social well-being [5]. The lack of adequate care exacerbates disparities in recovery outcomes, leaving those in SSA with poorer quality of life compared to patients in high-income countries. Uncovering these gaps will inform strategies to improve access to effective surgical management and rehabilitation, ultimately enhancing patient recovery and quality of life in the SSA region.

This systematic review aims to investigate the impact of surgical management on patients' quality of life following lower extremity fractures in SSA. By evaluating physical, functional, psychological, and social/work-related outcomes, this study seeks to provide insight into the broader effects of orthopedic trauma care and highlight the disparities in treatment and recovery. A better understanding of how surgical interventions can impact the lives of patients in resource-limited settings will inform strategies to improve outcomes for this vulnerable population.

Methods: Literature Search: A systematic review was conducted following PRISMA-2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PubMed, Embase, Cochrane, Web of Science, African Index of Medicine, African Journal of Medicine, Global Health Journal databases were searched for English-language and French-Language studies that evaluate post-operative quality of life outcomes for patients with lower extremity fractures treated surgically in Sub-Saharan Africa. The search terms used are listed in Table 1. The studies were then screened by title and abstract using the systematic review software Rayyan and were exported to an excel document. Articles included via title and abstract were reviewed in full text for inclusion and exclusion criteria. Finally, the studies were extracted, and a data analysis was conducted.

Study Eligibility criteria: Inclusion criteria consisted of studies reporting patients who underwent surgical management of lower extremity fractures in Sub-Saharan Africa. Eligible papers were published in English or French between January 2000 and January 2025 and comprised level II-IV evidence. French-language studies were translated using online tools. Exclusion criteria included cadaver or animal studies, studies lacking sex-specific outcomes, non-US studies, and publications enrolling patients with conditions other than lower extremity fractures. Lower extremity fractures were defined as fractures involving the hip, femur, tibia, fibula, ankle, or foot. Orthopedic surgical interventions were defined as operative procedures performed to treat fractures of the lower extremity, including but not limited to internal fixation, intramedullary nailing, and external fixation.

Table 1: Search Terms Used per Categorical Search Strategy.

Search Strategy Category	Search Terms Used
Lower Extremity	("Lower extremity" [mh] OR "Lower limb" [mh] OR "Femoral" [mh] OR "Femur" [mh] OR "Tibial" [mh] OR "Tibia" [mh] OR "Fibular" [mh] OR "Fibula" [mh] OR "Ankle" [mh] OR "Foot" [mh] OR "Knee" [mh] OR "Patellar" [mh] OR "Long bone" [mh] OR "Lower limb trauma" [mh] OR "Leg injury" [mh] OR "Leg trauma" [mh] OR "Lower limb fractures" [mh] OR "Lower extremity injury" [mh] OR "lower extremity" [tiab] OR "lower limb" [tiab] OR "femoral" [tiab] OR "femur" [tiab] OR "tibial" [tiab] OR "tibia" [tiab] OR "fibular" [tiab] OR "fibula" [tiab] OR "ankle" [tiab] OR "foot" [tiab] OR "knee" [tiab] OR "patellar" [tiab] OR "long bone" [tiab] OR "lower limb trauma" [tiab] OR "leg injury" [tiab] OR "leg trauma" [tiab] OR "lower limb fractures" [tiab] OR "lower extremity injury" [tiab])
Fracture	("Fracture" [mh] OR "Fractures" [mh] OR "Bone break" [mh] OR "Trauma-related fracture" [mh] OR "Open fracture" [mh] OR "Closed fracture" [mh] OR "Comminuted fracture" [mh] OR "Displaced fracture" [mh] OR "Non-displaced fracture" [mh] OR "Malunion" [mh] OR "Nonunion" [mh] OR "Fracture complications" [mh] OR "Fracture healing" [mh] OR "Fracture management" [mh] OR "fracture" [tiab] OR "fractures" [tiab] OR "bone break" [tiab] OR "trauma-related fracture" [tiab] OR "open fracture" [tiab] OR "closed fracture" [tiab] OR "comminuted fracture" [tiab] OR "displaced fracture" [tiab] OR "non-displaced fracture" [tiab] OR "malunion" [tiab] OR "nonunion" [tiab] OR "fracture complications" [tiab] OR "fracture healing" [tiab] OR "fracture management" [tiab])
Surgery	("Orthopedic surgery" [mh] OR "Orthopaedic surgery" [mh] OR "Orthopedic" [mh] OR "Orthopaedic" [mh] OR "Surgical intervention" [mh] OR "Surgical fixation" [mh] OR "Fracture fixation" [mh] OR "Open reduction and internal fixation" [mh] OR "ORIF" [mh] OR "External fixation" [mh] OR "tibial shaft" [mh] OR "femoral shaft" [mh] OR "Intramedullary nailing" [mh] OR "IM nailing" [mh] OR "Locking plates" [mh] OR "Bone grafting" [mh] OR "Minimally invasive orthopedic surgery" [mh] OR "Surgical management of fractures" [mh] OR "Plating" [mh] OR "Intramedullary rods" [mh] OR "Fracture reduction" [mh] OR "Crush fracture" [mh] OR "Closed reduction" [mh] OR "Open reduction" [mh] OR "Bone union" [mh] OR "Fracture healing" [mh] OR "Fracture debridement" [mh] OR "External fixation frame" [mh] OR "Tension band wiring" [mh] OR "Hemiarthroplasty" [mh] OR "Arthrodesis" [mh] OR "Joint replacement" [mh] OR "Joint stabilization" [mh] OR "Total hip replacement" [mh] OR "Total knee replacement" [mh] OR "Traction" [mh] OR "Osteotomy" [mh] OR "Orthopedic stabilization" [mh] OR "Orthopaedic stabilization" [mh] OR "Orthopedic surgery" [tiab] OR "Orthopaedic surgery" [tiab] OR "Orthopedic" [tiab] OR "Orthopaedic" [tiab] OR "Surgical intervention" [tiab] OR "Surgical fixation" [tiab] OR "Fracture fixation" [tiab] OR "Open reduction and internal fixation" [tiab] OR "ORIF" [tiab] OR "External fixation" [tiab] OR "tibial shaft" [tiab] OR "femoral shaft" [tiab] OR "Intramedullary nailing" [tiab] OR "IM nailing" [tiab] OR "Locking plates" [tiab] OR "Bone grafting" [tiab] OR "Minimally invasive orthopedic surgery"

	[tiab] OR "Surgical management of fractures" [tiab] OR "Plating" [tiab] OR "Intramedullary rods" [tiab] OR "Fracture reduction" [tiab] OR "Crush fracture" [tiab] OR "Closed reduction" [tiab] OR "Open reduction" [tiab] OR "Bone union" [tiab] OR "Fracture healing" [tiab] OR "Fracture debridement" [tiab] OR "External fixation frame" [tiab] OR "Tension band wiring" [tiab] OR "Hemiarthroplasty" [tiab] OR "Arthrodesis" [tiab] OR "Joint replacement" [tiab] OR "Joint stabilization" [tiab] OR "Total hip replacement" [tiab] OR "Total knee replacement" [tiab] OR "Traction" [tiab] OR "Osteotomy" [tiab] OR "Orthopedic stabilization" [tiab] OR "Orthopaedic stabilization" [tiab])
Quality of Life Outcomes	("Quality of Life" [mh] OR "QoL" [mh] OR "Health-related quality of life" [mh] OR "HRQoL" [mh] OR "Functional outcomes" [mh] OR "Patient-reported outcomes" [mh] OR "PROs" [mh] OR "Post-surgical outcomes" [mh] OR "Physical function" [mh] OR "Daily living capabilities" [mh] OR "SF-36" [mh] OR "Short Form 36" [mh] OR "EQ-5D" [mh] OR "EuroQol-5D" [mh] OR "AQoL" [mh] OR "WHOQOL-BREF" [mh] OR "PROMIS" [mh] OR "Patient satisfaction" [mh] OR "Health perception" [mh] OR "Health-Related QoL" [mh] OR "Disease-specific QoL tools" [mh] OR "PedsQL" [mh] OR "NeuroQoL" [mh] OR "Quality of Life in Neurological Disorders" [mh] OR "NeuroQoL" [mh] OR "SF-36 for specific conditions" [mh] OR "Oswestry Disability Index" [mh] OR "ODI" [mh] OR "Western Ontario and McMaster Universities Osteoarthritis Index" [mh] OR "WOMAC" [mh] OR "Knee Injury and Osteoarthritis Outcome Score" [mh] OR "KOOS" [mh] OR "Foot and Ankle Outcome Score" [mh] OR "FAOS" [mh] OR "Disabilities of the Arm, Shoulder, and Hand" [mh] OR "DASH" [mh] OR "Lower Extremity Functional Scale" [mh] OR "LEFS" [mh] OR "Physical Functioning" [mh] OR "SF-36 Physical Functioning" [mh] OR "EQ-5D Mobility" [mh] OR "Return to ambulation" [mh] OR "Return to activity" [mh] OR "Postoperative rehabilitation" [mh] OR "Functional rehabilitation" [mh] OR "Post-surgical mobility" [mh] OR "Rehabilitation outcomes" [mh] OR "Timed Up and Go" [mh] OR "Six-Minute Walk Test" [mh] OR "Muscle strength" [mh] OR "Handgrip strength" [mh] OR "Walking speed" [mh] OR "Range of motion" [mh] OR "ROM" [mh] OR "Pain Levels" [mh] OR "Numeric Pain Rating Scale" [mh] OR "NPRS" [mh] OR "McGill Pain Questionnaire" [mh] OR "Pain Disability Index" [mh] OR "PDI" [mh] OR "Brief Pain Inventory" [mh] OR "BPI" [mh] OR "Psychological health" [mh] OR "Mental health outcomes" [mh] OR "Emotional health" [mh] OR "Psychosocial outcomes" [mh] OR "Depression" [mh] OR "Anxiety" [mh] OR "Post-traumatic stress disorder" [mh] OR "PTSD" [mh] OR "Pain perception" [mh] OR "Chronic pain" [mh] OR "Visual analog scale" [mh] OR "VAS" [mh] OR "Hospital anxiety and depression scale" [mh] OR "HADS" [mh] OR "Beck depression inventory" [mh] OR "BDI" [mh] OR "Generalized anxiety disorder-7" [mh] OR "GAD-7" [mh] OR "Post-traumatic stress disorder checklist" [mh] OR "PCL" [mh] OR "State-Trait Anxiety Inventory" [mh] OR "STAI" [mh] OR "Impact of Event Scale" [mh] OR "IES-R" [mh] OR "Kessler Psychological Distress Scale" [mh] OR "K10" [mh] OR "Symptom Checklist-90" [mh] OR "SCL-90" [mh] OR "Social Reintegration" [mh] OR "Work status" [mh] OR "Social participation" [mh] OR "Community engagement" [mh] OR "Social Support Questionnaire" [mh] OR "SSQ" [mh] OR "Multidimensional Scale of Perceived Social Support" [mh] OR "MSPSS" [mh] OR "Mini-Mental State Examination" [mh] OR "MMSE" [mh] OR "Montreal Cognitive Assessment" [mh] OR "MoCA" [mh] OR "Rosenberg Self-Esteem Scale" [mh] OR "RSES" [mh] OR "Cognitive Failures Questionnaire" [mh] OR "CFQ" [mh] OR "quality of life" [tiab] OR "QoL" [tiab] OR "health-related quality of life" [tiab] OR "HRQoL" [tiab] OR "functional outcomes" [tiab] OR "patient-reported outcomes" [tiab] OR "PROs" [tiab] OR "post-surgical outcomes" [tiab] OR "physical function" [tiab] OR "daily living capabilities" [tiab] OR "SF-36" [tiab] OR "Short Form 36" [tiab] OR "EQ-5D" [tiab] OR "EuroQol-5D" [tiab] OR "AQoL" [tiab] OR "WHOQOL-BREF" [tiab] OR "PROMIS" [tiab] OR "patient satisfaction" [tiab] OR "health perception" [tiab] OR "Health-Related QoL" [tiab] OR "Disease-specific QoL tools" [tiab] OR "PedsQL" [tiab] OR "NeuroQoL" [tiab] OR "Quality of Life in Neurological Disorders" [tiab] OR "NeuroQoL" [tiab] OR "SF-36 for specific conditions" [tiab] OR "Oswestry Disability Index" [tiab] OR "ODI" [tiab] OR "Western Ontario and McMaster Universities Osteoarthritis Index" [tiab] OR "WOMAC" [tiab] OR "Knee Injury and Osteoarthritis Outcome Score" [tiab] OR "KOOS" [tiab] OR "Foot and Ankle Outcome Score" [tiab] OR "FAOS" 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"depression" [tiab] OR "anxiety" [tiab] OR "post-traumatic stress disorder" [tiab] OR "PTSD" [tiab] OR "pain perception" [tiab] OR "chronic pain" [tiab] OR "visual analog scale" [tiab] OR "VAS" [tiab] OR "hospital anxiety and depression scale" [tiab] OR "HADS" [tiab] OR "Beck depression inventory" [tiab] OR "BDI" [tiab] OR "generalized anxiety disorder-7" [tiab] OR "GAD-7" [tiab] OR "post-traumatic stress disorder checklist" [tiab] OR "PCL" [tiab] OR "State-Trait Anxiety Inventory" [tiab] OR "STAI" [tiab] OR "Impact of Event Scale" [tiab] OR "IES-R" [tiab] OR "Kessler Psychological Distress Scale" [tiab] OR "K10" [tiab] OR "Symptom Checklist-90" [tiab] OR "SCL-90" [tiab] OR "Social Reintegration" [tiab] OR "work status" [tiab] OR "social participation" [tiab] OR "community engagement" [tiab] OR "Social Support Questionnaire" [tiab] OR "SSQ" [tiab] OR "Multidimensional Scale of Perceived Social Support" [tiab] OR "MSPSS" [tiab] OR "Mini-Mental State Examination" [tiab] OR "MMSE" [tiab] 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Sub-Saharan Africa	("Africa South of the Sahara" [mh] OR "Angola" [mh] OR "Benin" [mh] OR "Botswana" [mh] OR "Burkina Faso" [mh] OR "Burundi" [mh] OR "Cabo Verde" [mh] OR "Cameroon" [mh] OR "Central African Republic" [mh] OR "Chad" [mh] OR "Comoros" [mh] OR "Congo" [mh] OR "Cote d'Ivoire" [mh] OR "Democratic Republic of the Congo" [mh] OR "Djibouti" [mh] OR "Equatorial Guinea" [mh] OR "Eritrea" [mh] OR "Eswatini" [mh] OR "Ethiopia" [mh] OR "Gabon" [mh] OR "Gambia" [mh] OR "Ghana" [mh] OR "Guinea" [mh] OR "Guinea-Bissau" [mh] OR "Kenya" [mh] OR "Lesotho" [mh] OR "Liberia" [mh] OR "Madagascar" [mh] OR "Malawi" [mh] OR "Mali" [mh] OR "Mauritania" [mh] OR "Mozambique" [mh] OR "Namibia" [mh] OR "Niger" [mh] OR "Nigeria" [mh] OR "Rwanda" [mh] OR "Sao Tome and Principe" [mh] OR "Senegal" [mh] OR "Seychelles" [mh] OR "Sierra Leone" [mh] OR "Somalia" [mh] OR "South Africa" [mh] OR "South Sudan" [mh] OR "Sudan" [mh] OR "Tanzania" [mh] OR "Togo" [mh] OR "Uganda" [mh] OR "Zambia" [mh] OR "Zimbabwe" [mh] OR "Angola" [tiab] OR "Benin" [tiab] OR "Botswana" [tiab] OR "Bobo Dioulasso" [tiab] OR

	"Burkina Faso" [tiab] OR "Burundi" [tiab] OR "Cameroon" [tiab] OR "Cape Verde" [tiab] OR "Central African Republic" [tiab] OR "Chad" [tiab] OR "Comoros" [tiab] OR "Congo" [tiab] OR "Brazzaville" [tiab] OR "Cote d Ivoire" [tiab] OR "Djibouti" [tiab] OR "Equatorial Guinea" [tiab] OR "Eritrea" [tiab] OR "Ethiopia" [tiab] OR "Gabon" [tiab] OR "Gambia" [tiab] OR "Ghana" [tiab] OR "Guinea" [tiab] OR "Bissau" [tiab] OR "Kenya" [tiab] OR "Lesotho" [tiab] OR "Liberia" [tiab] OR "Madagascar" [tiab] OR "Malawi" [tiab] OR "Mali" [tiab] OR "Mauritania" [tiab] OR "Mauritius" [tiab] OR "Mozambique" [tiab] OR "Namibia" [tiab] OR "Niger" [tiab] OR "Nigeria" [tiab] OR "Rwanda" [tiab] OR "Sao Tome e Principe" [tiab] OR "Senegal" [tiab] OR "Seychelles" [tiab] OR "Sierra Leone" [tiab] OR "Somalia" [tiab] OR "South Africa" [tiab] OR "South Sudan" [tiab] OR "Sudan" [tiab] OR "Swaziland" [tiab] OR "Tanzania" [tiab] OR "Togo" [tiab] OR "Uganda" [tiab] OR "Zaire" [tiab] OR "Zambia" [tiab] OR "Zimbabwe" [tiab] OR "south sahara" [tiab:~2] OR "southern sahara" [tiab:~2] OR "east sahara" [tiab:~2] OR "eastern sahara" [tiab:~2] OR "west saraha" [tiab:~2] OR "western saraha" [tiab:~2] OR "sub saraha" [tiab:~2] OR "sub sarahan" [tiab:~2] OR "southern africa" [tiab:~2] OR "Abidjan" [tiab] OR "Abuja" [tiab] OR "Accra" [tiab] OR "Addis Ababa" [tiab] OR "Cape Town" [tiab] OR "Dar es Salaam" [tiab] OR "Durban" [tiab] OR "Harare" [tiab] OR "Johannesburg" [tiab] OR "Juba" [tiab] OR "Kampala" [tiab] OR "Kinshasa" [tiab] OR "Lagos" [tiab] OR "Luanda" [tiab] OR "Lusaka" [tiab] OR "Mogadishu" [tiab] OR "Nairobi" [tiab] OR "Pretoria" [tiab] OR "Windhoek" [tiab] OR "Dodoma" [tiab] OR "Maputo" [tiab] OR "Jinja" [tiab] OR "Nigerians" [tiab] OR "Angolans" [tiab] OR "Beninese" [tiab] OR "Botswanans" [tiab] OR "Burkinabé" [tiab] OR "Burundians" [tiab] OR "Cameroonians" [tiab] OR "Cape Verdeans" [tiab] OR "Central African Republic citizens" [tiab] OR "Chadians" [tiab] OR "Comorians" [tiab] OR "Congolese" [tiab] OR "Congo Brazzaville citizens" [tiab] OR "Ivorians" [tiab] OR "Djiboutians" [tiab] OR "Equatorial Guineans" [tiab] OR "Eritreans" [tiab] OR "Ethiopians" [tiab] OR "Gabonese" [tiab] OR "Gambians" [tiab] OR "Ghanaians" [tiab] OR "Guineans" [tiab] OR "Guinea-Bissauans" [tiab] OR "Kenyans" [tiab] OR "Lesotho citizens" [tiab] OR "Liberians" [tiab] OR "Madagascans" [tiab] OR "Malawians" [tiab] OR "Malians" [tiab] OR "Mauritanians" [tiab] OR "Mauritians" [tiab] OR "Mozambicans" [tiab] OR "Namibians" [tiab] OR "Nigeriens" [tiab] OR "Nigerians" [tiab] OR "Rwandans" [tiab] OR "São Tomé and Príncipe citizens" [tiab] OR "Senegalese" [tiab] OR "Seychellois" [tiab] OR "Sierra Leoneans" [tiab] OR "Somalians" [tiab] OR "South Africans" [tiab] OR "South Sudanese" [tiab] OR "Sudanese" [tiab] OR "Swazis" [tiab] OR "Tanzanians" [tiab] OR "Togolese" [tiab] OR "Ugandans" [tiab] OR "Zairians" [tiab] OR "Zambians" [tiab] OR "Zimbabweans" [tiab])

*Please note that we suggest this table be included as a supplement to the manuscript.
*Note that all Search Terms were adapted accordingly to accommodate for database preferred search language

Study Selection and Data Extraction

Once all the studies from the databases listed above were identified, two research team members (L.F. + A.P.) independently screened each article's title using previously determined exclusion criteria. The remaining articles were then screened by their abstracts. The full text of each qualifying article was then reviewed and either included or excluded from the final list. After each step, the respective lists of included and excluded articles were compared. If there were disagreements on inclusions, both team members would review the article again separately before meeting to discuss their reasoning, and a joint decision would be made to include or exclude the article. The two previously mentioned team members then divided the final list of included articles and extracted the data from each full text publication.

Quality of life data was extracted from each study and divided into the following categories: health-related quality of life, including but not limited to patient satisfaction, pain scales, EQ-5D (EuroQol 5-Dimension 5-Level Questionnaire) or WHOQOL-BREF; functional, including but not limited to return to activity, return to ambulation, rehabilitation outcomes, range of motion, or SF-36 score; psychological, including but not limited to mental health outcomes such as depression or anxiety or post-traumatic stress disorder; social and occupational, including but not limited to work status and social participation; complications including infections, non-union, and mortality.

Risk of Bias Assessment

Two independent authors (LF+ AP) evaluated each included study using the MINORS criteria as shown in Table 2. The scoring for each question includes a 0 if not reported, 1 if reported, but insufficient, and 2 if reported and sufficient. The maximal score for a comparative study is 24 points, and 16 points for a non-comparative study.

Table 2: Characteristics of Included Studies and MINORS Assessment.

First Author	Study Design (Level of Evidence)	MINORS (Comparative or Non-Comparative)	# of Patients (Male/Female)	Mean Age	Lower Extremity Fracture	Surgical Intervention	Outcomes	Findings
Adesope Adesina, S. [1]	Prospective Cohort (2)	11 (NC)	94 (71/23)	x	Open Femur; Open Tibia	SIGN IMN	Complications: Infection, Nonunion (Radiographic Healing,)	By the 12th post-operative week, at least 79% of patients who underwent IMN had ongoing radiographic healing and achieved functional recovery milestones (KF/SA > 900, FWB, and PS&S/SAER).
Albright, P. D. [6]	Prospective Cohort (2)	19 (C)	240 (201/39)	33	Open Tibial Shaft	Tibia SIGN IMN; External Fixation	Health: EQ-5D; Complications: Infection	Increased deep infection risk was associated with surgery delayed beyond 24 hours, AO/OTA Type 42C fractures, OTA-Open Fracture Classification muscle loss, and a varus coronal angle on immediate postoperative AP radiographs. Worse 1-year EQ-5D scores were independently linked to wound length ≥ 10 cm, OTA-Open Fracture Classification of muscle or bone loss, and reoperation.
Areu, M. M. M. [8]	Prospective Case Series (4)	13 (NC)	30 (16/14)	71	Closed Intertrochanteric Femur	SIGN IMN and Lateral SIGN Plate	Functional: Modified Harris Hip	SIGN IMN and augmentation by a lateral plate (IMN+P) can achieve high functional scores (77% good/excellent

							Score; Complications: Infection, Nonunion	mHHS) and low complication rates (3% infection, 7% reoperation, 3% nonunion) for intertrochanteric femur fractures in a resource-limited setting like Juba Teaching Hospital in South Sudan.
Ativor, V. [9]	Prospective Cohort (2)	19 (C)	119 (99/20)	36.1 +/- 13.4	Open Tibial Shaft	Operative with Cast or Splint; External Fixation; IMN; Plate & Screw Fixation; Amputation	Health: HRQOL; Psychosocial: Insurance Status, Household Setting, Income	No significant association was found between socioeconomic factors (insurance status, household setting, income) and treatment choice. While univariate analysis showed higher 1-year HRQOL with intramedullary nailing, this was not significant in the multivariate model. Unexpectedly, higher baseline income was associated with lower 1-year HRQOL in the multivariate analysis.
Babalola, Olasunkanmi M. [10]	Retrospective Cohort (3)	10 (NC)	11 (Unable to Stratify Based on Data Distribution)	35	Closed Femur; Open and Closed Tibia	SIGN IMN	Functional: Ambulation Complications: Nonunion	Open locked intramedullary nailing achieved a 91.7% union rate at 4 months, comparable to reported outcomes for closed nailing in simple and segmental fractures and offers an effective alternative in resource-limited settings.
Bach, O. [11]	Retrospective Case Series (4)	9 (NC)	31 (Unable to Stratify Based on Data Distribution)	x	Open Femur; Open Tibia and Fibula; Open Foot	External Fixation; Amputation	Functional: Range of Motion, Gait	Despite significant challenges in resource-constrained environments (e.g., late presentation with infection, lack of advanced equipment), applying contemporary biological principles of open fracture treatment using External Fixation can achieve comparable functional outcomes to first-world countries (80% significant functional recovery)
Chiroma, M. M. [16]	Prospective Cohort (2)	13 (NC)	25 (17/8)	71.68	Closed Femoral Neck	Hemiarthroplasty	Functional: Harris Hip Score	Early functional outcomes of hemiarthroplasty for femoral neck fractures in the elderly are good and satisfactory, making it a viable option particularly in resource-limited settings.
Chiroma, M. M. [17]	Cross Sectional (3)	13 (NC)	25 (17/8)	71.68	Closed Femoral Neck	Hemiarthroplasty	Health: EQ-5D, EQ-VAS	Hemiarthroplasty effectively improves the health-related quality of life in elderly patients suffering from femoral neck fractures, as evidenced by significant improvements across all dimensions of the EQ-5D and in the EQ-VAS score at 6 months post-surgery.
Chokotho, L. [18]	Prospective Cohort (2)	20 (C)	187 (149/34)	39	Closed Femoral Shaft	SIGN IMN; Skeletal Traction	Health: EQ-5D-3L; Functional: SMFA; Psychosocial: Return to Work	Intramedullary nailing (IMN) improved early (≤6 months) postoperative quality of life, function, and return-to-work time compared to skeletal traction (ST). In resource-limited settings, ST can yield similar 1-year outcomes to IMN if fracture union occurs; however, about one-third of ST patients experienced treatment failure requiring surgical conversion.
Cortez, A. [19]	Randomized Control Trial (1)	20 (C)	126 (109/17)	32.7	Open Tibial Shaft	IMN; External Fixation	Health: EQ-VAS; Functional: FIX-IT; Complications: Nonunion (mRUST)	Participants with unresolved primary events had significantly lower EQ-5D-3L scores (0.83 ± 0.2) than those without primary events (0.99 ± 0.04) or with resolved events (0.98 ± 0.07, $p < 0.001$). Infected nonunion was associated with significantly lower EQ-5D-3L and EQ-VAS scores compared to participants without primary events ($p < 0.001$), whereas isolated infection or aseptic nonunion showed no significant difference in EQ-VAS ($p = 0.3$). Infected nonunion also had significantly lower FIX-IT and mRUST scores than those without primary events.
Elbahri, H. M. H. [22]	Cross Sectional (3)	12 (NC)	37 (15/22)	66.7	Proximal (Trochanteric or Subtrochanteric) Femur	Gamma Nail IMN	Health: EQ-5D, Satisfaction; Functional: Oxford Hip Score	Health-related quality of life (EQ-5D-5L) was fair in 67.6% of patients, good in 21.6%, and poor in 10.8%, with none reporting excellent outcomes. On the Oxford Hip Score, 54.1% achieved satisfactory joint function. Post-surgical complications were common (91.9%), though infection and delayed union occurred in individual cases. Only 27% of patients reported partial satisfaction with treatment, while 73% were dissatisfied.
Eliezer, E. N.	Prospective	15 (NC)	270 (230/40)	31.6	Open and	SIGN IMN;	Health: EQ-	Intramedullary nailing for femoral shaft

[23]	Cohort (2)				Closed Femoral Shaft	SIGN Fin Nail IMN; AO Universal Nail IMN; Plates and Screws	5D; Functional: Squat and Smile Test; Psychosocial: Employment; Complications: Nonunion (mRUST)	fractures was associated with a low risk of reoperation. Infection was the most common reason for reoperation. Lack of formal employment was associated with a higher reoperation rate (7.5% vs. 1.2% for formally employed)
Enweluzo, G.O. [24]	Prospective Cohort (2)	10 (NC)	197 (145/52)	36.9	Open Tibia	Plaster of Paris; IMN; Plates and Screws; External Fixation	Psychosocial: Return to Work; Complications: Infection	Of the patients, 124 (62.9%) returned to pre-morbid work, 56 (28.4%) returned with limitations such as knee stiffness, and 17 (8.7%) were unable to resume pre-morbid work due to amputations, significant shortening, or persistent bone infection.
Flores, M. J. [25]	Secondary Analysis (2)	12 (NC)	100 (80/20)	34	Open Tibia	IMN; External Fixation; Operative with Cast	Psychosocial: Return to work, Difference in Wages, Household economics	By follow-up, 50% of participants had returned to work, with complications reducing RTW rates (27% vs. 73%, P = 0.028). Mean time to RTW was 27 weeks, and pre-injury work hours were not regained until 1 year (P ≤ 0.001). Post-surgery, 23% faced financial difficulties, more common with adverse events (P = 0.009); 60% borrowed funds and 82% sold assets to cover expenses, with borrowing differing significantly between groups (P = 0.05).
Gross, T. [29]	Prospective Cohort (2)	18 (C)	89 (69/20)	33.4	Open and Closed Femoral Shaft	Antegrade femoral nail IMN	Health: SF-36; VAS; Functional: Harris Hip Score, Range of Motion; Complications: Infection	In the South African cohort, mean pain decreased from 3 months to 1 year (VAS: <1; Harris Hip p = 0.002). Physical SF-36 scores at 1 year remained below baseline (p < 0.05), though walking and lifting capacity were preserved. Patients reported higher body pain (p = 0.0001) and reduced work capacity (p = 0.0001). Follow-up at 1 year was 63%.
Haonga, B. T. [30]	Randomized Control Trial (1)	24 (C)	221 (189/32)	32.9	Open Tibia	IMN-111 + EF-110	Health: EQ-5D, EQ-VAS; Complications: Nonunion (mRUST)	Intramedullary nailing was associated with significantly higher EQ-5D-3L scores at 6 weeks, with trends favoring nailing at 12 and 26 weeks that diminished by 1 year. EQ-VAS scores were significantly lower at 6 weeks and approached significance at 12 and 26 weeks, also diminishing by 1 year. Modified RUST scores favored intramedullary nailing at all time points except 26 weeks.
Holler, J. T. [31]	Prospective Cohort (2)	11 (NC)	7 (3/4)	36.1	Severe Open Tibia	External Fixation	Health: EQ-5D, EQ VAS; Functional: Daily Living Activity; Psychosocial: Transportation, Employment loss, Income, Family Support, Mental Health	Gustilo-Anderson Classification Type IIIB open tibia fractures not treated with appropriate soft-tissue coverage experience consistently poor QOL, high complication rates (100% infection and nonunion), and severe socioeconomic effects
Ibrahim, J. M. [32]	Prospective Cohort (2)	13 (NC)	272 (230/42)	31.6	Open and Closed Femoral Shaft	SIGN Standard Nail IMN; SIGN Fin Nail IMN; AO Universal Nail IMN; Plate and Screws	Health: EQ-5D; Functional: Range of Motion; Complications: Infection, Nonunion	At one-year post-surgery, lower EQ-5D scores were significantly predicted by multiple factors. The strongest contributors were lower RUST scores (each 1-point increase raised EQ-5D by 0.014) and higher pain (each 1-point increase reduced EQ-5D by 0.003). Other factors associated with reduced EQ-5D included current smoking, OTA/AO class B fractures (vs. class A, B = -0.035), complications requiring reoperation (B = -0.12), decreased knee flexion and ROM (<90° vs. >120°, B = 0.325), and inability to perform a complete squat.
Kelemework, A. D. [38]	Cross Sectional (3)	7 (NC)	122 (88/34)	38	Open and Closed Ankle: Combined Medial and Lateral Malleolar	IMN; External Fixation	Functional: O and M Ankle Score	A high proportion (82.9%) of patients achieved good to excellent functional outcomes after surgical treatment of ankle fracture. Age (<40 years) and early surgical intervention were identified as significant positive predictive factors for

					(62%), Tri malleolar (16.40%), Medial malleolar (14%), Lateral Malleolar (7%)			better functional outcomes.
Ketema, E. [40]	Cross Sectional (3)	11 (NC)	151 (113/38)	31.4	Open and Closed Tibial Shaft; Isolated Tibia or Combination of Tibia and Fibula	SIGN IMN	Functional: KOOS	57.6% of patients had good knee functional outcomes, while 42.4% had poor outcomes. Female sex were 3.2 times more likely to have poor outcomes. Patients aged 34-50 were 3.34 times more likely, and those 51-66 were 23 times more likely to have poor outcomes compared to ages 17-33 years. Open fractures 5.9 times more likely to have poor outcomes. 3.1 times more likely to have poor outcomes w/ partially completed post-op physiotherapy compared to those who fully completed it.
Kisitu, D. K. [41]	Randomized Control Trial (2)	20 (C)	55 (37/18)	39	Open Tibia	Unreamed IMN; External Fixation	Health: Eq-5D-3L, EQ-VAS; Functional: FIX-IT	In rural Uganda, unreamed intramedullary nailing for open tibial shaft fractures did not produce clinically meaningful improvements in functional outcomes compared with external fixation. However, intramedullary nailing likely reduced malunion (10% vs. 33%) and superficial infection (19% vs. 42%). Within 12 months, it modestly improved EQ-5D-3L (0.05 points) and EQ-VAS (3.2 points), with high probabilities of HRQoL improvement (EQ-5D-3L 96%; EQ-VAS 76%), though the likelihood of exceeding clinically important differences was under 50%. External fixation remains a viable alternative when cost or other barriers limit nailing.
Kouassi, K. J. E. [43]	Prospective Cohort (2)	13 (NC)	40 (29/11)	32.77	Open Tibial Shaft	External Fixation	Health: SF-12; Functional: LEFS, Functional Satisfaction; Complications: Infection	Overall, 80% of patients had satisfactory functional outcomes (42.5% very good, 37.5% good, 15% fair, 5% poor), with a mean LEFS score of 61.5 ± 10.5, indicating "a little bit of difficulty." Biplanar frames were associated with significantly better outcomes than monoplanar constructs ($p = 0.039$). There were 20 infections, including 13 pin-track infections (32.5%), which were generally managed successfully with oral antibiotics and pin-site care. Pin-track infection was the only significant predictor of chronic infection (OR = 24.33, $p = 0.017$).
Liu, M. B. [46]	Prospective Cohort (2)	16 (C)	85 (70/15)	x	Open and Closed Distal Diaphyseal Femur	SIGN Fin Nail IMN; Standard IMN	Health: Eq-5D, VAS pain; Functional: Knee ROM, Squat and Smile Score, Limb Length Discrepancy; Complications: Infection, Nonunion	EQ-5D scores showed a significant drop in quality of life immediately post-injury in both groups, gradually improving over 1 year, with only a 12-week difference favoring Standard Nail ($p = 0.04$). Fin Nail patients initially reported higher overall pain, significant at 12 weeks (VAS $p = 0.01$) and on weight-bearing ($p = 0.04$), but pain equalized by 1 year. No significant differences were observed at any time point for RUST scores, knee range of motion, or Squat and Smile functional test scores.
Masterson, S. [48]	Prospective Cohort (2)	22 (C)	192 (147/45)	33	Open and Closed Femur; Open and Closed Tibia	IMN	Psychosocial: Return to Work Earning Capacity	75% of participants were employed pre-injury. At 6- and 18-months post-injury, employment rates were 34.4% and 56.3%, respectively, with 70.1% of previously employed participants having returned to work by 18 months. Multivariate analysis identified older age, pre-injury unemployment, and informal sector work as factors reducing the likelihood of employment at 18 months, while among those employed pre-injury, only increasing age reduced the likelihood of returning to work.
Mathieu, L. [49]	Prospective Cohort (2)	10 (NC)	27 (24/3)	30 +/- 18	Open Femur; Open Tibia; Open Ankle	Amputation, Plaster Cast, External Fixation;	Functional: Functional Satisfaction	For patients with healed fractures, functional outcome was considered satisfactory in 12 cases and average in 6

						ORIF		cases due to knee stiffness, often complicated by a lack of physical rehabilitation.
Mebouinz, F. N. [50]	Prospective Cohort (2)	12 (NC)	66 (30/36)	91	Femoral Neck and Per trochanteric	Dynamic Hip Screw; Gamma nail IMN; Total Hip Replacement	Psychosocial: Autonomy-Katz	Post-surgery, recovery of autonomy progressively increased: 9.1% at 1 month, 17.5% at 3 months, 23.5% at 6 months, and 22% at 1 year ($P < 0.001$). Factors associated with reduced autonomy at 1 month included late admission ($P = 0.02$), verticalization >15 days ($P = 0.02$), decubitus complications ($P = 0.004$), anemia ($P = 0.02$), and ASA score ≥2 ($P = 0.05$). No significant difference in autonomy was observed between hip fixation and hip prosthetic replacement at 1 month ($P = 0.83$).
Mody, K. S. [52]	Cross Sectional (3)	10 (NC)	442 (34/8)	36 +/-14.08 s	Femoral Shaft	IMN; Skeletal Traction	Health: Standard of Living: Psychosocial: Financial Well-Being, Return to Work, Income Earner Status, Food Security	In Malawi, post-injury patients faced major financial burdens: transport costs averaged $2.87 per visit, 40% had not returned to work at 1 year, and 29% reported decreased household income. Food insecurity affected 49%, and 76% relied on unpaid caregivers. Coping strategies included selling assets (14%), borrowing (17%), and changing residence (24%). Eleven percent withdrew children from school. Despite free healthcare, lack of financial risk protection caused significant indirect costs and hardship.
Mohammed Hassan Elbahri, H. [53]	Cross Sectional (3)	12 (NC)	37 (15/22)	66.7	Proximal (Trochanteric or Subtrochanteric) Femur	Gamma Nail IMN	Health: Satisfaction, Health-related QoL; Functional: Oxford Hip Score	The mean time from fracture to surgery was 8 ± 15 days. Most patients (62.2%) began bearing weight on postoperative day 2. Health-related quality of life was fair in 67.6%, good in 21.6%, and poor in 10.8%, with no reports of excellent quality. Oxford Hip Scores indicated satisfactory joint function in 54.1%, mild-to-moderate impairment in 29.7%, moderate-to-severe impairment in 13.5%, and severe impairment in 2.7%.
Naude, J. J. [54]	Retrospective Cohort (3)	14 (C)	45 (39/6)	38.2 ± 11.5	Open and Closed Distal Tibia	Circular Ring Fixator	Health: EQ-5D; Functional: ASAMI Functional and Bone Scores, Functional Foot Index, Four Step Square Test, Timed Up and Go Test	Excellent or good bone scores were achieved in over 90% of patients across all groups. Functional Foot Index and mobility tests (TUG, FSST) showed no significant differences between proximal, midshaft, and distal fractures ($p > 0.5$). EQ-5D index and VAS scores differed significantly: distal fractures had the highest EQ-5D index (0.72) and proximal fractures the lowest (0.55, $p = 0.001$), with VAS scores significantly lower for proximal fractures (65) compared to midshaft (82.3) and distal (75) groups ($p = 0.001$).
Ochieng, S. R. [57]	Prospective Cohort (2)	20 (C)	60 (41/19)	51.6	Closed Femoral Neck	Osteosynthesis; Hemiarthroplasty; Total Hip Replacement	Functional: WOMAC	Postoperative WOMAC scores showed most patients had worsened ADL, pain (81.6%), and stiffness (83.3%) compared to pre-injury ($p < 0.001$). Patients >50 had less pain than those ≤50 ($p = 0.006$). In patients ≤50, osteosynthesis (OS) led to poorer pain and ADL scores than HA ($p < 0.05$), with no difference between HA and THA. Stiffness was better in younger patients and males. In those >50, comorbidities worsened ADL ($p = 0.016$), while anterolateral hip approach improved ADL versus lateral approach ($p = 0.007$).
Opondo, E. [59]	Prospective Cohort (2)	18 (C)	148 (115/33)	42	Femoral Shaft	IMN; Skeletal Traction	Functional: Limb Length Discrepancy; Complications: Nonunion	At 12 weeks post-trauma, 55.1% of surgically treated patients achieved normal mobility without support versus 29.1% with traction (OR 3.80, $p = 0.004$). Malunion occurred in 43.1% of the conservative group versus 30.4% of the surgical group. Overall, 84.1% of surgical patients achieved union without malunion compared to 57% of conservative patients ($p = 0.001$).
Schade, A. T. [65]	Prospective Cohort (2)	15 (NC)	297 (248/39)	34	Open Tibial Shaft	Plaster of Paris; IMN; External Fixation; Plates	Health: EQ-5D; Functional:	By 1-year post-injury, function and quality of life remained below baseline for Gustilo I-II (SMFA 10.5, QALYs

						and Screws; Amputation	SMFA	0.73) and Gustilo III fractures (SMFA 14.9, QALYs 0.67). Intramedullary nailing substantially improved both outcomes across all fracture grades. Delaying definitive fixation beyond 5 days increased infection risk fivefold compared with fixation within 2 days (OR 5.1, 95% CI 1.8-16.1; p = 0.02).
Tsegaye, Y. A. [68]	Prospective Cohort (2)	11 (NC)	60 (56/4)	27.5	Open and Closed Distal Tibia	ORIF; External Fixation; Skeletal Traction	Functional: Neers	48.3% of patients had excellent, 30% good, 10% fair, and 11.7% unsatisfactory functional outcomes. Patients with closed distal femur fractures were five times more likely to achieve excellent outcomes than those with open fractures (AOR 2.49, 95% CI 1.07-5.8), and those with regular follow-up were seven times more likely to achieve excellent outcomes compared to patients without regular follow-up (AOR 7.16, 95% CI 1.11-46.22).
Veldman, F. J. [69]	Retrospective Cohort (3)	10 (NC)	59 (25/34)	43.1	Open Ankle	Plaster of Paris; External Fixation; ORIF; K-Wires, Plates and Screws	Functional: AOFAS	The average AOFAS score was 68.2/100 (fair outcome), ranging from 38 to 95. Nine patients had poor outcomes (<60), six fair (60-79), two good (80-89), and four excellent (90-100). Excluding Gustilo-Anderson IIIB injuries, the mean score was 69.2 (fair). Anatomical fracture reduction was significantly associated with fair to excellent outcomes compared to non-anatomical reduction, which led to poor outcomes (p = 0.046).
Von Kaeppler, E. P. [70]	Prospective Cohort (2)	19 (C)	141 (117/24)	31.5	Infraisthmic Femoral Shaft	FIN nail IMN; SIGN nail IMN	Health: EQ-5D, Pain; Functional: Range of Motion; Complications: Nonunion	At 1 year, reoperation rates were similar (Antegrade 2%, Retrograde 4%; P = 1.0). No differences were observed between groups (Antegrade nd Retrograde) in EQ-5D, RUST scores, or maximum knee extension at any time point. By 1 year, both groups surpassed the RUST union threshold (>9), with 65% of Antegrade and 77% of Retrograde patients achieving bony union. Antegrade patients had greater knee flexion at 6 weeks (P = 0.021), but this difference did not persist. Pain outcomes were similar overall, except Retrograde patients reported more knee pain at 6 months (P = 0.017).
Yaokreh, J. B. [72]	Retrospective Cohort (3)	9 (NC)	20 (13/7)	10.3	Closed Femoral Shaft	ESIGN Open Reduction w/ k wires	Health: Satisfaction; Functional: Leg Length Discrepancy	Elastic stable intramedullary nailing with open reduction provides satisfactory results with few major complications
Yaokreh, J. B. [73]	Retrospective Cohort (3)	17 (C)	62 (42/20)	10	Femoral Shaft	ORIF; IMN; K-Wire fixation/PORIKF; Skeletal Traction with spica cast	Health: Satisfaction; Functional: Return to Daily Activity, Leg Length Discrepancy	Satisfactory outcomes (good to excellent by Flynn criteria) occurred in 91.3% of PORIKF cases versus 78% in the ST/SC group, though this difference was not statistically significant (P = 0.3012). Unacceptable shortening (>2 cm) occurred only in the ST/SC group. Time to return to daily activities was significantly shorter for PORIKF (9.1 weeks) compared to ST/SC (14.1 weeks; P < 0.05), a 30-day difference.

*Please note that we suggest this table be included as a supplement to the manuscript.

Abbreviations: NC (non-comparative); C (comparative); IMN (Intramedullary Nail); SIGN (SIGN Fracture Care International Nail); KF/SA (KneeFflexion/Shoulder Abduction); FWB (Full-Weight Bearing); PS&S/SAER (Shoulder Abduction-ER); AO/OTA (Orthopedic Fracture and Dislocation Classification System); EQ-5D (EuroQol 5-Dimension 5-Level Questionnaire); mHHS (Modified Harris Hip Score); HRQOL (Health- Related Quality of Life); EQ-VAS (EuroQol Visual Analogue Scale); SMFA (Short Musculoskeletal Function Assessment); ST (Skeletal Traction); RUST (Radiographic Union Scale for Tibial Fractures); mRUST (Modified Radiographic Union Scale for Tibial Fractures); FIX-IT (Function Index for Trauma); SF-12 (Short Form 12 Health Survey); LEFS (Lower Extremity Functional Scale); RTW (Return to Work); VAS (Visual Analog Score); SF-36 (Short Form 36 Health Survey); QOL (Quality of Life); ROM (Range of Motion); KOOS (Knee injury and Osteoarthritis Outcome Score); HA (Hemi-Arthroplasty); THA (Total Hip Arthroplasty); WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index); ORIF (Open Reduction Internal Fixation); TUG (Timed Up and Go Test); FSST (Four Step Square Test); AOR (Adjusted Odds Ratio); PORIKF (Primary Open Reduction + Intramedullary Nailing + K-

Wire Fixation); ST/SC (Skeletal Traction with Spica cast); ESIGN (Elastic stable intramedullary nailing)

Results

A total of 255 studies were identified and screened in the initial search (Figure 1). Thirty-seven studies (14.5%) met the inclusion criteria and were analyzed in this review (Table 2). There were 3 level I, 21 level II, 11 level III, and 2 level IV studies. For non-comparative studies, the mean MINORS score was 11, while the mean for comparative studies was 19.

In 37 included studies, 3,784 fractures in 3,780 patients were reported, including 2,923 males, 811 females, and unstratified sex in two studies. Patient ages ranged from 10 to 91 years, with three studies not reporting mean age. Follow-up ranged from 3 to 48 months, with two studies lacking follow-up data. Of the 37 studies, 9 reported a single outcome, while 28 reported multiple outcomes. Outcomes assessed included health-related quality of life (17 studies), functional outcomes (27 studies), psychosocial outcomes (8 studies), post-operative infection (7 studies), and nonunion (10 studies).

Road traffic accidents (RTAs), including motor vehicle crashes, motorcycle accidents, and pedestrian injuries, were the most common mechanism (n = 2,199). Falls affected 407 patients, gunshot injuries, 129 patients, and other causes (assaults, work-related injuries, crush injuries, impalement) 223 patients. Seven studies did not report mechanisms.

Femoral fractures (n = 1,875) were reported in 22 studies and tibial fractures (n = 1,793) in 18 studies. Femoral fractures were further classified as shaft/diaphyseal (10 studies), proximal (7 studies), distal (1 study), and unreported (5 studies). Tibial fractures included shaft/diaphyseal (7 studies), distal (2 studies), and unreported (12 studies); no proximal tibial fractures were reported. Open femur fractures were reported in 11 studies, closed in 13; open tibial fractures in 14 studies, closed in 6. Additional fractures include fibula (n = 110), ankle (n = 182), and foot (n = 1). Fracture classifications are reported in Table 3.

Intramedullary nailing (IMN) was the most common reported surgical intervention, primarily for femur (15 studies) and tibia (11 studies) fractures. External fixation (EF) was mainly applied in tibia fractures (13 studies), with occasional use in foot and ankle fractures. Plates and screws were used across femur, tibia, and ankle fractures. Operative treatment with casting or splinting was common in tibia fractures. Skeletal traction and open reduction with internal fixation (ORIF) were used mainly in femur and ankle fractures. Surgical interventions are summarized in Table 4.

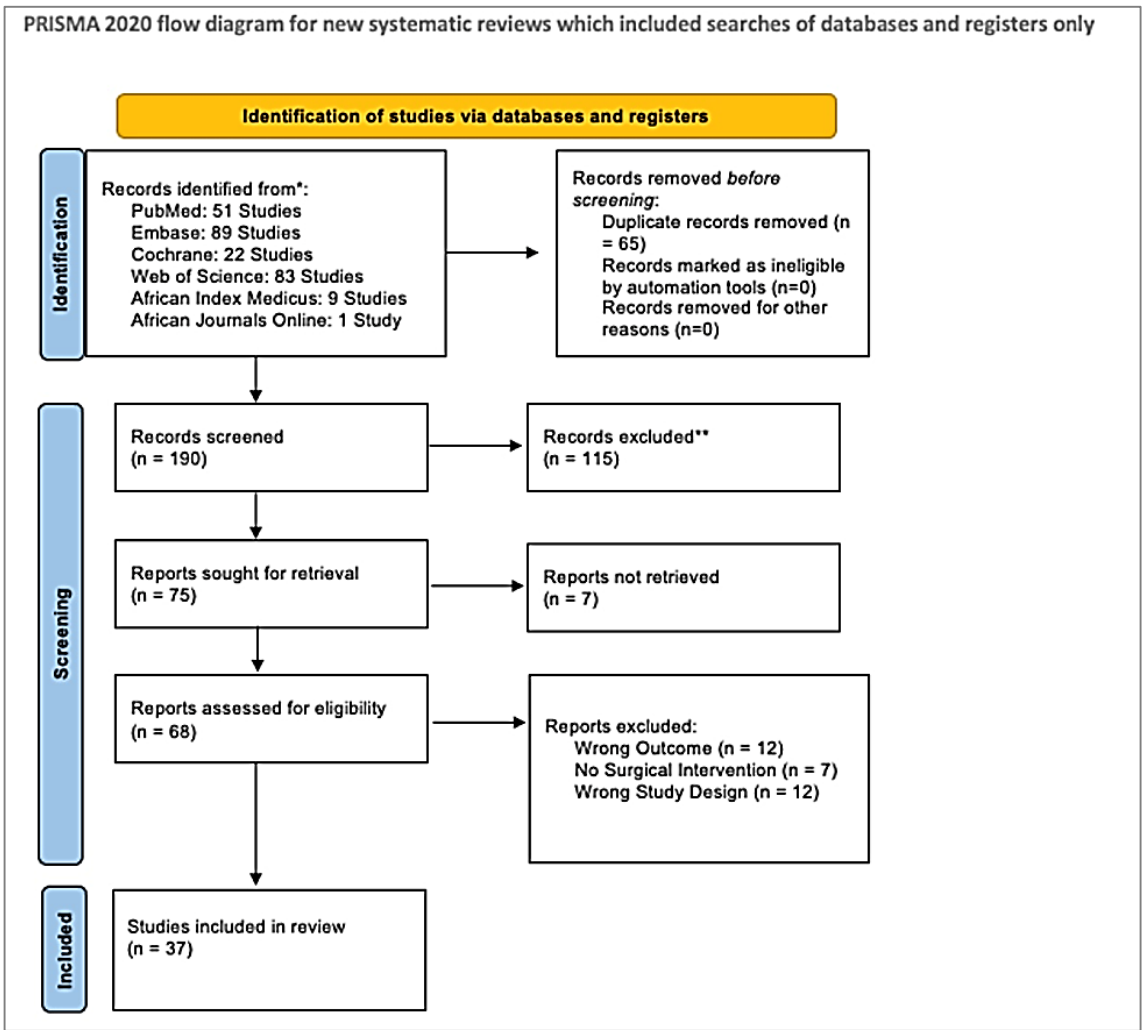

Fig 1: PRISMA Flow Chart for Inclusion of Articles number of articles screened, included, and excluded. Each article was screened by 2 team members.

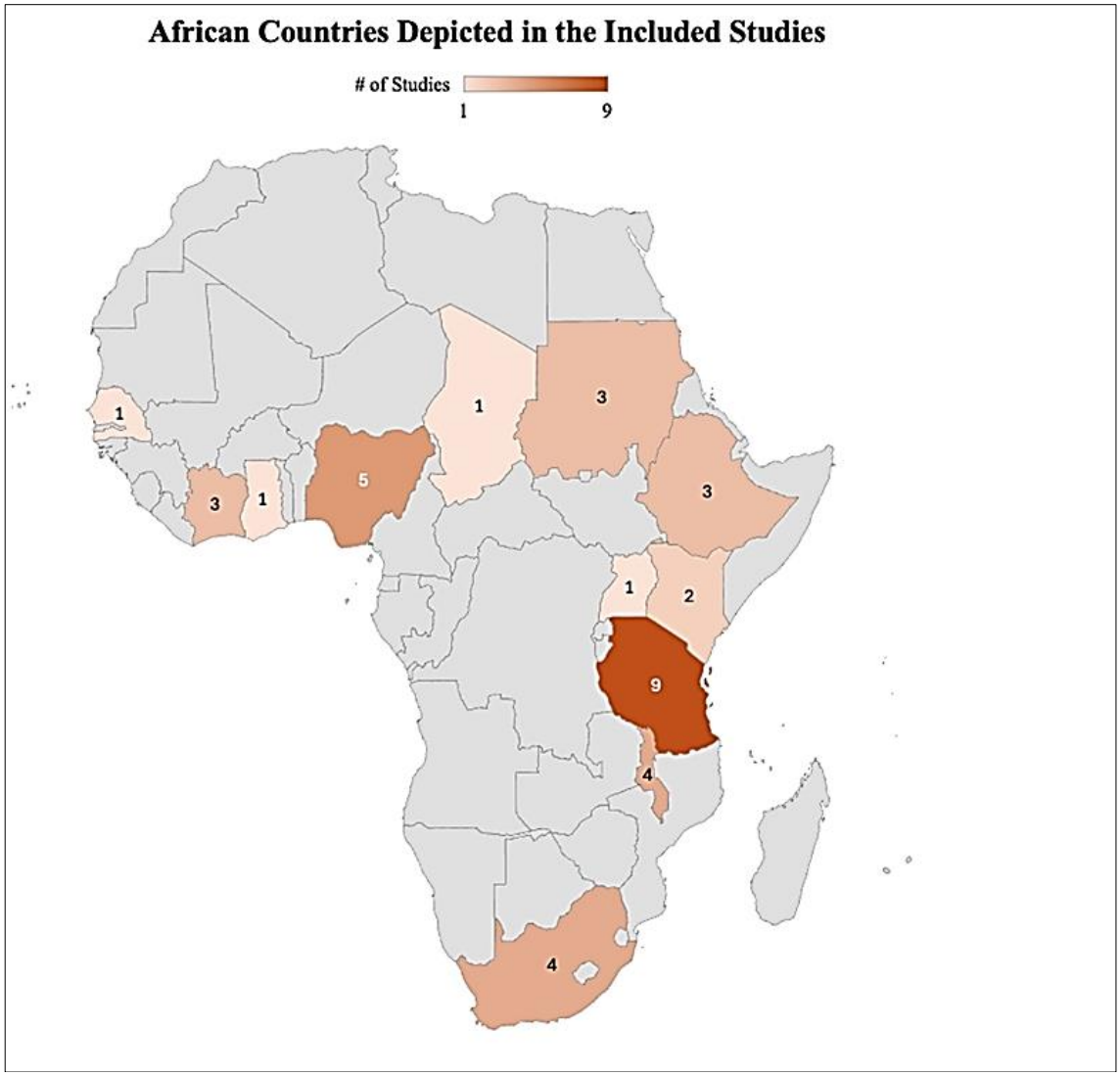

Fig 2: Heat map of African Countries Represented in the Included Studies.

The map depicts the distribution of included articles across countries, with Tanzania (n=9) and Nigeria (n=5) having the highest representation, followed by Malawi and South Africa (n=4 each). Other countries with fewer studies include Sudan (n=3), Ethiopia (n=3), Ivory Coast (n=3), Kenya (n=2), and single-study representation from Ghana, Uganda, Chad, and Senegal.

Table 3: Classification of Fractures based on different orthopedic classification systems.

Classification System	Type / Subtype	Number of Fractures
Gustilo-Anderson Classification	Type 1	251
	Type 2	195
	Type 3A	458
	Type 3B	75
	Type 3C	7
	Type 3 (Unspecified)	38
AO/OTA Classification	Type A	658
	Type B	426
	Type C	198
	Type 31A1	12
	Type 31A2	15
	Type 31A3	3
	Type 32	413
	Type 32A	37
	Type 32B	41
	Type 32C	7
	Type 41	11
	Type 42	136
	Type 42A	33
	Type 42B	17

	Type 42C	5
	Type 43	17
DORR Classification	A	36
	B	36
	C	14
Weber Ankle Classification	Weber A	1
	Weber B	37
	Weber C	14

Table 4: Reported Surgical Interventions by Fracture Site within Included Studies.

Surgical Intervention	Femur	Tibia	Foot	Ankle	Fibula
Intramedullary Nailing	15	11	0	1	1
External Fixation	3	13	1	1	0
Plates and Screws	4	3	0	2	0
Operative w/ Cast or Splint	1	5	0	1	0
Amputation	0	3	0	0	0
Hemiarthroplasty	3	0	0	0	0
Total Hip Arthroplasty	2	0	0	0	0
Skeletal Traction	5	2	0	0	0
Open Reduction & Internal Fixation	5	0	0	2	0
Osteosynthesis	1	0	0	0	0
K Wires	2	0	0	1	0

Distribution of operative techniques is shown by anatomic location, with intramedullary nailing most frequently reported for femoral and tibial fractures, and external fixation frequently used in tibial fractures. Other interventions included plates and screws, casting or splinting, skeletal traction, arthroplasty, amputation, and wiring techniques.

Table 5: Functional Outcome Measures Reported within Included Studies.

Functional Outcome	# of Studies	Functional Outcome	# of Studies
mHHS	3	LEFS	1
Ambulation/Gait	2	Functional Satisfaction	2
ROM	4	Limb Length Discrepancy	3
SMFA	2	ASAMI Functional and Bone Scores	1
FIX-IT	2	Timed Up and Go Test	1
Oxford Hip Score	2	Four Step Square Test	1
Squat and Smile Test	2	Foot Function Index	1
Return to Daily Living Activity	2	WOMAC	1
Functional O and M Ankle Score	1	Neers	1
KOOS	1	AOFAS Score	1

A range of outcome tools were used to assess postoperative recovery, including hip-specific scores (mHHS, Oxford Hip Score), knee and ankle measures (KOOS, AOFAS, Functional O and M Ankle Score), and general functional assessments (ROM, ambulation/gait, SMFA, FIX-IT, WOMAC). Additional measures included limb length discrepancy, return to daily living activity, patient satisfaction, and performance-based tests such as the Timed Up and Go and Four Step Square Test. Abbreviations: mHHS (Modified Harris Hip Score); SMFA (Short Musculoskeletal Function Assessment for Tibial Fractures); FIX-IT (Function Index for Trauma); SF-12 (Short Form 12 Health Survey); LEFS (Lower Extremity Functional Scale); ROM (Range of Motion); KOOS (Knee injury and Osteoarthritis Outcome Score); WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index); AOFAS (American Orthopedic Foot and Ankle Society Score); ASAMI (Association for the Study and Application of the Method of Ilizarov).

Health-Related Quality of Life Outcomes

Seventeen studies (17/37, 45.9%) reported 1-year EQ-5D or EQ-VAS outcomes Negative predictors of HRQoL included wound length >10 cm (P = 0.006), extensive muscle loss (P = 0.002), bone loss (P = 0.03), reoperation (P<0.001), smoking, OTA/AO class B injuries, lower RUST scores, and reduced knee flexion (all P<0.05).

Six studies reported early benefits of IMN over EF or nonoperative management, with higher EQ-5D scores at 6 weeks, 3 months, and 6 months. However, these differences generally dissipated by 1 year, with no significant differences in EQ-5D or EQ-VAS. One study comparing Fin Nail and Standard Nail IMN reported transient lower EQ-5D and higher pain at 12 weeks for Fin Nail patients, which resolved by 1 year (p>0.4). Similarly, one study comparing antegrade and retrograde nails found no long-term HRQoL differences, though retrograde nails were associated with increased knee pain at 6 months (p = 0.017).

Recovery patterns indicated persistent deficits at 1 year in five or more studies, with mean EQ-5D scores ranging from 0.71 to 0.95, depending on complications and fracture severity. Patients with infected nonunion or requiring reoperation had significantly lower EQ-5D and EQ-VAS scores. Fracture location influenced outcomes in two studies: proximal fractures had the lowest EQ-5D (0.55) and EQ-VAS (65), whereas distal fractures had higher scores (0.72, 75; P = 0.001).

Patient satisfaction was reported in four studies, with mixed results: two studies showed high satisfaction, and two

reported lower satisfaction post-surgery. Pain generally decreased over time, with mean VAS <1 at 1 year. SF-36 physical and mental component scores indicated persistent mild disability. Additional reported impacts included limitations in daily living, property loss, and financial strain in one study.

Functional Outcomes

Twenty-seven studies (27/37, 73.0%) reported functional outcomes following lower extremity surgical interventions (Table 5), using heterogeneous measures including patient-reported scores, clinician-assessed mobility, and objective performance tests. The most frequently reported measures were the Modified Harris Hip Score (mHHS; 3 studies), range of motion (ROM; 4 studies), and limb length discrepancy (LLD; 4 studies).

Hip function improved substantially postoperatively. mHHS increased markedly, with one study reporting a rise from 16.2 preoperatively to 80.96 at six months, and 76% achieving good or excellent outcomes. Patients without preoperative deformity or shortening had higher 1-year mHHS (P = 0.002 and P = 0.003), with no differences by fracture type. Non-union patients were 24 times more likely to report moderate or severe pain (P = 0.001). Oxford Hip Scores indicated 54.1% satisfactory function and 16.2% moderate-to-severe dysfunction.

ROM and ambulation recovery were substantial, with 80-91.7% achieving full, painless weight-bearing; up to 12% remained disabled due to severe open fractures. KOOS scores showed 57.6% good knee function, and LEFS scores averaged 61.5 ± 10.5, with 80% achieving satisfactory function. Squat-and-Smile and ROM tests revealed no implant-related differences at 1 year, though antegrade nailing improved knee flexion at 6 weeks (P = 0.021). Minor LLD (<15 mm) occurred in surgical patients; unacceptable LLD (>2 cm) was limited to conservative cohorts. LLD did not significantly affect function, and surgical patients achieved better mobility (55.1% normal ambulation vs. 29.1% in traction; OR = 3.80, P = 0.004).

Two studies reported SMFA (Short Musculoskeletal Functional Assessment) outcomes, with intramedullary nailing associated with lower Bothersome and Functional index scores at 6 weeks, 3 months, and 6 months post-injury, indicating less dysfunction. Median 1-year SMFA was 7.35, improved from pre-injury scores of 0, with IMN patients showing greater functional gains than external fixation (-11.2 SMFA dysfunction index). Return to work by 6 months was higher in IMN patients (26/37) than ST patients (24/51, P = 0.02). Daily living activities were delayed in conservatively treated patients, with PORIKF patients returning to activity 30 days earlier (P<0.05). FIX-IT scores were similar between IMN and EF, though infected non-unions had lower scores.

80% reported funcational satisfactory outcomes (42.5% very good, 37.5% good, 15% fair, 5% poor). LEFS scores indicated 80% of patients had satisfactory overall function, with mean scores of 61.5 ± 10.5. ASAMI scores were excellent/good in 73-94% of cases, OFAS ankle scores averaged 68.2 (fair), and Neer scoring showed 48.3% excellent, 30% good, 11.7% unsatisfactory outcomes. WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) revealed persistent limitations in activates of daily living, pain, and stiffness, particularly in older patients or those undergoing osteosynthesis.

Psychosocial Outcomes

Eight studies (8/37, 21.6%) reported post-operative psychosocial outcomes. Patients experienced reduced employment, income loss, and reliance on family support. Return to work rates ranged from 50-70% for 12-18 months, often with reduced productivity. Complications such as infection, delayed healing, or amputation worsened financial, emotional, and functional outcomes. Caregiver burden was significant and follow up barriers including travel costs and reliance on traditional bone setters limited recovery.

Infection

Seven studies (7/37, 18.9%) reported infection-related complications following lower extremity surgical interventions. Infection risk increased with fracture severity, ranging from 3.3 to 12.2 percent in Gustilo type I to IIIA fractures and reaching 77.8% in type IIIB fractures (p<0.001). Delays to surgery beyond 24 hours were consistently associated with deep infection and infected nonunion. One study reported lower superficial infection rates with IMN compared EF, while another identified pin tract infection as a strong predictor of chronic infection (OR 24.3, p = 0.017). In one cohort, persistent infection prevented 44 patients from returning to work.

Post-operative Nonunion

Ten studies (10/37, 27.0%) reported fracture healing outcomes. Nonunion was uncommon, with most patients achieving radiographic and clinical union by 4-12 months. One study reported union rates ranging from 91.7% to 97%. IMN was associated with faster early radiographic healing compared with EF, while delayed healing correlated with lower one year quality of life. Reoperation for nonunion was rare, and conservative management was associated with higher malunion rates, whereas surgical treatment achieved high union without malalignment (p = 0.001).

Discussion

A total of 37 studies met inclusion criteria in this systematic review, including 3,780 patients with 3,784 fractures, most sustained from road traffic accidents. Femoral and tibial fractures predominated, with surgical management largely favoring intramedullary nailing. IMN was consistently associated with higher union rates, faster recovery, and superior short-term health-related quality of life compared to EF or conservative care. Seventeen studies reported HRQoL outcomes, 27 assessed functional recovery, and eight evaluated psychosocial outcomes. While short-term surgical results were favorable, long-term outcomes highlighted persistent pain, functional limitations, infection risk, and socioeconomic hardship.

RTAs are leading cause of injury and death across SSA, where structural financial and systemic barriers exacerbate their impact. Despite representing just 15% of the global population and owning only 3% of the world's vehicles, the region accounts for nearly one-fifth of global road deaths [72]. This disproportionate burden reflects inadequate road safety infrastructure, poorly maintained roads, and limited enforcement of traffic legislation [28, 72]. Within this regional context, country-level analyses reveal both the burden of RTAs and gaps in the literature. Tanzania reports some of the highest RTA related mortality rates, yet orthopedic research remains scarce, likely underrepresenting the true

impact [13, 39, 65]. Nigeria continues to face an overwhelming trauma burden from RTAs, where delayed surgical care frequently results in infections, malunion, and permanent disability [5]. Surgeons cite motivated staff and sub specialization as strengths, but emphasize the lack of prehospital care, financial barriers, and resource shortages that hinder outcomes [4]. In Malawi, rising rates of femoral fractures from RTAs has outpaced the availability of surgical resources and equipment worsening long-term functional deficits for survivors [76]. South Africa, though better resourced, still struggles with inequities in access and systemic delays [7]. Across SSA, delays in surgical intervention raise critical concerns about survivors' quality of life, including persistent pain, mobility limitations, and lasting socioeconomic consequences.

Fracture management in SSA is dominated by femoral and tibial injuries, with IMN and EF being the most frequently reported surgical techniques. While IMN is recommended over EF in management of open tibial fractures Gustilo-Anderson types I-IIIA, both techniques remain widely utilized, reflecting differences in availability, provider expertise, and operative infrastructure [15]. Comparative studies show no significant differences in union time, nonunion, or deep infection rates between IMN and EF, though short term differences in pain and quality of life have been reported without sustained long term benefit [37, 45]. EF often predominates in resource-constrained environments, sometimes supplemented by K-wires, owing to its relative technical simplicity and minimal equipment demands[77]. Despite these findings, outcomes in many low-resource settings are less determined by preferred fixation methods and more profoundly shaped by systemic barriers. Delays to surgery, lack of sterile equipment, and insufficient perioperative capacity contribute to high complication rates, with surgical site infections reported at approximately 11%, often linked to delayed management of open fractures, and recurrence of nonunion in long bones documented at 10.8% [47, 75]. Rural patients face added risk from long travel distances and limited access, while urban centers struggle with overwhelming caseloads and operating room constraints [59]. Strengthening pre-hospital transport, triage, imaging, and operative infrastructure, while equipping providers with the skills and resources to deliver timely procedures, is essential to reduce preventable morbidity and improve long-term outcomes [2, 14, 34].

Health-related quality of life after orthopedic trauma in SSA depends on both surgical effectiveness and systematic barriers to recovery. The EQ-5D provides a standardized method to capture patient outcomes including mobility, self-care, usual activities, pain and discomfort, and anxiety and depression and has demonstrated responsiveness in musculoskeletal conditions, making it a valuable tool for clinical assessment and health policy evaluation [21, 36, 63]. In this review, patient satisfaction was generally favorable, particularly with intramedullary nailing, and short-term HRQoL assessed by EQ-5D and SMFA showed clear benefits of surgical intervention compared with external fixation or conservative care. Most surgically treated patients achieved good to excellent functional recovery, including improved ambulation, range of motion, and return to activity, supporting surgery as a reliable means of restoring independence. However, long-term outcomes often decline by one year, with many patients experiencing residual pain, functional limitations, and restrictions in daily activities. Outcomes are poorest in war affected, rural, and underserved settings, where delays to care, higher complication rates, and limited infrastructure and equipment are compounded by shortages in occupational and physiotherapy services [3, 35, 55]. While awareness of these inequities is growing, there is an insistent need to equip SSA with the infrastructure and equipment to address the current burden of trauma [20].

The psychosocial impact of orthopedic trauma in SSA remains poorly studied, leaving emotional and socioeconomic consequences largely unrecognized, [57]. Evidence from Tanzania shows high rates of depression symptoms among orthopedic patients, with longer hospital stays predicting greater severity [57]. Injury disrupts employment and income, disproportionately affecting young men and contributing to a broader disability crisis in a workforce where most rely on self-employment or agricultural work [12]. Complications such as infection, delayed healing, or amputation further worsened financial, emotional, and functional outcomes. Limited follow up due to travel costs and reliance on traditional bone setters reduces rehabilitation effectiveness, while gender-based violence adds complexity to musculoskeletal injury patterns [44, 61]. Optimizing outcomes requires not only timely surgical intervention but also early psychological support and targeted socioeconomic interventions to mitigate the multifaceted impact of trauma on patients and their families [27].

Addressing the orthopedic trauma burden in SSA requires coordinated action across clinical care, rehabilitation, and health system infrastructure. Expanding timely surgical access through increased operating capacity, workforce training, and deployment of fellowship trained orthopedic traumatologists is essential to reduce complications such as infection and nonunion [5, 20, 33]. Strengthening integrated rehabilitation and psychosocial support, including occupational and physiotherapy training and community based follow up, can mitigate long term disability and socioeconomic impact [66]. Concurrent health system improvements such as robust infection prevention, reliable supply chains, and streamlined workflows are critical to ensuring safe, equitable care [63]. Standardized outcome reporting with long term follow up will enable benchmarking and continuous improvement, though achieving sustainable equity will require sustained, coordinated investment[5].

Limitations

The quality and design of the included studies limit the strength of conclusions, as many were retrospective and non-comparative with moderate MINORS scores. Follow-up duration varied considerably, with some studies reporting as little as three months, potentially underestimating long-term functional impairments, psychosocial consequences, and complication rates. Outcome reporting was heterogeneous, particularly for health-related quality of life and functional measures, complicating direct comparisons. Patient-level details, including fracture subtypes, comorbidities, and sex-specific outcomes, were often incomplete. Contextual factors in SSA, such as limited surgical infrastructure, delayed presentation, and constrained rehabilitation resources, may exacerbate complications and limit the generalizability of findings. Despite these limitations, the findings highlight key areas for improvement and provide a

foundation for future high-quality research that can meaningfully enhance patient care and recovery in SSA.

Conclusions

Surgical intervention for lower extremity fractures in SSA is associated with high union rates and favorable short-term functional outcomes, particularly with intramedullary nailing. However, long-term quality of life remains limited by high infection rates in severe open fractures and persistent psychosocial and economic challenges. While current outcomes are sufficient for fracture healing and early recovery, they remain insufficient for sustained quality of life and long-term rehabilitation. Efforts to enhance timely surgical access, expand the use of modern fixation techniques, and implement standardized outcome reporting, infection prevention, rehabilitation, and psychosocial support are essential to optimize long-term outcomes in Sub-Saharan Africa.

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