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Original Research Article

COMPARATIVE STUDY OF EXTERNAL FIXATOR AND INTRAMEDULLARY NAILING IN PATIENTS WITH GUSTILO TIBIO FIBULAR FRACTURE TYPE III A: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: *Gustilo type IIIA tibiofibular fractures present a significant challenge in orthopedic trauma due to extensive soft tissue damage and high risk of complications such as infection, malunion, and non-union. Optimal fixation strategy remains debated, particularly in severe open fractures.* ***Objective:*** *To assess and compare the clinical outcomes of intramedullary nailing (IMN) versus external fixation (EF) in the management of Gustilo type IIIA tibiofibular fractures.* ***Study Design:*** *Prospective randomized controlled trial.* ***Setting:*** *Conducted at Khyber Teaching Hospital, Peshawar, Pakistan.* ***Duration of Study:*** January 2024 to June 2024. ***Methods:*** *A total of 140 patients aged 18–65 years with confirmed Gustilo type IIIA tibiofibular fractures were enrolled and randomized into two equal groups: IMN group (n=70) and EF group (n=70). All procedures were performed under standardized surgical protocols. The primary clinical outcomes assessed included fracture union, malunion, non-union, infection, and need for reoperation. Follow-up assessments were conducted for at least 12 months postoperatively. Statistical analysis was performed using SPSS version 26. Chi-square test was used for categorical variables and p-values < 0.05 were considered statistically significant.* ***Results:*** *The IMN group showed superior clinical outcomes to the EF group. Successful union was achieved in 91.4% of IMN patients versus 78.6% in the EF group (p=0.03). Malunion rates were lower in the IMN group (4.3% vs. 14.3%, p=0.04), as were non-union (5.7% vs. 17.1%, p=0.03), reoperation (7.1% vs. 18.6%, p=0.04), and infection rates (4.3% vs. 18.6%, p=0.008).* ***Conclusion:*** *Intramedullary nailing demonstrated significantly better outcomes than external fixation in managing Gustilo type IIIA tibiofibular fractures, with higher union rates, fewer infections, and reduced need for reoperation. IMN should be considered a preferable option for this fracture type in appropriately selected patients..*

Keywords: Gustilo IIIA Fracture, Intramedullary Nailing, External Fixation, Tibiofibular Fracture, Randomized Controlled Trial, Fracture Union, Infection Rates

INTRODUCTION

The management of complications related to open fractures of the tibia presents major obstacles, often exceeding the capabilities of conventional treatment methods. Open tibia fractures indicate the most prevalent type of open long bone fractures, occurring at an annual incidence rate of 3.4 per 100,000 individuals (1). All available methods may be employed to achieve stability within Grade II wounds with suitable soft tissue coverage. This comprises intramedullary devices, flexible inner plating equipment established via biological methods, whether reamed or unreamed, external fixators, and a combination of these options (2). Skeletal traction offers significant risks, as any form of traction permits movement at the fracture site, regardless of how well-balanced the traction may be. In cases of type III fractures, in which soft tissue protection is unfeasible, the available treatment options are limited to intramedullary devices and external fixation (3-6).

Surgeons utilize intramedullary nailing to insert a metal rod within the tibial marrow canal, thereby ensuring stable internal fixation of fractures. Applying this therapy allows patients to have early mobility and contributes to positive results in fracture healing (7). The external fixation procedure includes using an external frame connecting bone pins or wires, stabilizing fractures. Healthcare professionals select external fixator treatment for patients undergoing significant tissue damage or contamination due to its ability to offer minimal accessibility to the body while concurrently addressing adjacent soft tissue injuries. A study evaluated the efficacy of intramedullary nailing compared to external fixation for the treatment of Gustilo Type III open tibial fractures. Intramedullary nailing demonstrated superior performance compared to external fixation in decreasing both rates of infection as well as healing complications in patients (8). The analysis of infection outcomes demonstrates that intramedullary nailing treatment displays superior infection control compared to external fixation procedures. The results revealed improved healing outcomes for intramedullary nailing patients, as they exhibited fewer complications that might impede fracture healing (9).

Gustilo tibiofibular fractures, typically arising from high-energy trauma, pose significant challenges regarding stabilization and the healing process of the fractures. The selection of the most effective method continues to be debated, as few studies directly compare these two approaches for this particular type of fracture. The rationale of this study is to assess and compare the outcomes of two commonly used methods for managing Gustilo tibiofibular fractures: external fixator and intramedullary nailing.

METHODOLOGY

This randomized controlled trial was conducted at the Department of Orthopedics of Khyber Teaching Hospital, Peshawar, from January 2024 to June 2024 after the hospital obtained ethical clearance. One hundred forty patients presenting with Gustilo type IIIA tibiofibular fractures were randomly allocated into two treatment groups using the lottery method, with seventy patients assigned to each group.

Patients in the IMN group underwent closed reduction and internal fixation using reamed locked intramedullary nails. In contrast, the EF group received unilateral external fixators with Schanz pins placed in safe anatomical corridors. All surgical procedures were performed by

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senior orthopedic surgeons with more than five years of trauma experience, following the standardized protocols.

Clinical and radiographic follow-up was conducted at 6 months postoperatively. Primary outcome measures included union, infection, no union, malunion and need for reoperation.

Data analysis was performed using SPSS 26. Age was calculated by mean and SD. Gender, comorbidities, and clinical parameters were assessed using frequencies and percentages. Chi Square test was used for comparing clinical parameters between both groups with a value of P notable at < 0.05.

RESULTS

We compared outcomes between intramedullary nailing (IMN) and external fixation (EF) in patients with Gustilo type IIIA tibio-fibular fractures; 70 patients were in each group. The mean age in IMN group was 45.54 ± 12.61 years and EF 44.33 ± 12.19 years. There were about 41 (58.6%) males in the IMN group and 39 (55.7%) in the EF, while females were 29 (41.4%) in IMN and 31 (44.3%) in EF (Figure 1). Diabetes prevalence was 19 (27.1%) in IMN and 15 (21.4%) in EF, hypertension was 18 (25.7%) and 16 (22.9%), respectively, and smoking was 3 (18.6%) versus 12 (17.1%), respectively (Table 1).

Clinical outcomes were in favor of the IMN group with a notably higher union success rate of 64 (91.4%) compared to 55 (78.6%) in EF (p=0.03). Malunion in IMN was3 (4.3%) and 10 (14.3%) in EF (p=0.04). Non-union rates were lower with IMN at 4 (5.7%) compared to 12 (17.1%) in EF (p=0.03). Reoperation was required in 5 (7.1%) of IMN cases and 13 (18.6%) with EF (p=0.04). Infection rates were also lower in the IMN group 3 (4.3%) compared to 13 (18.6%) in EF (p=0.008) (Table 2).

Table 1: Comorbidities in both groups

Comorbidities and demographics		Groups			
		IMN		EF	
		N	%	N	%
Gender	Male	41	58.6%	39	55.7%
	Female	29	41.4%	31	44.3%
Diabetes	Yes	19	27.1%	15	21.4%
	No	51	72.9%	55	78.6%
Hypertension	Yes	18	25.7%	16	22.9%
	No	52	74.3%	54	77.1%
Smoking	Yes	13	18.6%	12	17.1%
	No	57	81.4%	58	82.9%

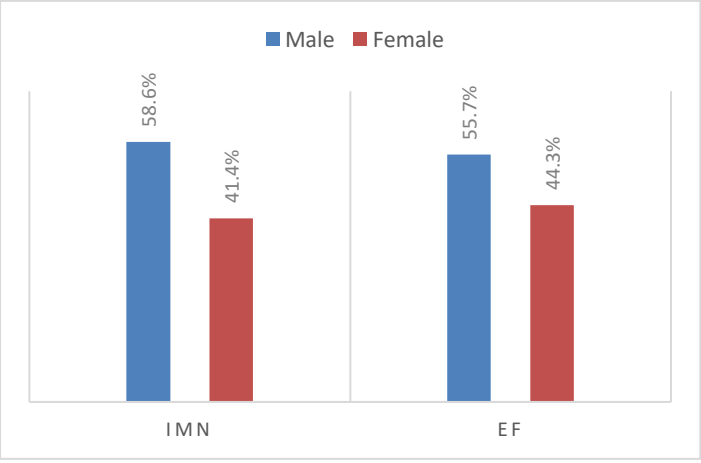

Figure 1: Gender distribution between both groups

Table 2: Comparison of clinical parameters between both groups

Clinical parameters		Groups				P value
		IMN		EF		
		N	%	N	%	
Union successful	Yes	64	91.4%	55	78.6%	0.03
	No	6	8.6%	15	21.4%	
Malunion	Yes	3	4.3%	10	14.3%	0.04
	No	67	95.7%	60	85.7%	
No union	Yes	4	5.7%	12	17.1%	0.03
	No	66	94.3%	58	82.9%	
Reoperation	Yes	5	7.1%	13	18.6%	0.04
	No	65	92.9%	57	81.4%	
Infection	Yes	3	4.3%	13	18.6%	0.008
	No	67	95.7%	57	81.4%	

DISCUSSION

Our study exhibited a 91.4% union rate with IMN, while 78.6% with EF, with notably lower rates of non-union (5.7% vs. 17.1%) and malunion (4.3% vs. 14.3%). These findings align with Ali et al, who observed a 92% union rate of IMN compared to 81% of EF, with non-union rates of 7% and 18%, respectively (10). Similarly, Munif et al noted a 4% non-union rate for IMN and 27% for EF, reinforcing IMN's superiority in achieving bony union (11). Umrani et al reported a less pronounced difference, 22.7% delayed union with IMN and 39.1% with EF, though their study included Gustilo IIIB fractures, which are more complex (12). The consistency across studies suggests that IMN's biomechanical stability enables early weight-bearing and reduces micromotion, which likely underpins its higher union rates.

Our data exhibited a stark contrast in infection rates, 4.3% with IMN and 18.6% with EF. This aligns with Ali et al., who showed that infection was observed in 16% of patients in EF and 7% in the IMN group (10). Munif et al showed that 6% of infections were for IMN and 31% for EF (11). Giovannini et al further support this finding, attributing EF's higher infection risk to pin-site complications and prolonged external hardware exposure (14). However, Umrani et al. reported a contrasting finding, reporting 13.6% deep infection with IMN while 8.7% with EF, possibly due to their inclusion of IIIB fractures or variations in postoperative care.[12] Despite this discrepancy the majority of evidence including our results highlights IMN's advantage in minimizing infections for IIIA fractures.

Our study noted lower reoperation frequency with IMN (7.1% vs. 18.6%), a trend similar to Munif et al they reported 10% reoperation rate in IMN group while 33% in EF group (11). IMN's lower reoperation burden may stem from its inherent stability, reducing the need for secondary procedures like dynamization or bone grafting. Ali et al. reported that IMN patients reported notably better functional scores (10). Conversely EF's association with ankle stiffness as reported by Umrani et al and delayed mobilization likely contributes to its inferior functional outcomes (12).

While our results and most literature favor IMN, Umrani et al. reported higher malunion rates with EF (26.1%) but comparable non-union rates (13.6% IMN vs. 8.7% EF). This discrepancy may reflect differences in fracture severity, their inclusion of IIIB injuries, or surgical technique. Additionally, Giovannini et al.'s research notes EF's utility in polytrauma or severely contaminated wounds, reminding us that IMN is not universally superior; context matters (13).

Our findings, when compared with other studies, strongly advocate for IMN as the first-line treatment for Gustilo IIIA fractures given its faster union, lower complication rates, and better functional outcomes. However, we also state that EF retains a role in resource-limited settings or IIIB fractures with extensive soft tissue loss. Future

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research should standardize the outcome measures and stratify results by Gustilo subtypes to clarify these discrepancies.

CONCLUSION

We conclude that intramedullary nailing exhibited superior outcomes for Gustilo IIIA tibiofibular fractures, with higher union rates, lower infections, and fewer reoperation needs compared to external fixation, supporting its preference in clinical practice.

DECLARATIONS

Data Availability Statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned. (IRBEC-SIK:KA-08-23)
Consent for publication
Approved
Funding
Not applicable

CONFLICT OF INTEREST

The authors declared an absence of conflict of interest.

AUTHOR CONTRIBUTION

HAIDER ALI (Post Graduate Orthopedic Resident)
Conception of Study, Development of Research Methodology Design, Study Design, manuscript Review, and final approval of manuscript. Manuscript drafting.
SHAHRUKH KHAN (Post Graduate Orthopedic Resident)
Manuscript revisions, critical input.
Data entry, data analysis, and drafting the article.
SAAD INAYAT ULLAH (Post Graduate Orthopedic Resident)
Study Design, Review of Literature.
WASEEM HAIDER (Post Graduate Orthopedic Resident)
Conception of Study, Final approval of manuscript.

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