Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.1096

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Pilon Fracture Management: Distal Tibial Locking Plate Vs Ilizarov

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ARTICLE INFO

Keywords
pilon fracture, locking plate, ilizarov, lower extremity, functional score.

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Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.
Conflict of Interest: No conflict of interest.
Funding: No funding received by the authors.

Article History
Received: 04-03-2025 Revised: 26-03-2025
Accepted: 06-04-2025 Published: 15-04-2025

ABSTRACT

Introduction: Several methods have been used to treat tibial pilon fractures, while the best course of action is still up for debate. In order to restore the distal fibula length and articular surface, these patients are typically treated in Europe with open reduction and internal fixation of the tibia, with bone grafting as needed. **Study design:** Randomized Controlled trial. **Settings:** Department of Orthopedic Surgery, Allied Hospital, Faisalabad. **Study duration:** November 2024 and February 2025. **Materials and Procedures:** 256 patients (128 in each group) of either gender, aged 18 to 50, who presented with Anderson grade 1 traumatic extra-articular/intra-articular distal tibial fractures were chosen. Patients with compartment syndrome, generalized bone or joint disease, pathological fractures, uncontrolled diabetes mellitus, peripheral vascular disease, other significant injuries or polytrauma, and prior surgery were excluded. The patients were split into two groups at random using the lottery method. Group A were undergone tibial locking plate and group B were undergone ilizarov technique. The lower extremity functional score (LEFS), as described by the patient, is the main result. The functional score for the lower extremities ranges from 0 to 80 points. **Results:** Patients in groups A and B had mean ages of 36.17 ± 8.33 and 37.02 ± 7.16 years, respectively. With a male to female ratio of 2.5:1, 182 (71.09%) patients were males and 74 (28.91%) were females. The mean LEFS score at 12 weeks was 61.80 ± 4.55 for group A and 64.66 ± 5.24 for group B (p-value = 0.0001). **Conclusion:** In comparison to ilizarov technique, this study found that tibial locking plate offers superior lower extremity function score.

INTRODUCTION

Ankle complications known as pilon fractures are brought on by high-energy trauma, such as falls from considerable heights or injuries sustained in traffic accidents. The mechanism of damage is axial loading with a rotating component. Pilon fractures account for 5–7% of all tibial fractures.[1] Pilon fracture management may be difficult due to patient factors like smoking, comorbidities, limited soft-tissue coverage, inadequate vascular supply, and complex fracture patterns (such AO Type-C). These features make surgery for pilon fractures more difficult and can have serious side effects such osteomyelitis, deep infections, delayed or nonunion, and post-traumatic arthritis.[2] Long-term impairment may arise from these consequences, which may necessitate further surgical treatments to cure infections, secondary arthritis, and amputations.[3]

Several methods have been used to treat tibial pilon fractures, while the best course of action is still up for debate. In order to restore the distal fibula length and articular surface, these patients are typically treated in Europe with open reduction and internal fixation of the tibia, with bone grafting as needed.[4] On the other hand, a number of trauma hospitals in North America have treated these patients by using minimally invasive internal fixation of the articular surface and immediate external fixation, which leaves the external fixator in place until bone union. According to published research, this method for plafond fractures produces positive results with few complications.[5]

However, because reduction is less invasive and involves less blood loss and soft-tissue exposure, the Ilizarov device has recently made it feasible to treat these patients with a single stage of treatment.[6] Ilizarov also allows for compression/distraction and alignment correction during and after surgery, if needed. Furthermore, the attachment is stable

enough to allow for early weight bearing.[7]
Regarding the best course of action for severe pilon fractures, our institute's surgeons cannot agree. In order to ascertain whether distal tibial locking plate with an Ilizarov device leads to (1) higher patient-reported lower extremity functional scores and (2) higher patient-reported outcome scores, such as patient satisfaction form (SF-12) and an increased likelihood of union, this randomized controlled trial study was conducted.

MATERIALS AND METHODS

This randomized controlled study included 256 patients (128 in each group) of either gender, ages 18 to 50, who visited the Allied Hospital, Faisalabad's Department of Orthopedic Surgery between November 2024 and February 2025 and who had Anderson grade 1 traumatic extra-articular/intra-articular distal tibial fractures within 15 days of injury. The WHO sample size calculator was used to determine the sample size for two means, with the following parameters: 80% power of study, 5% level of significance, and 66.55 ± 3.07[8] and 67.55 ± 2.6[8] for the expected means in groups A and B, respectively. Exclusion criteria included peripheral vascular disease, generalized bone or joint disease, pathological fractures, compartment syndrome, uncontrolled diabetes mellitus, other severe injuries or polytrauma, and previous surgical procedures.
The study was started after being approved by the ethical committee and the appropriate authorities. Written informed consent was acquired. The patients were split into two groups at random using the lottery method. Following enhanced trauma life support, the orthopaedic bay's initial treatment for open pilon fractures included debridement, wound lavage, analgesia, reduction, and the use of an above-knee splint. They were treated in accordance with the on-call consultant's fracture management protocol since our trauma consultants were in agreement about how to handle these fractures. During the ward rounds the next day, the physician who advocated for the tibial locking plate had a procedure for evaluating soft tissues for blisters and edema. Patients were operated on within 48 hours of presentation if their soft tissue condition allowed it and they were fit for anesthesia; if not, a calcaneal traction pin was inserted, and the injured extremity was raised on a Bohler-Braun frame to allow blisters and swelling to go down before surgical fixation. Preoperative antibiotics were administered to all patients and continued for 48–72 hours. The hospital protocol was followed for administering deep vein thromboprophylaxis (DVT).
General or spinal anesthesia was used for ORIF. A minimally invasive plate osteosynthesis approach that entailed dissecting the distal tibia and sliding the plate submuscularly was used to place the locking plate during ORIF. The surgeon was left to make decisions on the specifics of the surgical strategy, reduction procedures, implant selection, fixation methods, and other tools or approaches. By opening the fracture site and accomplishing reduction under C-arm and visual guidance, fracture reduction was accomplished. The sole requirement was that, as is customary for all distal tibial locking plates, fixed-angle screws be used in the implant's distal holes. Depending on the surgeon's intraoperative judgment, an autograft was utilized to encourage union or if shortening was expected.
To stabilize pilon fractures, an Ilizarov external fixator (SK Surgicals, Karachi, Pakistan) was employed. The surgeon was in charge of the surgical procedure, the use of bone graft, and the fabrication of the frame, which included rings, wires, and half pins. The frames were made by hand. Under fluoroscopic guidance, a closed technique was used to reduce fractures. Our facilities did not use limited internal fixation with an Ilizarov external fixator because it was not a common procedure. In every case, a fixator was used to span the ankle joint. There are footplates on every Ilizarov frame. The surgeon made the decision to remove the foot plate. In patients with nonunion, the frames were compressed in addition to corticotomy. The Ilizarov frames stay in place for the duration of fracture healing in individuals who have nonunion or delayed healing.
All trauma patients were observed by the physiotherapist and the operating surgeon in the clinic for a minimum of 12 weeks, and then yearly with the physiotherapist, with the patients' permission to remain anonymous. For auditing purposes, patient-reported outcomes are routinely collected. The primary outcome is the lower extremity functional score (LEFS), as reported by the patient. Lower extremity functional scores vary from 0 to 80 points, where 0 denotes full function and 80 denotes total disability. It has been demonstrated that it is a powerful, practical clinical and research instrument with good responsiveness and acceptability for assessing disability caused by lower limb impairment.
In this study, data was collected and analyzed using SPSS Ver. 25. Frequencies and percentages were computed for qualitative attributes such as gender, fracture type, and injury manner. For quantitative information including age, fracture length, BMI, and LEFS scores, the mean and standard deviation were calculated. An independent samples t-test was used to compare the LEFS scores of the two groups at 12 weeks. To account for effect modifiers such age, gender, fracture type, manner of injury, and fracture length, stratification was employed. A p-value of less than or equal to 0.05 was considered statistically significant, and the post-stratification independent samples t-test was employed.

RESULTS

The study's participants ranged in age from 18 to 50, with

a mean age of 36.24 ± 7.78 years. Patients in groups A and B had mean ages of 36.17 ± 8.33 and 37.02 ± 7.16 years, respectively. With a male to female ratio of 2.5:1, 182 (71.09%) patients were males and 74 (28.91%) were females. The duration of fracture was 6.93 ± 1.42 weeks on average. 67 (52.34%) of the 128 patients had open fracture in group A and 67 (52.34%) in group B, while 61 (47.65%) had closed fracture in group A & 61 (47.65%) in group B. Road traffic accident is the main mode of injury in both groups and was found in 47 (36.72%) in group A and in 52 (40.62%) in group B patients. Patients who had tibial locking plate surgery weighed an average of 87.47±7.80 kg, while those who had ilizarov weighed an average of 80.69±12.19 kg. This variation resulted in a significant mean difference in the BMI score (p=0.02), with the Ilizarov group's mean BMI being 28.86±3.76 kg/m2 and the tibial locking plate group's mean BMI being 31.18±1.27 kg/m2.

According to Table I, the mean LEFS score at 12 weeks was 61.80 ± 4.55 for group A and 64.66 ± 5.24 for group B (p-value = 0.0001). Table 2 displays the stratification of the LEFS score at 12 weeks by age, gender, BMI, fracture type, manner of injury, and fracture length.

Concerning the problems in both groups, two patients (1.56% each) who underwent tibial locking plate procedures experienced complicated regional pain syndrome (CRPS), malunion, and amputation. In the Ilizarov group, four patients (3.12%) each suffered nonunion, superficial, deep, and pin tract infections, while eight patients (6.25%) had malunion. Three patients (2.34%) had an amputation problem during the Ilizarov treatment, just like the tibial locking plate group.

Table 1

Comparison of LEFS Score Between Both Groups

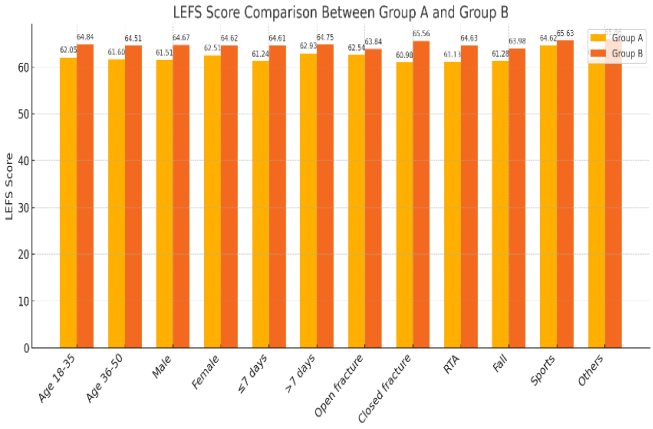
	Group A (n=198)		Group B (n=198)		P-value
	Mean	SD	Mean	SD	
LEFS score	61.80	4.55	64.66	5.24	0.0001

Table 2

Stratification of LEFS Score at 12 Weeks with Respect to Age, Gender, BMI, Fracture Type, Manner of Injury, and Fracture Length.

Variables		Group A (n=128)		Group B (n=128)		P-value
		LEFS score		LEFS score		
		Mean	SD	Mean	SD	
Age (years)	18-35	62.05	5.02	64.84	5.20	0.0001
	36-50	61.60	4.18	64.51	5.31	0.0001
Gender	Male	61.51	4.69	64.67	5.57	0.0001
	Female	62.51	4.13	64.62	4.41	0.0001
Duration of fracture (days)	≤7	61.24	4.45	64.61	5.11	0.0001
	>7	62.93	4.58	64.75	5.54	0.0001
Type of fracture	Open	62.54	4.78	63.84	6.40	0.0001
	Closed	60.98	4.16	65.56	3.40	0.0001
Nature of injury	RTA	61.13	5.45	64.63	6.47	0.0001
	Fall	61.28	4.26	63.98	5.15	0.0001
	Sports	64.62	1.07	65.63	2.16	0.0001
	Others	61.60	3.98	65.86	2.04	0.0001

Figure 1



DISCUSSION

According to our research, Patients in groups A and B had mean ages of 36.17 ± 8.33 and 37.02 ± 7.16 years, respectively. It is analogous to a research by Giannoudis VP et al. on comparable fractures.[9] The male prevalence for these injuries was 71.09% in our analysis, compared to 67% in the study by Tukade MB et al.[10] This could be because males are more likely than females to experience occupational exposure and related injuries. Nonetheless, the study conducted by Giannoudis VP et al.[9] was similar in that 77% of the patients were men.

Similar to earlier research, the most common cause of injury in both groups in this study was traffic accidents (38.67% of cases), which were followed by falls from a height.[11-13] The majority of injuries that are ascribed to men who fall from heights can be explained by the nature of their jobs, which include going to fields and scaling trees to obtain cattle feed. It is common knowledge that automobile accidents are the leading cause of all types of severe injuries.

At 12 weeks, group A's mean LEFS score was 61.80 ± 4.55, while group B's was 64.66 ± 5.24 (p-value = 0.0001). The lower extremity functional score (LEFS) parameters used in a study[8] to evaluate the ultimate outcome were quite similar for both groups; the P group's mean score was 67.15, while HI's was 66.55. In terms of the ultimate functional outcome, there was no discernible difference between the two groups. In terms of functional outcome, the follow-up findings seen in this study may vary in the future.

According to a meta-analysis, the EF group had a noticeably higher incidence of nonunion than the ORIF cohort, even though there was no difference between the two cohorts in terms of deep infections.

Additionally, the EF cohort had a higher incidence of superficial infection than the ORIF group (9.3%).[14] The results of the current investigation indicated superficial infection, which is in line with the meta-analysis reported above (7.7% vs. 9.3%). The presence of Schanz pins or wires near the joint increases the risk of septic arthritis, and prolonged use of EF is associated with pin-track infections.[15] All eleven proximal and four distal fractures that underwent delayed union were able to mend on their own, according to Kumar et al.[12] In contrast, Lim et al. detected superficial infection in nine cases and severe infection in one case after conclusively managing open pilon fractures with thin wire fixation.[13] Four scenarios involved delayed union and infections, and each was associated with a high Gustilo-Anderson grade. Important incidences of infection, skin necrosis, or symptomatic implants were not reported by Hu et al. when they examined Gustilo I and II pilon fractures treated with ORIF utilizing a lateral technique.[16] A UK study found that 13 out of 59 patients (22%) experienced pin tract infections after CEF, which is greater than the current trial.[17] On the other hand, a number of researchers claim that ORIF results in deep infections and other major soft tissue issues.[18] In a sample of 401 patients, Olson et al. found that the ORIF group had a 17% deep infection rate.[19] The rates of superficial infection from open fractures varied from 6% to 8% in smaller studies and from 8% to 28% and 43% in larger studies.[20]

The overall infection percentages (deep: open, 10%; closed, 7%; superficial: open, 54%; closed, 21%) were similar, reflecting the most recent ORIF literature.[21] For open fractures, the most common sequelae were nonunion (24%) and posttraumatic arthritis (16%), whereas for closed fractures, the most common sequelae were superficial infection (21%) and posttraumatic arthritis (24%).[22] Patients in a different Italian research suffered AO Type-43C7 fractures. There were reports of four Type-III C, seven Type-III B, and three Gustilo Type-IIIA injuries. 24 Six people (43%), experienced delays in union.[23]

One study found that the major union proportion was 58%. 23 Six patients (42%) with delayed union recovered after around 10 months.[23] The comparatively high incidence of delayed union might have been influenced by the profound infection that appeared in 67% of cases.[21] Seven out of 76 patients (9.2%) who got ORIF had a surface infection; only two patients (2.6%) had a deep infection that necessitated a formal debridement; no flap was required.[18] One study used minimum ORIF in combination with the Ilizarov external fixator approach for treatment.[23] Three patients developed pin-site infections after bone grafting, and one patient developed a serious infection.[23] Although there are risks associated with both ORIF and EF operations, the most recent research backs up the argument made in this study that, depending on the injury, it is preferable to conduct the ORIF surgery unless there is a compelling cause to require the EF procedure.

There were various restrictions on this investigation. First, there was no clinical information available about the participants' pre-intervention function that could be contrasted with the post-intervention clinical results. By removing patients with a history of ankle function impairment, this restriction was reduced.

CONCLUSION

In comparison to ilizarov technique, this study found that tibial locking plate offers superior lower extremity function score. Therefore, in order to lower the morbidity of these patients, we advise that tibial locking plate be utilized as the initial treatment for pilon fractures.

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