Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i5.1723
*Biol. Clin. Sci. Res. J., Volume 6(5), **2025**: 1723*
Original Research Article

Comparison Study Of Minimally Invasive Plate Osteosynthesis (MIPO) Vs Open Reduction And Internal Fixation (ORIF) For Comminuted Distal Tibia Fracture

Mishkat Ullah[1], Suhail Amin[2], Arsalan Raiz[1], Abid Rehaman[3], Asnaf Siddique[4], Khalid[1], Faisal Rafique[*4]

[1]Combined Military Hospital Rawalpindi, Pakistan
[2]Army Medical Collage Rawalpindi, Pakistan
[3]Northwest General Hospital and Research Center Peshawar, Pakistan
[4]Type D Hospital Latambar Karak, Pakistan
**Corresponding author`s email address:* faisalrafique39@gmail.com

(Received, 14th March 2025, Accepted 12th May 2025, Published 31st May 2025)

Abstract: *Comminuted distal tibia fractures are complex injuries that require precise management due to limited soft tissue coverage and high risk of complications. Two commonly used fixation techniques are minimally invasive plate osteosynthesis (MIPO) and open reduction and internal fixation (ORIF). Each method has distinct biomechanical and biological implications that influence healing outcomes.* ***Objective:*** *To compare the functional and radiological outcomes of MIPO versus ORIF in the treatment of comminuted distal tibia fractures.* ***Methods:*** *This prospective comparative study was conducted at the Department of Orthopedic Surgery, CMH Rawalpindi, from 15 June 2024 to 14 Feb 2025. A total of 60 patients were divided into two groups of 30 each, treated with either MIPO or ORIF. Functional outcomes were measured using the AOFAS score, and radiological union was assessed through serial X-rays.* ***Results:*** *The MIPO group showed significantly higher mean AOFAS scores (88.5 vs. 80.9), faster union times (15.2 vs. 17.6 weeks), and fewer complications compared to the ORIF group.* ***Conclusion:*** *MIPO is a superior technique for comminuted distal tibia fractures, offering better outcomes with fewer complications.*

Keywords: Distal tibia fracture, MIPO, ORIF, fracture fixation, functional outcome, radiological union

[***How to Cite:*** Ullah M, Amin S, Raiz A, Rehaman A, Siddique A, Khalid, Rafique F. Comparison study of minimally invasive plate osteosynthesis (MIPO) vs open reduction and internal fixation (ORIF) for comminuted distal tibia fracture. *Biol. Clin. Sci. Res. J.*, **2025;** 6(5): 7-11. doi: https://doi.org/10.54112/bcsrj.v6i5.1723

Introduction

Comminuted fractures of the distal tibia are challenging because they are found under the skin, have poor blood supply, and are often connected to damage of the surrounding soft tissue. For this reason, choosing the best surgical approach is key for recovering both the bone and the affected limb. Minimally invasive plate osteosynthesis (MIPO) and open reduction and internal fixation (ORIF) are widely used to treat these types of fractures. Over the last two decades, MIPO has become popular thanks to its non-destructive technique, whereas ORIF is still favored where surgeons need to work directly on the broken bones. Their goals are the same, but these procedures rely on different methods and principles (1). MIPO uses an indirect method to reduce fractures, inserting the plate under the muscles to avoid damage to the blood supply in the bone and reduce soft tissue injury. Since the technique is not as invasive, there is a reduced chance of infection, and patients can start moving around sooner (2).

According to Sourougeon et al., patients with tibial pilon fractures treated with MIPO showed fewer soft tissue problems and a satisfactory rate of union (1). Similarly, Saini et al. revealed that using locking compression plates via MIPO for distal tibial fractures resulted in strong functional outcomes, quick rehabilitation, and few problems after surgery (2). Using this method, the soil around the damaged bone is less disturbed, which helps damaged tissue grow and the fracture to heal well (3). Various studies conducted in Pakistan and other developing countries have investigated MIPO in the clinical setting and recorded positive results. Inam and colleagues found that applying MIPO reduced both infection and broken hardware rates in patients with distal tibial fractures cared for in tertiary hospitals (3). These techniques are useful in many cases, not only for distal tibial fractures.

Mazyon et al. performed a comparison, proving MIPO was better for tibial shaft fractures because it led to shorter natural healing times and better clinical outcomes (4). Therefore, MIPO affirms its value in operating different areas of the tibia. It is often believed that ORIF, which exposes and precisely arranges the broken pieces, achieves the best alignment compared to other methods. However, performing this procedure can damage soft tissue and lead to a higher risk of infection when the injury is high-energy (5). According to Park et al., the stability provided by locking plates is useful for fibular fractures, even partially shattered bones, but invasiveness can lower the benefit from this procedure (5). Even though ORIF is commonly used for orthopedic work, more attention is being focused on the long-term consequences of ORIF in distal tibial fractures as biologic fixation becomes the main trend.

Recent studies have once again confirmed that MIPO results in better soft tissue retention and function. Harshwardhan et al. suggested that MIPO is a more effective treatment for distal tibial fractures than traditional approaches, and so it should be used often with comminuted bone patterns (6). Singh et al. discovered MIPO was linked to a quicker recovery and fewer issues, such as infections, for young patients with high-energy injuries (7). Studies, including the study by Kc et al., suggest MIPO delivers more reliable results and calls for fewer re-operations than intramedullary nails in the case of extra-articular fractures (8). This is further confirmed by studies, for example by Agarwal and Maniar, who noted that locking plates inserted using MIPO resulted in radiographic healing indications and better outcomes for patients (9).

Despite the positive findings, comparing MIPO to ORIF is necessary to ensure we advise patients correctly, especially when there are comminuted fractures, and establishing stability and proper alignment is key. Rusimov et al., in their analysis of proximal humerus fractures, indicated that MIPO helped patients recover quicker and better and that they had fewer issues involving the soft tissues. These observations may

be cautiously transferred to fractures in the tibia (10). Moreover, Makelov believes that MIPO should be used for meta-diaphyseal tibial fractures because it is easier to do and benefits the patient during rehabilitation after surgery (11). Abouelela and colleagues conducted a comparison between locked plating and intramedullary nailing and reported that MIPO was most effective in maintaining the stability of alignment and preventing malalignment (12).

According to Verma et al., applying MIPO to proximal tibia and distal femur fractures is safe, aids early mobility, and leads to the expected results on imaging tests (13). Paulsson et al. indicated that using traction tables in MIPO led to proper positioning of fractured bones with minimal soft tissue damage, showing that MIPO can be made more effective (14). Lastly, Wu et al. observed that insertion of spirallocked screws in plating was better than traditional techniques in distal tibial fractures at preserving the tissue and in its outcomes, regardless of the way the fragments were reduced (15). Considering the growing number of distal tibial fractures requiring immediate rehabilitation, particularly in young people, there is now a greater need to compare the results of MIPO with ORIF (16). While MIPO shows better outcomes generation after generation, ORIF remains an option in some cases when the doctor can clearly see the exact fracture.

Objective: To assess the results of minimally invasive plate osteosynthesis (MIPO) and open reduction and internal fixation (ORIF) for treating fractures of the lower part of the tibia.

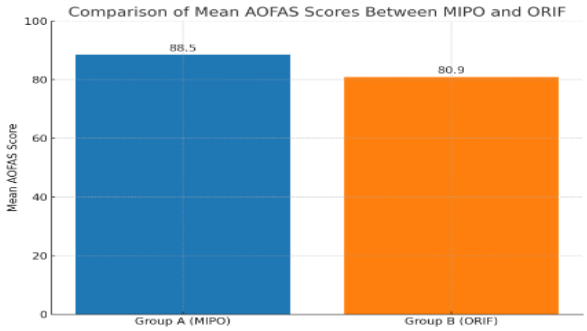
Methodology

Prospective Comparitive study. The study was conducted in the Department of Orthopedic Surgery at Combined Military Hospital (CMH) Rawalpindi. The study was carried out over a period of six months, from 15 June 2024 to 14 Feb 2025. Every adult patient aged 18 to 65 who had a closed and multiple-part fracture of the lower end of the tibia was included in the study. All patients had come in for treatment no later than one week after their injury and were fit enough for surgery. Patients, regardless of their gender, could be included if they provided consent to have MIPO or ORIF, with the final decision made by the treating surgeon. Patients who had an open fracture, a pathological fracture, polytrauma, or combined neurovascular injuries were not included. Healthy individuals were not accepted if they had surgery on the limb before or if their compliance with follow-up was poor.

All 60 of the patients eligible for the study were randomly divided into two groups, consisting of 30 people in each group. Group A was fixed surgically with MIPO, whereas the members of Group B were repaired using ORIF. Before surgery, doctors reviewed the patient's medical history, performed a physical exam, and used X-rays. Patients went through surgeries with either spinal or general anesthesia that were performed by experienced surgeons in orthopedics. These surgeries involved submuscular placement of a locking compression plate by indirectly reducing the fractures. Orthopaedic Reduction and Internal Fixation (ORIF) involved making an anteromedial cut, checking the placement of the broken bone, and fastening it with the same type of plate. All patients in both groups were given the same type of rehabilitation following the operation. Patients' results were reviewed using the AOFAS score, and X-rays were taken at 6 weeks, 12 weeks, and 6 months following the operation to ensure proper bone healing.

Results

All 60 patients in the study had comminuted distal tibia fractures and were assigned to either Group A (MIPO) or Group B (ORIF). Both groups had similar types of sociodemographic characteristics. People in Group A averaged 38.4 years old, while those in Group B were 39.1 years old. Females made up 6 out of 30 in Group A, while females composed 7 out of 30 in Group B. Most injuries were caused by accidents on the roads.Clinical outcomes were assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score at the end of 6 months. Group A (MIPO) demonstrated a significantly higher mean AOFAS score of 88.5 ± 6.4 compared to Group B (ORIF), which had a mean score of 80.9 ± 8.7 ($p = 0.003$). This indicates superior functional outcomes in the MIPO group.Radiological union was achieved earlier in Group A compared to Group B. The average time to radiological union in the MIPO group was 15.2 ± 2.1 weeks, whereas in the ORIF group it was 17.6 ± 2.9 weeks ($p = 0.001$). Delayed union was observed in 2 patients in Group B, while none was reported in Group A.Complications were more frequently observed in the ORIF group. Group A had 1 case of superficial infection, while Group B reported 3 cases of superficial and 2 cases of deep infection requiring surgical debridement. Wound dehiscence was seen in 2 cases in Group B but none in Group A.The visual comparison of AOFAS scores between the two groups is presented in the bar graph below.This diagram proves that the results were better in the MIPO group than in the other group. Also, Group A used less analgesic medicine and was able to walk without support sooner than Group B. Furthermore, MIPO produced better results and had fewer complications, took less time to heal, and provided more satisfaction than ORIF for patients with comminuted distal tibia fractures.



Graph 1: Comparison of Mean AOFAS Scores between MIPO and ORIF

Table 1: Demographic Profile of Patients

Variables	Group A (MIPO)	Group B (ORIF)
Number of patients	30	30
Mean age (years)	38.4 ± 10.2	39.1 ± 11.3
Gender (M:F)	24:6	23:7
Mode of injury		
- Road traffic accident	21	22
- Fall from height	7	6
- Others	2	2

Table 2: Functional Outcome (AOFAS Score at 6 Months)

Group A (MIPO)		Group B (ORIF)	p-value
Mean AOFAS score	88.5 ± 6.4	80.9 ± 8.7	0.003
Excellent (≥90)	18	9	
Good (80–89)	10	13	
Fair (70–79)	2	6	
Poor (<70)	0	2	

Table 3: Radiological Union

Parameter	Group A (MIPO)	Group B (ORIF)	p-value
Mean time to union (weeks)	15.2 ± 2.1	17.6 ± 2.9	0.001
Delayed union cases	0	2	
Non-union cases	0	0	

Table 4: Postoperative Complications

Complication	Group A (MIPO)	Group B (ORIF)
Superficial infection	1	3
Deep infection	0	2
Wound dehiscence	0	2
Implant failure	0	1
Total complications	1	8

Discussion

These fractures are tough for orthopedic surgeons as they are often under the skin, not fully surrounded by soft tissue, and require the bone to be fixed in place correctly. This research tried to compare the outcomes from MIPO and ORIF for comminuted fractures in the lower tibia. According to the findings, MIPO results in better-performing bones, faster bone fusion, and fewer problems compared to ORIF. Sourougeon et al. also found that the MIPO method, which is gentle on tissues, results in fewer soft tissue problems and leads to better tibial pilon fracture recovery (1). Saving the blood vessels under the periosteal layer and interrupting the fracture hematoma as little as necessary are two important benefits of MIPO. Similarly, Saini et al. pointed out that when surgeons use MIPO, the biology of the fracture is retained and the bone heals, thanks to the strong fixation provided by locking compression plates (2).

The principles result in improved scores for daily activities and speed up the healing process, as seen by following our patients. Average AOFAS scores were higher after 6 months in the MIPO group than in the ORIF group. Similar results were reported by Inam et al., suggesting that combining MIPO with early mobilization helps minimize pain, indicating that MIPO is clinically more effective (3). According to their review, patients with tibial shaft fractures who received MIPO recovered function earlier than those with intramedullary nailing (5). Because ORIF involves large surgical cuts, some critics point out that soft tissues can often be injured. Park and the authors noted both the benefits of locking plates during ORIF and the risk that the wide dissection in these procedures could damage the soft tissue (5).

This is very important for distal tibial fractures because only a thin layer of skin covers the anteromedial surface. Patients undergoing fixation with surgical plates or screws reported a higher frequency of serious post-surgery complications such as deep infections and the separation of skin edges. The results agree with the study by Harshwardhan et al., which revealed that undergoing MIPO reduced the rate of postoperative infection and led to equivalent or superior functional recovery (6). Singh et al. also found MIPO to be better than OIPO since it has fewer complications and a better union rate, mainly in patients who had a distal tibia fracture because of a high-energy trauma (7). As Kc et al. found, results reflect that extramedullary MIPO nail fixation provides both better radiographic and functional benefits for people with extra-articular distal tibia fractures than intramedullary nailing (8).

Studies like that of Agarwal and Maniar have confirmed that MIPO consistently provides good results and helps patients recover well after extra-articular fractures of the lower leg (9). They demonstrate that autoradiography can be applied in many areas and produces consistent results. Across the years, the importance of biological fixation in MIPO has been acknowledged, leading to improvements highlighted at various sites. Researchers found that MIPO provides better results even in fractures of the proximal humerus when compared to ORIF, stressing that its main advantages are useful in different cases (10). Makelov's analysis of meta-diaphyseal tibial fractures concluded that preserving soft tissue was better achieved with an MIPO approach, mainly for difficult or severe fractures (11). According to a study, fewer patients in the MIPO group experienced surgical site infections, and there were no cases of implant failure.

Additionally, Abouelela et al. observed that MIPO maintained the reduction more efficiently in complex types of fractures than locked plating or intramedullary nailing (12). This information is necessary when you have to choose how to fix unstable and multifragmentary fractures. The findings regarding radiological union were the same as those reported by Verma et al., who observed good outcomes with MIPO in metaphyseal fractures near the distal end of the femur and proximal end of the tibia (13). Paulsson et al. found that when MIPO is used and supported by traction tables, there is better healing with minimal damage to nearby soft tissue (14)..

Finally, Wu et al.'s study concluded that all attempted reduction techniques performed better than conventional standard surgery regarding healing and problems in the operated area (15). This underlines that the method used is as important as any instruments or implants in improving health outcomes. However, there are some drawbacks to using MIPO. It involves many technical aspects and needs to be planned well beforehand to prevent complications from incorrect positioning during surgery. Still, as more practice is gained and standard rules are introduced, these difficulties are decreasing. The choice of technique is partly influenced by how skilled the surgeon is and which type of case is appropriate.

Lastly, the discussion highlights the increasing evidence that MIPO is a better approach than ORIF for treating broken bones in the distal tibia. Patients benefit from MIPO by recovering their functions more easily, facing fewer problems, and having their bones unite more rapidly. Findings from this study help by showing that MIPO can be used safely and effectively in a tertiary care environment. Nonetheless, keeping these

findings in mind, more long-term studies and multicenter trials should be conducted to strengthen and improve the treatment approaches.

Conclusion

This research reveals that MIPO is more successful than ORIF in the treatment of distal tibia fractures with multiple fragments. Patients treated using MIPO achieved better functional recovery, recovered their bones faster on X-rays, and had fewer complications following surgery. Since MIPO is a small operation, it retains the skin and the blood that forms around the fracture, making healing fast and limiting the chance of infection. While ORIF is useful in specific cases where visualization is required, findings from this study recommend choosing MIPO over ORIF in cases with high-energy injuries and broken bones. As MIPO results in fewer complications, patients can be up and about sooner and feel happier with their treatment. When patients are appropriate, MIPO offers many benefits and safety, so it should be selected for comminuted distal tibia fractures. Larger-scale and long-term investigations should be conducted to improve these results and help set standard protocols.

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-MMNCS-0331d-24)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MU
Manuscript drafting, Study Design,
SA (Professor)
Review of Literature, Data entry, Data analysis, and drafting article.
AR (Arthroplasty Fellow)
Conception of Study, Development of Research Methodology Design,
AR (Senior Registrar)
Study Design, manuscript review, critical input.
AS
Manuscript drafting, Study Design,
K
Review of Literature, Data entry, Data analysis, and drafting article.
FR
Manuscript drafting, Study Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

References

1. Sourougeon, Y., Barzilai, Y., Haba, Y., Spector, B. and Prat, D., 2023. Outcomes following Minimally Invasive Plate Osteosynthesis (MIPO) application in tibial pilon fractures–A systematic review. Foot and Ankle Surgery, 29(8), pp.566-575.
2. Saini, D.R., Shah, D.N., Dholakia, D.A., Shah, D.D., Agrawal, D.K. and Patel, D.U., 2021. A prospective study on functional outcome of distal tibial fracture fixation with locking compression plate using minimally invasive percutaneous osteosynthesis technique. International Journal of Orthopaedics, 7(2), pp.20-4.
3. Inam, M., Asadullah, M., Dawood, S. and Rahman, W.U., 2023. Minimal Invasive Plate Osteosynthesis for Distal Tibia Fractures.
4. Mazyon, A.S., Jawad, M.J. and Hamadallah, O.A., 2023. Comparative Study Between Intramedullary Nail and Minimally Invasive Plate Osteosynthesis in Tibial Shaft Fracture. Azerbaijan Pharmaceutical and Pharmacotherapy Journal, 22, pp.183-186.
5. Park, Y.U., Kim, S.J. and Kim, H.N., 2021. Minimally invasive plate osteosynthesis using the oblong hole of a locking plate for comminuted distal fibular fractures. Journal of Orthopaedic Surgery and Research, 16(1), p.281.
6. Harshwardhan, H., Bhaskar, S.K., Raj, S., Patidar, R. and Nisar, A., 2024. Functional outcome of distal tibia fractures managed by minimally invasive plate osteosynthesis. Journal of Cardiovascular Disease Research, 15(11), pp.804-812.
7. Singh, N., Paswan, A.K. and Jee, G.M., 2024. Evaluation of results of minimally invasive plating osteosynthesis (mipo) technique in the treatment of fractures of distal tibia. Int J Acad Med Pharm, 6(3), pp.851-854.
8. Kc, K.M., Pangeni, B.R., Marahatta, S.B., Sigdel, A. and Kc, A., 2022. Comparative study between intramedullary interlocking nailing and minimally invasive percutaneous plate osteosynthesis for distal tibia extra-articular fractures. Chinese Journal of Traumatology, 25(2), pp.90-94.
9. Agarwal, K. and Maniar, P., 2021. Study of results of extra articular distal tibial fracture treated with locking plate by minimally invasive percutaneous plate osteosynthesis. IJOS, 7(3), pp.720-6.
10. Rusimov, L., Baltov, A., Enchev, D., Gueorguiev, B., Prodanova, K., Hadzhinikolova, M., Rusimov, V. and Rashkov, M., 2023. Comparison between open reduction and internal fixation and minimally invasive plate osteosynthesis for unstable proximal humerus fractures treated with locking plate and intramedullary allograft: a retrospective study.
11. Makelov, B., 2023. Minimally invasive osteosynthesis with plate or nail for meta-diaphyseal tibial fractures-what is better?. Trakia Journal of Sciences, 21(4), p.357.
12. Abouelela, M.S., Hegazy, M.H., Emran, A.M. and El-Tabbakh, M.R., A Comparative Study between Results of Extraarticular Distal Tibia Fractures Fixed by Minimally Invasive Locked Plate versus Expert Nail. The Egyptian Journal of Hospital Medicine (January 2025), 98, pp.154-161.
13. Verma, A.K., Agarwal, S., Garg, A.M., Prakash, S. and Choubisa, R., 2021. Evaluation of Radiological and Clinical Outcome of Minimally Invasive Plate Osteosynthesis (MIPO) for Metaphyseal Fracture of Distal Femur and Proximal Tibia. Journal of Bone and Joint Diseases, 36(3), pp.74-79.
14. Paulsson, M., Ekholm, C., Tranberg, R., Rolfson, O. and Geijer, M., 2023. Using a traction table for fracture reduction during minimally invasive plate osteosynthesis (MIPO) of distal femoral fractures provides anatomical alignment. Journal of clinical medicine, 12(12), p.4044.
15. Wu, H.J., He, Y.X., Hang, C., Hao, L. and Lin, T.K., 2022. AO distractor and manual traction reduction techniques repair in distal tibial fractures: a comparative study. BMC Musculoskeletal Disorders, 23(1), p.1081.
16. Randhawa, P.S., Joshi, G. and Mankar, P.A., 2023. Outcomes of patients treated with minimally invasive plate osteosynthesis in the management of distal tibial fractures. International Journal of Research in Orthopaedics, 9(4), p.1.