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Original Research Paper

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# AN EVALUATION OF POSTERIOR MALLEOLUS FRACTURE FIXATION WITH LOW PROFILE T -PLATE

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## ABSTRACT

**Background:** Most of the research indicates the requirement for fixation since the posterior malleolus fracture is an intra-articular fracture of the ankle joint. On the best fixation strategy, there is not any consensus in the literature. The study's goal is to evaluate the functional, radiological, and clinical results of low-profile T plate fixation of a posterior malleolus fracture. **Aim:** To evaluate the fixation of posterior malleolus fracture with low profile T plate. **Objectives:** To investigate the clinical, radiological, and functional outcomes of posterior malleolus fracture fixation with plate. **Method:** This prospective study comprised 20 patients who visited the orthopaedic department with ankle fractures involving posterior malleolus fractures. The Haraguchi classification method was used to classify the posterior malleolus fractures using computed tomography. The posterior malleolus fragment was fixed with a T plate using a posterolateral technique. The American Orthopaedic Foot and Ankle Society (AOFAS) score is used for a follow-up of 24 weeks for clinical assessment. **Results:** Most cases presented were in the age range of 31 to 51 years, and out of 20 cases, 80% were of the posterolateral type and 40% were medial extensions on CT scans. All the cases achieved union, none of the patients had intra-articular defects after fixation. At 24 weeks, the mean AOFAS score was 84.39.75. The outcomes according to the AOFAS Ankle-Hindfoot scale were excellent in 14 (70%) of the cases, good in 5 (25%) of the cases, and fair in 1 (5%) of the case based on the criteria utilised. **Conclusion:** To achieve anatomical reduction, absolute stability and rigid fixation, direct visualisation of the fracture fragment with minimal wound complications is needed. These factors all show the benefit of fixing posterior malleolus fracture with T plate using a posterolateral approach.

## KEYWORDS :

## INTRODUCTION

The posterior malleolus also known as the third malleolus, is the posterolateral protrusion of the distal tibia. The robust and compact posterior tibiofibular ligament is derived from the posterior malleolus. As with other intra articular fractures, malleolus fractures demand precise reduction and reliable internal fixation. Inaccurate reduction of malleolus fractures can cause osteoarthritis, post-traumatic painful limitation of mobility, or even both. [1] On how to effectively measure ankle stability after a fracture, there is no radiologic or clinical unanimity, nevertheless. On how to decrease and stabilise the posterior malleolus, there is no definitive guideline[2]

When the fragment size ranges from 20% to 33% of the tibial plafond, fixation of the posterior malleolar fracture is typically needed.[3] The posterior malleolar fracture can be fixed using a variety of surgical methods. One method is indirect reduction and anteroposterior (AP) screw fixation, which is the most popular fixation technique used by orthopaedic surgeons.

However, this technique does not guarantee accurate reduction, particularly given the presence of soft tissue interposition, comminution, loose fragments, and the additional difficulty of determining anatomical reduction using an image intensifier alone.[3]

Ankle fractures with involvement of the posterior malleolus have a poor prognosis. Intra-articular step-offs and fragment displacement ≥ 2 mm impacted intercalary fragments, involvement of the fibular notch and instability of the syndesmosis, represent parameters relevant for the surgical reconstruction and the functional and radio morphological outcome independent of fragment size.[4] A valid assessment of these parameters can only be achieved via computed tomography (CT) including multiplanar 2D and 3D reconstruction.

Although this is an intraarticular fracture, it is important to restore the anatomy, implant mechanical limb support, and enable the fracture to heal without complications. This encourages early joint movement and a return to function.[4] Absolute stability and anatomical reduction were possible by adopting the buttress mode of plate fixation and direct reduction of the posterior malleolus fragment.

Plate applies force to the bone perpendicular to the flat surface of the plate in order to reinforce (buttress) a weak section of cortex. In this instance, a plate was positioned across the metaphyseal region to support the distal tibia's interarticular fragment, neutralising the shear force during axial loading and preventing shortening and shearing of the intra articular fragment. By doing this, the mending process of the bone is prevented from collapsing. Pre contoured or anatomical plates may be utilised to achieve the same way of plate fixation for a better result.[5] Pre-contoured T-shape plates were utilised in this study. As a result, plate fixation can produce satisfying results for the patient and surgeon by achieving adequate anatomical alignment and stability of the ankle joint.

## AIM AND OBJECTIVES

**Aim:** To evaluate the fixation of a posterior malleolus fracture with a plate.

**Objective:** To investigate the clinical, radiological and functional outcomes of posterior malleolus fracture fixation with plate.

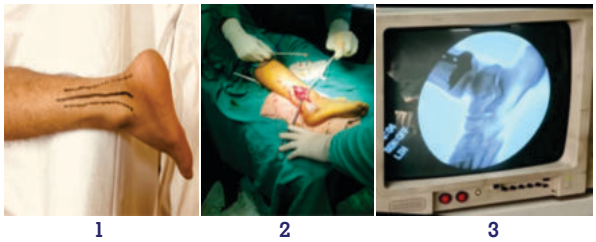
## MATERIAL AND METHODS

This prospective study was conducted at the Department of Orthopaedics, Government Medical College, Amritsar, and included 20 patients who had ankle fractures with posterior malleolus fractures. The study lasted from January 2020 to

December 2021. This study was approved by the Institutional Ethical Committee and written informed consents were obtained from patients or their guardians. The patients included in this study were Males and females belonging to >14 years age group, who have Tri malleolar fracture, Posterior fragment of tibial Pilon fracture and Isolated posterior Malleolar fracture and excluded who have very small posterior fragment. After admission and stabilisation of the patient, X-ray of the ankle with anteroposterior view, lateral view and mortise view and routine investigations were done for all the patients. After confirming the posterior malleolar fracture, CT scan of ankle fracture were done then Haraguchi classification was used for classification of fracture of posterior malleolus.

The leg was immobilised with a plaster of Paris slab below the knee, limb elevation was performed, and oral analgesics were initiated. The local skin condition was evaluated. The fracture morphology, as well as the level and extent of articular involvement, were all evaluated. After obtaining proper consent, the patient was placed in the prone position and IV antibiotics were administered. The tourniquet was then put on. After cleaning the fractured limb with betadine scrub, it was painted with betadine solution and draped. After the limb had been exsanguinated, the tourniquet was inflated.

**Surgical Approach:** The longitudinal incision was made midway between the posterior border of the lateral malleolus, and the lateral border of the Achilles tendon. Blunt dissection through fat protected the sural nerve while exposing the deep fascia of the leg, which was incised sharply. The internervous plane was formed by the lateral retraction of the peroneal tendon (superficial peroneal nerve) and the FHL (tibial nerve). Even at this level, the FHL has muscular origins from the fibula and tibia, and it was elevated and retracted medially to expose the posterior malleolus.[3] The fracture site was exposed, and the fracture was reduced with reduction forceps and secured with k wires. The reduction was checked with a C-Arm before being fixed with a T-shaped locking dynamic compression plate.



1 2 3

**1- Image of an incision line,**
**2- Image of an intraoperative T- shape plate fixation,**
**3- Image of an intraoperative plate fixation under the C- arm**

After fixing the posterior malleolus in a trimalleolar fracture, other fixations were performed.[6]First, a posterolateral approach (plane between peronei and FHL) is used, followed by posterior malleolus fixation. Second, a posterolateral approach (plane lateral to the peronei tendons) and distal fibula fixation done Third, after posterior malleolus fixation and lateral malleolus fixation, the medial malleolus fixation done. Lateral malleolus fracture fixation was accomplished with a K wire or plate, and medial malleolus fracture fixation was accomplished with TBW medial malleolus or malleolar screw fixation in the appropriate position.

The stability of the reduction was evaluated using the C-Arm after the medial malleolus was fixed. Cotton's test was performed to look for associated syndesmotic injury.[3]

Then the tourniquet was deflated. The wound was stitched in layers, after complete haemostasis was achieved. Splintage was then applied after dressing.

**Image 4:** Closure of the incision wound.

**Image 5:** Wound after stich removal

Post-operative care was provided, and the limb was elevated. After the patient had recovered from anaesthesia, x-rays were taken. The post-operative dressing was changed at the appropriate time, and the suture was removed after 12 days, depending on the wound status. The splint was removed two weeks later.

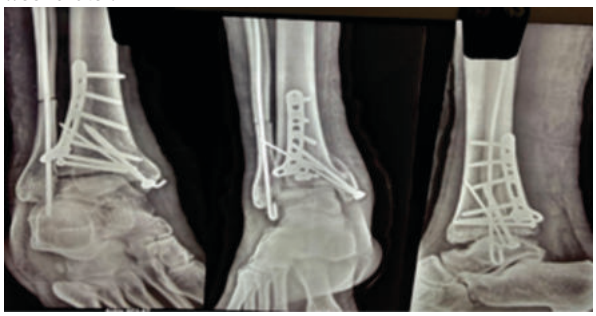


**Image 6.** A-Immediate post operative X-Ray

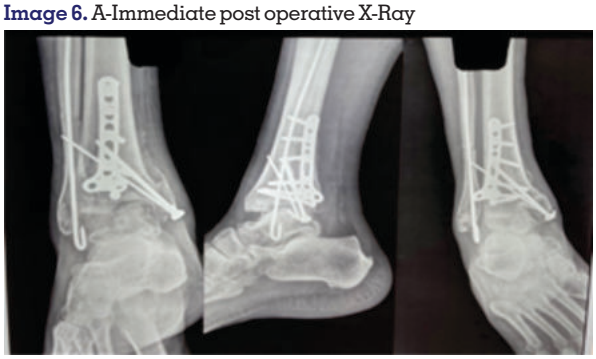


**Image 7** -X Ray at 6weeks

**Post-operative follow-up and assessment method**

All patients were followed up in the OPD at the third and sixth weeks, and then every six weeks for six months, and x-rays were taken and patients were assessed, and at 24 weeks, patients were graded based on functional score i.e., Ankle Hind Foot Scale (By American Orthopaedic Foot and Ankle Society /AOFAS) consisting of 100 points that uses three criteria for assessing ankle joint functioning. These are their names: - 40 points for pain, 50 points for function, and 10 points for alignment. Ankle-Hindfoot Scale (AOFAS):[7]

## RESULTS

Tri malleolar type fractures were present in all 20 (100%) of the selected patients. With an average age of 44.95+/-12.05 years, the patients in this study ranged in age from 20 to 70 years. 60% of patients were between the ages of 31 and 50 years. 20 patients participated in the study, with 12 (60%) female patients and 8 (40%) male patients. Most of the patients (75%) suffered fractures in traffic-related incidents, 20% of the patients had fallen down the stairs and 5% of patients developed a fracture after a fall from a height. The right lower limb was injured in 14 (70%) of the posterior malleolar fracture cases in this collection, while the left side was injured in 6 (30%) of the cases. Based on CT scans, 16 (80%) of the 20 patients according to the Haraguchi

classification had posterolateral type of posterior malleolus fractures, while 4 (20%) had medial extension fractures. 15% of patients received care within the first two days of their injuries, 70% of cases in this series received care within three to four days, 10% of cases received care within five to six days, and 5% of patients received care more than six days after their injuries. 70% of patients were released within 10 to 12 days of their stay, 10% were released after 10 days, and 20% were released after 15 days. It took 12.00±2.12 days on average for people to stay. 20 cases were examined; 14 (70%) of them had radiological union at the 12-week follow-up, while 6 (30%) of them had not. On follow-up at the 16th week, all 20 (100%) patients had unions. 20 cases were examined, 13 (65%) of those had no pain, 6 (30%) had mild (occasional) pain, 1 (5%) had moderate (daily), and none had severe pain. Upon examination of the 20 cases, wounds in 19 of them had healed without exhibiting any symptoms of a superficial or deep infection. One case (5%), which had a superficial infection, was treated with the proper antibiotics (based on the sensitivity of the culture), antiseptic dressings every other day, and the wound was cured in two to three weeks. 15 (75%) of the cases had no problems, while 3 (15%) of the cases reported ankle stiffness.

**TABLE 1: Scoring of patients according to AOFAS at 24 weeks.**

| AOFAS | No. of cases | % age |
|---|---|---|
| >80 | 14 | 70.0 |
| 60-80 | 5 | 25.0 |
| <60 | 1 | 5.0 |
| Total | 20 | 100.0 |
| Mean AOFAS | 84.3 | ±9.72 |

Of of 20 cases, 14 (70%) achieved an AOFAS score of 80 or higher at 24 weeks. At 24 weeks, the mean AOFAS score was 84.3±9.75. The outcomes were excellent in 14 (70%) cases, good in 5 (25%) cases, and fair in 1 (5%) case according to the AOFAS criteria that were applied.

**TABLE 2: Outcomes of the study according to AOFAS criteria**

| Outcomes | No. of cases | % age |
|---|---|---|
| Excellent | 14 | 70.0 |
| Good | 5 | 25.0 |
| Fair | 1 | 5.0 |
| Total | 20 | 100.0 |

Posterior malleolus injuries are the complex significant ankle injuries. They are caused indirectly by shearing and tensile forces applied through the talus. The literature on posterior malleolus fractures fixation with plate is limited. In recent years increased attention has been paid to the importance of anatomical reduction and internal fixation of the ankle fracture involving posterior malleolus. Recent advances have resulted in an evolution in the management strategies of posterior malleolus fractures, improved analysis of biomechanics, improvement in fixation techniques and analysis of results of recent studies contributed toward a better surgical outcome. The goal of treatment in these patients is to provide fracture union with a painless full motion of the ankle and with an anatomical restoration of the injured ankle.

## DISCUSSION

In cases of unstable posterior malleolus, the closed approach of treatment is frequently insufficient for restoring the anatomy and biomechanics of the ankle. In contrast, research that support ORIF for restoring the joint's native structure and stability offer greater outcomes. A high percentage of excellent and good results were reported when posterior malleolar fractures were treated with precise open reduction and stable internal fixation.[8] The effectiveness of utilising plates to treat posterior malleolar fractures was assessed in this study. The findings of the current study are contrasted with those of earlier, related investigations.

The patients in our study had a mean age of 44.9 years. In addition, our findings are consistent with studies by Firat Fidan et al[9] in 2021, SM Vehage et al[10] al where the mean age of the patients was 49 years, and Chen DW et al[43] in 2014, where the mean age of patients was 46.5 years and Karaca S et al[8] found that the mean age of patients was 55.9 years.

There were 8 men (40%) and 12 women (60%) in our study. In the studies of, Firat Fidan et al.[9] discovered a high incidence of female injuries (56%), SM Verhage et al.[10] noted a higher incidence of trimalleolar fracture in females (78%) compared to males (22%), Neumann et al.[11] noted a higher incidence in females in 2021, and Karaca S et al.[7] reported a higher incidence in females in their study from 2016 as well.

In our study, road traffic accidents account for 75% of all cases of ankle fractures, making them a common cause. One patient (5%) and four (20%) patients, respectively slip from stairs and fell from a height.

Right side (60%) was more commonly affected than left (40%) in our study. In a study conducted by Firat fidan et[56] al found 55% involvement of right side and left side 44 %. The results of our study are comparable with this study.

Axial CT scan of fractures of the posterior malleolus are categorised using the Haraguchi classification system[12]. This classification divides posterior malleolus fractures into three groups:

- Posterolateral-oblique type, Type 1 (67%)
- Medial-extension type, type 2 (19%)
- Small-shelled type, Type 3 (14%)
- In our study, the inclusion criteria comprised both type 1 and type 2 categories.

**Table 3: Haraguchi Classification Used For This Study**

| Type of posterior malleolus fracture on CT scan | No. of cases | %age |
|---|---|---|
| Posterolateral Type | 16 | 80.0 |
| Medial Extension Type | 4 | 20.0 |
| Total | 20 | 100.0 |

In line with a study by Firat Fidan et al.[9], where the incidence of type 1 injury was 69.2% and the incidence of type 2 injury was 18.5%, the most frequent form of injury in our study was type 1 (80%), followed by type 2 (20%). The findings of our investigation are consistent with the Haraguchi classification.[12]

The time between the injury and the operation is crucial and frequently affects the result. Infection rates frequently rise when surgery is postponed. So, it is ideal to operate on the patients as soon as possible.[13] In research by Karaca S et al.[8], the average time until surgery was 1.1 days, while Firat Fidan et al. operated on their patients with a mean time interval of 4.7 days as well. Our patients underwent surgery in an average of 3.45 days. We successfully stayed on schedule and within the allowable time frame. In our study, the average length of time spent in the hospital following surgery was 12.0 days. Our study's findings are consistent with those of a study by Firat Fidan et al.[9], in which the average length of postoperative hospitalisation was 7.8 days.

According to Firat Fidan, the duration of the union process has been roughly 10 weeks.[9] In our study, most patients showed union by 12 weeks, and the average patient showed union by 13 weeks, which was close to the union attained in the previous study.

**Table 4: Complications Occurred In This Study**

| Complication | No. of cases | % age |
|---|---|---|
| Nil | 15 | 75.0 |

| | | |
|---|---|---|
| Stiffness | 3 | 15.0 |
| Superficial infection | 2 | 10.0 |
| Total | 20 | 100.0 |

In our study, 18 (90%) of the wounds healed with the primary intention, with no signs of a deep or superficial infection. Using the proper medicines (subject to culture sensitivity) and antiseptic dressings every other day, the wound healed in 2 (10%) cases of superficial infection within 2-3 weeks. Firat Fidan et al. in his study of 30 patients, noted a superficial infection in 2 (3.1%) of the patients. 15 cases (about 75%) had no symptoms, while 3 (15%) individuals exhibited ankle stiffness[9]. All these cases of stiffness were of medial extension type of posterior malleolus on the basis of Haraguchi classification. In 2020 Camilo Miranda De Pinho Tavares et al[13] experienced 44.2% cases had skin complications that caused delayed healing. The majority of the issues were minor and were fixed in the next one to two months. In our investigation, which was comparable to the study by Firat Fidan et al.[9], we saw no cases of non-union, delayed union, or deep vein thrombosis (DVT).

### Outcomes

For clinical evaluation postoperatively, the American Orthopaedic Foot and Ankle Society (AOFAS) scoring system[7] was employed, and the mean AOFAS score of our study was 84.39.72 at follow-up of 6 months. According to the established criteria of the AOFAS score represented outcomes that were excellent in 14 cases (or 70%), good in 4 cases (or 25%), and fair in 1 case (or 5%). The AOFAS score in the study by Firat Fidan et al.[9] was 91.6, which is higher than the AOFAS score in our study because we only followed up on the cases for 6 months while Firat Fidan et al. followed up on the cases for 12 months.

In the study from 2014, Chen DW et al. revealed that the mean AOFAS score was 87.8 (Good) at a mean follow-up of 36.2 months. Zheng Wang et al.15 reported in 2020 that the mean AOFAS score of the study's patients was 90.8 at the mean follow-up of 18.9 months. The mean AOFAS score was 96 after a mean follow-up of 7.9 years, according to Weigelt L, Hasler J et al[16] in 2020. While the previously mentioned studies followed up on the cases for longer periods of time, and over the time, there is a chance that this score reflects improvement.

Limitations of the study include its small cohort size (only 20 patients), brief follow-up time, and CT scan-based design, which is more expensive.

## CONCLUSION

In all intra articular fractures, anatomical reduction is crucial, but it is even more crucial if a weight-bearing joint, such the ankle, is involved. In addition to preventing the possibility of reduction loss, open reduction and internal fixation ensure high standards of reduction with low profile T plate which provide us joint stability, better mechanics of ankle joint, early mobilization, and decreased joint stiffness because of smoothened surface of low-profile T-plate and minimal irritation to surrounding tissue. However, there was stiffness in the medial extension type of posterior malleolus fracture. Thus, in more than 95% of patients, the surgical outcomes were more than satisfactory.

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