National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2022; 6(1): 26-30
Received: 16-11-2021
Accepted: 20-12-2021

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Posterior malleolus fractures and their role in prognosis of malleolar fractures

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DOI: https://doi.org/10.33545/orthor.2022.v6.i1a.345

Abstract
Introduction: The treatment of ankle fractures with involvement of the posterior tibial margin remains a subject of debate. We have evaluated the clinical, radiological, and functional outcome of such fractures in 25 patients, all of which were managed surgically over an average follow- up period of 6 months. The treatment options available for malleolar fractures, to attain a proper anatomical alignment and stability of ankle joint, can lead to rewarding outcome for the patient.
Materials and Methods: 25 patients with posterior malleolus fractures were managed surgically between June 2019 to November2021 were included in this series. The mean age, gender ratio, mode of trauma, fracture union time, and complications were noted. The AOFAS Hindfoot scores were used for assessing the Ankle function.
Results: Of the 25 patients in the study, 21 were males and 4 were females. The mean age was 38.12 years. The mean fracture union (radiological) time was 14.04 weeks (range: 10–18 weeks). However Ankle function was excellent in 17 cases (68%) on the AOFAS hindfoot score with a average AOFAS score of 94.8. Also platting gives a better result than using cannulated cancellous screws. Better syndesmotic stability is observed after surgically treating posterior malleolus fractures.
Conclusion: Fixation of the posterior malleolus to reduce persistent fragment displacement, regardless of size, as well as to restore syndesmotic stability, may lead to improved outcomes. We conclude that posterior malleolar fractures encountered in clinical practice need thorough assessment and meticulous surgical intervention. We achieved stable fixation and performed early mobilization of the ankle joint, which limits the complications of mainly ankle stiffness and have achieved excellent clinical and functional outcomes of surgically fixing the posterior malleolus fractures.

Keywords: Posterior malleolus fracture

Introduction
The fragment of the posterior rim of the tibia was dealt with in great detail, including radiology, by Étienne Destot who as the first used the term “malléole postérieure” (posterior malleolus) in his book of 1911. Destot correlated radiographic finding with anatomical experiments providing basis for determining the mechanism of injury for appearance in X-ray. Destot coined the term third malleolus to the posterior fragment [1]. Shelton mar VIN L said “Ankle is the most injured joint of the body but the least well treated [2] Lauge Hansen [3, 4] made important contribution to the treatment of ankle injuries. He produced these fractures experimentally and termed it as genetic classification.
The treatment of ankle fractures with involvement of the posterior tibial margin remains a subject of debate. It does seem clear that fractures of the lateral and medial malleolus have a significantly worse prognosis in functional outcome when they include a posterior tibial fragment. A large posterior fragment may give more incongruity and more cartilaginous damage, leading to a chronically subluxated talus and thus posttraumatic arthritis. Eventually, this causes restrictions in ankle function and pain. When a posterior fragment is present, surgical technique fails more often in the anatomic reduction of the joint. Because of the important biomechanical function of the posterior tibial margin in weight bearing and ankle stability, the affected ankle is prone to a worse functional outcome. Despite its significant role in functional outcome, relatively little attention has been paid to the treatment of the posterior tibial fragment.

The purpose of this study is to assess the functional outcome and results of surgical treatment of posterior malleolar fractures. The treatment options available for malleolar fractures, to attain a proper anatomical alignment and stability of ankle joint, can lead to rewarding outcome for the patient and surgeon.

Materials and Methods

Twenty patients with fresh posterior malleolus fractures who attended Tertiary care Hospital, SURAT, between June 2019-June 2021 were studied.

Type of study: Prospective observational study

Duration of study: 15 to 18 months

Source of Data

The study was conducted on patients who have undergone surgical fixation in posterior malleolus fracture during June 2019-June 2021 in skeletally matured patients in Department of Orthopedics at Surat Municipal Institute of Medical Education and Research, Surat.

Patients were followed up at 6, 12, 24 weeks to know the clinical and functional status of the patients.

Sample size: 25

The purpose of this study is to assess the functional outcome and results of surgical treatment of posterior malleolar fractures. The treatment options available for malleolar fractures, to attain a proper anatomical alignment and stability of ankle joint, can lead to rewarding outcome for the patient and surgeon.

Inclusion Criteria

- Patients with age between 18 and 60 years of age
- Recent history of trauma
- Patients willing to undergo surgery and giving written informed consents.

Exclusion Criteria

- Patients with age less than 18 years or more than 60 years
- Neglected posterior malleolus fracture
- Patient not willing to undergo surgery
- Pathological fractures

Out of the total 25 cases, majority of the patients (76%) were within the age group of 30-50 years of age while only 8% were in the age group of 51-60 years. Amongst the 25 cases, number of males (21) were more than the number of females (4). All surgeries were done at the same institute. Institutional Ethical Committee approved the study.

As soon as the patients were brought to the casualty a complete survey was carried out to rule out significant injuries. Then the patients' radiographs were taken, anteroposterior, lateral and mortise views of the ankle joints. CT scan was taken in indicated cases. On admission to the ward detailed history was taken relating to the age, sex, occupation, address, mode of injury past and associated medical illness. Patients general condition was assessed and then they were put through a thorough clinical examination. A careful examination was needed to determine the status of the skin, soft tissues, and neurovascular structures, as well as the bones and ligaments. The entire lower leg, including the fibula, should be examined. Combinations of tenderness, swelling, or ecchymosis over the bone, ligaments, or joint line suggest an injury. The stability of the joint should be assessed, especially when these findings are associated with normal x-rays. Based on the physical findings, an anterior drawer, inversion, eversion, or external rotation stress test may be helpful.

On inspection, relation of ankle to foot either normal, equinus, calcaneus – valgus or varus, Inter relation of malleoli and fossa in the front of malleoli, prominence of tendo achilles, fossa on both sides of tendo achilles. Pattern, position and size of heel for broadening was examined.

On palpation, all bones forming the ankle i.e., lower end of tibia fibula including both malleoli, calcaneus and talus are looked for, local bony tenderness and bony irregularities, displacement, unnatural mobility crepitus, inter relation of malleoli, springing of fibula dorsalis pedis and posterior tibial artery pulsations were checked and noted. Active and passive movements of ankle joint are noted Analgesics were given and patients were put on a below knee posterior POP slab to alleviate pain. Also antibiotics and tetanus toxoid and tetanus immunoglobulins were given as needed.

Although injury to neurovascular structures was uncommon in an ankle injury, massive swelling, particularly when associated with a crush or penetrating injury, ankle dislocation, or fracture or fractures of the tibia or foot, may compromise blood flow and result in ischemia; and compartment pressure measurements, Doppler imaging, and transcutaneous measurement of PO2 can be used along with clinical judgment to assess the vascular status and determine if decompression or other intervention was indicated.

The standard radiographic evaluation of the ankle includes, anteroposterior, lateral and mortise views were taken.

CT scan was done to exclude the intraarticular fractures of distal tibia and to plan for posterior malleoli fixation.

Surgical Technique [5]

Under appropriate anesthesia the patient was put in prone position on table. Pneumatic tourniquet was applied to the proximal thigh after noting the time. The affected limb was draped from the knee joint to the nail tip and then painted betadine solution the foot was covered with a glove.

Timing of surgery lasted around 1 to 1 ½ hours, open reduction and internal fixation of the malleolar fractures were performed or plating with screws.

Prone Position

Superficial Dissection

Nerve Isolation

Plate Placement

Reduction was usually affected by pulling the foot forward and then maximally dorsiflexing the ankle as well as dorsiflexing the

big toe at the metatarsophalangeal joint. This maneuver aids in reduction of the fragment by tensing the posterior capsule of the ankle and the flexor hallucis longus tendon.

An open reduction was carried out, through an extended regular lateral or a posteriorly placed lateral incision or through a regular posterolateral approach. The posterior aspect of the tibia and the fractured fragment was exposed by enlarging the interval between the peroneal tendons and the flexor hallucis longus muscle.

Reduction was affected with a small periosteal elevator. It was inserted into the fracture site while the foot was held in plantar flexion to ease the tension on the posterior capsule. The fragment was gently eased inferiorly by the elevator at the same time that it was pushed anteriorly with the thumb. The reduced fragment was held with two Kirschner wires, and an intra operative lateral view of the ankle was obtained. After confirmation of the reduction, the fragment was fixed with screws and plates. In 4 cases we have fixed posterior malleoli with one 4 mm cancellous screw.

Follow Up

Elevation of the affected limb was done. x- rays anteroposterior, lateral and mortise views were taken. Wounds were inspected on 3rd day. Sutures were removed on 15th post operative day on an average. Below knee pop cast was given and discharged with instruction of non-weight bearing crutch walk for a period of 6 weeks and to come for follow-up after 3 weeks and the patient were followed up by the same operating surgeon

Weight bearing was restricted for 6 weeks. If the bone condition and other factors prevented secure fixation, the fracture was protected and longer. At 4 weeks the POP was removed. Clinical examination was done regarding tenderness and movement of ankle. At 6 weeks x- ray of the ankle was taken both AP and lateral views and looked for signs of fracture union and then were advised partial weight bearing for further period of 6 weeks with elastocrepe bandage and elevation of the limb at night times and active movements of ankle joints. After radiological signs of healing, a rehabilitation program was started. The aim was to gain full mobility, muscular strengthening and proprioception as soon as possible. The total rehabilitation period depends on the individual patient's progression. The final goal is to restore ache free functional to full range of motion and strength. The union time and complications were noted. Patients were allowed full weight bearing on the affected limb. Regular follow up was done at 6, 12 and 24 weeks after discharge till the fracture united.

Functional and radiological results were analyzed using the AOFAS Hindfoot scoring system. The evaluation was based on physical and radiological examination. Physical examination included the measurement of active dorsiflexion and plantar flexion of injured ankle compared with the uninjured ankle, with forepart of foot in neutral position.

Final scores were based on the combined point scores from seven categories of subjective objective and radiographic evaluation. Results were designated as excellent good fair and poor. A score of 96- 100 points was considered excellent; 91 to 95 good; 81- 90 points fair and zero to 80 points.

Results

Out of the total 25 cases, majority of the patients (76%) were within the age group of 30-50 years of age while only 8% were in the age group of 51-60 years. Amongst the 25 cases, number of males (21) were more than the number of females(4)., Road Traffic accidents were the most common cause of posterior malleolus fractures with a peak incidence in third decade of life. The right side was observed to be more frequently involved in posterior malleolus fractures as compared to the left side. Average time from injury was 5 days. Most patients (80%) were operated within the first week of trauma. Delay in the surgery in other patients occurred due to various factors like associated head or chest injury, local site edema or other medical conditions. 1 patient was operated 2 weeks from the time of injury due to poor local condition and other patient had delay due to head and chest injury. Posterior malleolus fractures were most commonly associated with Supination-External rotation type (68%) followed by Pronation- External Rotation type (24%) and less often associated with SE3 and PA3 type of injuries. Posterior malleolus were most commonly fixed with posterolateral approach and plates were used for osteosynthesis. 4 cases were fixed with percutaneous aaproach with a cannulated cancellous screws. Almost 52 percent of cases were radiologically united, within 11 to 13 weeks and majority of the rest of the cases united within 14 to 16 weeks and others showed signs of union till 18 weeks. All 25 cases were united by 18 weeks. It was observed that majority of patients (80%) who were operated had no difficulty in returning to daily activity while other 20% had mild to moderate difficulty in returning to daily activity.

However, there were no patients with severe difficulty in returning to daily activity at the end of 6 months of follow up.

92% of the patients who were operated had no pain at 6 months while only 1 patient had mild and 1 patient had moderate pain at 6 months.

However, there were no patients with severe pain at the end of 6 months of follow up.

Results were evaluated using AOFAS Hindfoot score at 6 months follow up in which it was observed that majority of the patients (92%) had a good to excellent score while only 8% had an adequate to poor score.

There was 1 patient with implant loosening, 1 patients with infection, 1 patient with hardware prominence. 17 out of 20 patients had no associated complications.


Pre-operative Radiographs


Immediate post operative 6 Month follow up


Dorsiflexion Planter flexion

Discussion

The aim of our study was to assess and present the injury characteristics and the clinical and functional outcome of results of surgical treatment of posterior malleolus fractures and compare with published studies and to know the complications of internal fixation in posterior malleolus fractures.

So far, only few studies on the surgical treatment of Posterior malleolus fractures have assessed outcomes with general health questionnaires.

Optimal treatment of trimalleolar fractures, especially treatment of the posterior malleolus in trimalleolar fractures remains a matter of debate amongst orthopaedic trauma surgeons. For a long period, the size of the posterior fragment was the decisive factor for reduction and fixation of the fragment. Traditionally, this is done for fragments larger than one quarter or one-third of the articular surface via ligamentotaxis followed by percutaneous anterior-to-posterior screw placement. In clinical practice, however, it is difficult to estimate the size of the posterior fragment on lateral photographs and even on 2D CT-scans.

The goals of treatment are to restore joint congruity, limb alignment, and early mobilization of joints.

Aim of our study is assess functional outcome in operatively treated posterior malleolus fractures in 25 cases. The analysis of the results was made in terms of age of the patient, sex distribution, lifestyle, mode of injury, analysis of type, modalities of treatment, complications & functional outcome at 6,12,24 weeks.

In our study, 21 male and 4 female in total study of 25 patients. These outnumbering of male patients over female is explained by the more active lifestyle and mobility of males and hence more chances of road traffic accidents.

This is in accordance with the series of 16 patients reported by Wang *et al*., [6] in which 12 were male and 4 female.

But in the study of Verhage *et al*. [7] there were 67 males and 102 females among 169 patients and in study of Tucek *et al*. [8] there was only 1 male in a study of 19 patients.

Table 1: Comparison of sex of patients

study	Total no. of patients	NO. of males	No. of females
Verhage et al	169	67	102
Tucek et al	19	1	18
Wang et al	16	12	4
our study	25	21	4

Posterior malleolus fractures are more seen in young age group due to involvement of high energy trauma. It is extremely important to do a stable fixation and in order to regain the complete range of motion.

Table 2: Comparison of age of patients

study	Total no. of patients	MEAN AGE
Verhage et al	169	52
Tucek et al	19	58
Wang et al	16	49.2
our study	25	38.12

The majority of fractures occurred between the age of 21 to 50 years accounting for 92% (23 patients) of the 25 patients. Our study population was quiet young when compared to other studies and had a mean age of just 38.12 at the time of trauma.

It was observed that maximum patients (75%) in the age group of 21-30 years had an excellent functional outcome at 6 months follow up whereas all the patients with poor functional outcome at 6 months were more than 60 years old. It was also observed that with increasing age, the AOFAS HINDFOOT score at 6 months follow up reduced.

As observed from the distribution, Road Traffic accidents were the most common cause of posterior malleolus fractures with a peak incidence in third decade of life.

It was observed that the mode of injury in most of the patients (88.88%) with an excellent to good functional outcome was road traffic accidents whereas all of the patients (100%) had a excellent functional outcome who suffered a domestic fall where as there were poor results observed with patients with fall from height which has also been proved statistically by the one way ANOVA test with a p value of 0.0091 which is less than 0.05.

There was almost equal distribution of patients with posterior malleolus fractures involved in moderate(household) and strenuous(laborer) activities. People with a sedentary lifestyle had comparatively lower incidence of posterior malleolus fractures.

Occupationally posterior malleolus fractures were seen in people with high level of activity, movement and travel. It is most commonly seen with people who travel more.

In our study mean time of union is 14.04 weeks, Wang *et al*. had mean time of 13.1 weeks in their study. It was observed that all patients(83%) in whom fracture union occurred between 11 to 13 weeks had a good to excellent functional outcome compared to the patients with union occurring after 16 weeks, who had a poor to fair functional outcome at 6 months follow up. Hence it can be concluded that a shorter duration required for union was associated with an improved functional outcome which is also statistically significant as the p value of one way ANOVA score is less than 0.05

It was observed that most of the patients (95%) with an excellent to good functional outcome had an injury-surgery interval of less than 1 week whereas most of the patients with poor functional outcome had an injury-surgery interval of more than 2 weeks.

Hence it can be concluded that longer the injury-surgery interval, the functional outcome at the end of 6 months was poorer.

It was observed that the type of operation (plating) in most of the patients (95.23%) with an excellent to good functional outcome where patients operated with cc screw (50%) has excellent functional outcome.

In our study we use modified AOFAS score for functional outcome.

Table 3: AOFAS score

study	Total no. of patients	AOFAS score
Verhage et al	169	93
Tucek et al	19	89.4
Wang et al	16	85.6
our study	25	94.8

Take home messages

Great variability in management of posterior malleolar fractures within the orthopedic community is evident, not only regarding the decision to address the fracture surgically, but also in approach and fixation technique. With increased utilization of CT scans, the true size of the fragment and the presence of articular impaction with associated intra-articular fragments have become more evident, which can aid in the decision-

making process. In particular, fixation of the posterior malleolus to reduce persistent fragment displacement, regardless of size, as well as to restore syndesmotic stability, may lead to improved outcomes. We conclude that posterior malleolar fractures encountered in clinical practice need thorough assessment and meticulous surgical intervention. Abduction and external rotation types of injuries are the most common types to be seen. We achieved stable fixation and performed early mobilization of the ankle joint, which limits the complications of mainly ankle stiffness and have achieved excellent clinical and functional outcomes of surgically fixing the posterior malleolus fractures.

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