

Isolated Posterior Tibial Margin Fracture Beyond Military Parachuting: A Case Report and Narrative Literature Review

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Abstract

Background: Isolated posterior tibial margin fractures are exceptionally rare injuries, historically described among military parachutists. However, recent reports suggest a changing epidemiological profile, with an increasing number of cases occurring in civilian populations. This report describes a new civilian case and reviews the current literature to highlight recent epidemiological, diagnostic, and therapeutic developments.

Case Presentation: A 32-year-old woman sustained an isolated posterior tibial margin fracture following a fall while descending stairs. Standard radiographs suggested the diagnosis, which was confirmed by computed tomography (CT). CT demonstrated fragment displacement, comminution, and involvement of approximately 25% of the tibial articular surface. The patient underwent percutaneous reduction and screw fixation through a posteromedial approach. At two months, fracture union was achieved, with complete recovery of ankle motion and no residual pain.

Literature Review: A narrative review of the literature was conducted using PubMed/MEDLINE to identify publications on isolated posterior tibial margin fractures. Recent evidence indicates that although the injury mechanism remains unchanged, the epidemiological profile has evolved from predominantly military parachutists to civilian patients. CT has become the imaging modality of choice for confirming the diagnosis and guiding treatment decisions. Surgical fixation is generally recommended for displaced fractures involving a substantial portion of the articular surface.

Conclusion: Isolated posterior tibial margin fractures should no longer be regarded as injuries exclusive to military parachutists. Early recognition and systematic CT evaluation are essential to avoid missed diagnoses and to optimize treatment. Appropriate management based on CT findings is associated with excellent functional outcomes.

Keywords: Posterior tibial margin; Posterior malleolus; Isolated fracture; Computed tomography; Case report; Narrative review

Introduction

Ankle fractures are among the most common injuries encountered in orthopedic trauma practice and account for a substantial proportion of lower-limb fractures [1-5].

Their anatomical complexity results in a wide spectrum of fracture patterns involving the malleoli and the ligamentous stabilizers of the ankle joint. While fractures of the lateral malleolus are the most frequent, posterior tibial margin fractures are usually associated with bi- or trimalleolar ankle fractures, particularly following high-energy trauma or in elderly patients [5-7].

In contrast, isolated fractures of the posterior tibial margin are exceptionally rare, accounting for less than 1% of ankle fractures [11-13]. First described by Tobin in 1943, these injuries were historically considered almost exclusive to military parachutists and became known as "paratrooper fractures" [8,14-18].

Over the last two decades, however, the epidemiology of this injury has evolved considerably. Improvements in military parachuting techniques have reduced its occurrence among soldiers, whereas an increasing number of cases have been reported in civilian patients following falls, sports-related injuries, and road traffic accidents [13,18,19,23,26]. Despite this epidemiological transition, diagnosis remains difficult because clinical findings are often nonspecific and conventional radiographs may fail to identify the fracture [14,20-26].

Computed tomography (CT) has therefore become the imaging modality of choice for confirming the diagnosis, accurately assessing fracture morphology, and guiding therapeutic management [13,26-28].

The aim of this report is to describe an unusual case of isolated posterior tibial margin fracture occurring in a civilian patient and to compare its clinical, radiological, and therapeutic characteristics with those reported in the literature. Through this comparison, we highlight the current epidemiological profile, diagnostic challenges, and management principles of this uncommon injury.

Case Report

A 32-year-old woman with no significant past medical history, employed as an administrative assistant in a commercial company, presented to our emergency department after sustaining a right ankle injury following a fall while descending stairs at her workplace. Although the exact mechanism of injury could not be clearly established, the accident was consistent with an axial loading force applied to the ankle.

On physical examination, the right ankle was swollen and tender, particularly over the posterior aspect of the joint. Active and passive ankle movements were painful and limited by pain. No skin lesions, deformity, or neurovascular deficits were observed. The remainder of the musculoskeletal examination was unremarkable.

Standard anteroposterior and lateral radiographs of the ankle were obtained. The anteroposterior view was unremarkable, whereas the lateral view demonstrated an isolated displaced fracture of the posterior tibial margin (Figure 1).



Figure 1: Anteroposterior and lateral views of the ankle showing the lesion visible on the lateral view.

To further characterize the injury, computed tomography (CT) of the ankle was performed. CT confirmed the diagnosis and provided a more accurate assessment of fracture morphology. It demonstrated displacement of the posterior fragment, articular involvement of approximately 25% of the distal tibial surface, and mild comminution without incarcerated intra-articular fragments (Figure 2).

Magnetic resonance imaging (MRI) was not performed because CT clearly established the diagnosis and revealed no associated osseous injuries. Clinical examination and imaging showed no evidence of gross ankle instability or syndesmotic diastasis, and MRI findings were not expected to modify the surgical management.

These findings supported the decision to proceed with surgical treatment.



Figure 2: Computed tomography showing the displacement, the articular involvement, and the size of the fragment.

Surgery was performed under regional anesthesia with fluoroscopic guidance. The patient was positioned supine with the affected knee flexed approximately 60° over a padded support, allowing unrestricted ankle motion. Reduction was achieved by placing the ankle in dorsiflexion, thereby restoring the anatomical position of the posterior fragment. Temporary stabilization was obtained using a Kirschner wire inserted from posterior to anterior. Definitive fixation was then achieved with a partially threaded cancellous screw introduced through a minimally invasive posteromedial approach under fluoroscopic control.

Postoperatively, the ankle was immobilized in a short below-knee plaster splint for three weeks to protect the fixation, reduce postoperative pain and swelling, and allow soft-tissue recovery during the early healing phase. Because stable fixation had been achieved, progressive rehabilitation was initiated thereafter to minimize ankle stiffness.

At the two-month follow-up, radiographs confirmed complete fracture union (Figure 3). The patient had regained full ankle range of motion without pain or instability and had returned to her usual daily activities without functional limitation.



Figure 3: Fracture consolidation at day 60.

Discussion

The posterior tibial margin, formerly referred to as the posterior malleolus, constitutes the posterior lip of the distal tibial articular surface and plays a crucial role in maintaining ankle stability through its articulation with the talus and the insertion of the posterior inferior tibiofibular ligament. Biomechanical studies have demonstrated that this ligament contributes approximately 42% of syndesmotic stability, emphasizing the functional importance of preserving the integrity of the posterior tibial margin during fracture management [9,10,28].

Epidemiological Evolution

Isolated fractures of the posterior tibial margin remain exceptionally rare, accounting for less than 1% of all ankle fractures [11-13]. Historically, these fractures were almost exclusively described in military parachutists. Tobin first reported this injury in 1943 and introduced the term paratrooper fracture, attributing the lesion to parachute landings performed with the ankle in plantar flexion, which generated axial compression of the talus against the posterior tibial margin [8]. Subsequent military studies confirmed this mechanism and reinforced the belief that this fracture was almost specific to parachuting activities [14-18].

However, the epidemiology of this injury has evolved considerably over recent decades. Improvements in parachute equipment and landing techniques have markedly reduced its incidence among military personnel [17,18].

Conversely, recent reports have documented an increasing number of isolated posterior tibial margin fractures in civilian patients following falls, sports-related injuries, and road traffic accidents [13,19,23,26]. Our patient, a 32-year-old civilian woman injured while descending stairs, is fully consistent with this changing epidemiological profile and supports the observations reported in recent literature.

Mechanism of Injury

Although the epidemiological profile has changed, the biomechanical mechanism responsible for the fracture appears to have remained essentially unchanged. Most authors agree that the lesion results from axial loading of the talus against the posterior tibial margin while the ankle is maintained in plantar flexion [8,13,16]. In military parachutists, this mechanism occurred during landing after a jump. In civilian trauma, similar forces may be generated during falls from stairs, sports accidents or road traffic collisions. Although the exact position of the foot at the time of injury could not be established in our patient, the clinical circumstances strongly suggest the same injury mechanism.

Diagnostic Considerations

The diagnosis of isolated posterior tibial margin fractures remains challenging because both the clinical presentation and conventional radiographic findings may be misleading. Patients usually present with pain, swelling and limited ankle motion, clinical features that are indistinguishable from ankle sprains or more common malleolar fractures [14,19-23].

Standard radiographs are frequently inconclusive because superimposition of the distal tibia and fibula on the lateral projection may obscure the posterior fragment [20-25]. Several authors have recommended careful palpation of the posteromedial aspect of the ankle together with an externally rotated lateral radiographic view to improve diagnostic accuracy [11,24,25].

Computed tomography (CT) has therefore become the reference imaging modality for this injury. Besides confirming the diagnosis, CT accurately evaluates fragment size, displacement, articular involvement and comminution, all of which are essential for treatment planning [13,26-28].

In the present case, the fracture was visible on the initial lateral radiograph because of fragment displacement. Nevertheless, CT proved indispensable by demonstrating approximately 25% articular involvement associated with mild comminution, findings that directly influenced our therapeutic decision.

Therapeutic Considerations

The management of isolated posterior tibial margin fractures should primarily be based on CT findings rather than on conventional radiographs alone [13,26-28]. Conservative treatment is generally indicated for nondisplaced or minimally displaced fractures without significant articular involvement [13]. Conversely, surgical fixation is recommended in the presence of fragment displacement, involvement of approximately one quarter or more of the tibial plafond, persistent ankle instability, or incarcerated intra-articular fragments [19,23,27,28].

In our patient, CT demonstrated displacement, comminution and involvement of approximately 25% of the articular surface. These findings justified operative treatment. Percutaneous reduction followed by posterior-to-anterior screw fixation restored anatomical congruity while minimizing soft-tissue dissection. At two months, complete fracture union had been achieved with full recovery of ankle motion and no residual pain, consistent with the favourable outcomes reported after appropriate surgical management [19,23,26].

Although posterior buttress plating is increasingly advocated for large or markedly comminuted posterior tibial margin fracture because of its biomechanical advantages, screw fixation remains an appropriate option in selected cases.

In our patient, the fragment involved approximately 25% of the articular surface, comminution was limited, and anatomical reduction with stable fixation was achieved using a minimally invasive posterior-to-anterior screw. This approach provided satisfactory stability while limiting soft-tissue dissection, and resulted in complete fracture union with excellent functional recovery.

Comparison with Previously Reported Cases

Comparison of the present case with previously published reports reveals both similarities and distinctive features. Similar to earlier studies, our patient presented with an isolated posterior tibial margin fracture caused by an axial loading mechanism, CT played a decisive role in diagnosis and treatment planning, and surgical fixation resulted in an excellent functional outcome [13,19,23,26]. However, unlike the historical military series described by Tobin and subsequent military authors [8,14-18], the present case occurred in a civilian woman following a domestic fall. This observation further supports the progressive epidemiological transition highlighted by recent systematic reviews [13] and emphasizes that this fracture should no longer be regarded as an injury confined to military parachuting.

Clinical Implications

This case carries several important clinical messages. First, isolated posterior tibial margin fractures should be considered in any patient presenting with persistent posterior ankle pain after axial loading trauma, regardless of military history. Second, CT should be performed whenever clinical suspicion persists despite inconclusive radiographs because it provides accurate assessment of fracture morphology and guides therapeutic decision-making [13,26-28]. Finally, treatment tailored to CT findings allows anatomical restoration of the articular surface and is associated with excellent functional outcomes [19,23,27,28].

Conclusions

Isolated posterior tibial margin fractures, once considered almost exclusive to military parachuting injuries, should now be recognized as part of the broader spectrum of ankle trauma encountered in civilian practice. The present case illustrates this evolving epidemiological pattern and highlights that low-energy mechanisms, such as simple falls, may also result in this specific injury.

Clinical diagnosis remains challenging due to nonspecific symptoms and the limited sensitivity of standard radiographs. As demonstrated in this case, computed tomography plays a central role in confirming the diagnosis, accurately characterizing fracture morphology, and guiding therapeutic decision-making.

Management should be individualized and primarily based on CT findings, particularly fragment displacement and the percentage of articular surface involvement. When surgical indications are met, minimally invasive fixation techniques allow anatomical reduction, stable fixation, and favorable functional outcomes.

Early recognition of this injury pattern, combined with appropriate imaging and timely management, is essential to prevent missed diagnoses and optimize long-term ankle function.

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