Volkmann and Tillaux Fracture in Adults. Unusual Bimalleolar Equivalent. A Case Report

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ABSTRACT
Fractures of the distal anterolateral malleolus of the tibia, or Tillaux-Chaput fractures, are frequently seen in skeletally immature patients and rarely in adults. The posterior distal ridge of the tibia or Volkmann's fragment may be presented as an isolated fracture, but most often forming part of ankle fracture-dislocation trimalleolar, quadrimalleolar, as well as in Maisonneuve-type injuries. However, the synchronous presence of Volkmann-Tillaux fractures is very unusual and rarely reported in the literature. We present a case of bimalleolar equivalent fracture in an adult, along with its diagnosis, classification, management and clinical-radiological evolution.
Keywords: Tillaux; Chaput; malleolar equivalent; Volkmann; bimaleolar; case report.
Level of Evidence: IV

Fractura de Volkmann y Tillaux en adultos. Equivalente bimaleolar inusual. Reporte de un caso

RESUMEN
Las fracturas del maléolo anterolateral distal de la tibia o de Tillaux-Chaput son frecuentes en los pacientes esqueléticamente inmaduros y son raras en los adultos. El reborde distal posterior de la tibia o fragmento de Volkmann puede presentarse como una fractura aislada, pero, con más frecuencia, como parte de una luxofractura trimaleolar, cuadrimaleolar, así como en lesiones de tipo Maisonneuve. Sin embargo, la presencia sincrónica de fracturas de Volkmann-Tillaux es muy inusual y pocas veces publicada. Presentamos un caso de fractura equivalente bimaleolar en un adulto, su diagnóstico, la clasificación, el manejo y la evolución clínico-radiológica.
Palabras clave: Tillaux; Chaput; equivalente maleolar; Volkmann; bimaleolar; reporte de caso.
Nivel de Evidencia: IV

INTRODUCTION

The distal tibiofibular joint is a syndesmosis, or fibrous joint, composed of two bones and four ligaments. The bony components are the distal tibia and fibula, while the ligamentous structures include the anteroinferior tibiofibular ligament, interosseous ligament, posteroinferior tibiofibular ligament, and transverse ligament.[1] At the apex of this syndesmosis, the tibial crest divides into an anterior margin that ends at the distal anterolateral portion of the tibial plafond, known as Tillaux-Chaput's tubercle, while the posterior ridge ends at the distal posterolateral tibial margin, called Volkmann's tubercle. Together, these structures form the triangular bony bed of the talocrural joint, which houses the distal 6 cm of the fibula.[2]

The distal posterior tibial margin was first described by Destot in 1911 and has been referred to as the third malleolus, although this may not be the most anatomically accurate term, as it does not resemble a small hammer (the original meaning of the Latin term malleolus). The distal anterolateral tubercle is known as Tillaux-Chaput's tubercle, named after the two French surgeons who studied this area in 1872 and 1907, respectively. Since 1996, thanks to the work of van Laarhoven,[3] it has also been referred to as the fourth malleolus.

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The anteroinferior tibiofibular ligament is the smallest of the syndesmotic ligaments, with a fibular insertion of 8.5 mm.[2] It originates from Tillaux-Chaput's tubercle and inserts into the distal anterior portion of the fibula, known as Wagstaffe-Le Fort's tubercle. This ligament provides 35% of syndesmotic stability. The posteroinferior tibiofibular ligament runs between Volkmann's tubercle and the posterior margin of the distal fibula, contributing 33% of syndesmotic stability. Its deep portion, known as the transverse inferior tibiofibular ligament, is a strong fibrocartilaginous structure just distal to the posteroinferior tibiofibular ligament. Lastly, the interosseous ligament, which is the distal extension of the interosseous membrane, is located 9.3 mm from the tibial plafond and contributes 22% of syndesmotic stability.[4]

Tillaux-Chaput fractures account for 2.9% of physeal injuries in skeletally immature patients. This injury results from trauma in adolescents aged 14 to 16 years, who present with asymmetric closure of the distal tibial physis. It is classified as a Salter-Harris type III fracture.[5] In contrast, this injury is rare in adults. As of 2019, only small series of cases had been published, with no more than 32 cases reported. The mechanisms of trauma in adults include ankle sprains (50%), traffic accidents (24%), and falls from heights (24%).[6]

Posterior malleolar fractures are often associated with lateral malleolar injuries, medial malleolar fractures, or Maisonneuve fractures. However, when isolated, they account for only 0.5–1% of all ankle fractures. As of 2016, the number of reported isolated cases did not exceed 75 patients. In these cases, the pathophysiological mechanism primarily involved axial loading with a fixed ankle in plantarflexion, although rotational forces were also thought to contribute.[7]

Ankle radiography is the first-line imaging modality in trauma patients. However, its sensitivity for detecting isolated posterior malleolar fractures is only 63%, and for Tillaux-Chaput fractures, it is as low as 50%. Given these limitations, the use of complementary imaging techniques, such as computed tomography (CT), has become standard practice in foot and ankle trauma. CT offers minimal motion artifacts, high image resolution, and the possibility of three-dimensional reconstruction. Although the radiation dose is approximately 1 mSv (compared to 0.01 mSv for conventional radiography), it remains within the low-dose range when compared to tomographic studies of other body regions.[8]

The classification systems proposed by Rammelt (2015) and Bartoníček (2021) provide a framework for categorizing these fractures. Tillaux-Chaput fractures are classified into three types based on size, involvement of the fibular incisura, and articular depression. For posterior malleolar fractures, there are five types, categorized by fragment morphology, the presence of an intercalary segment, medial extension, and involvement of the tibial incisura. These classifications help guide surgical approach and management.[9,10]

Here, we present the diagnosis and management of a rare injury in an adult patient with ankle trauma. The patient sustained a simultaneous anterior and posterior malleolar fracture, with no other associated injuries, representing a bimalleolar equivalent fracture. To date, only a few cases of this specific injury pattern have been published.

CLINICAL CASE

A 62-year-old housewife, previously independent in her self-care and household activities, with non-insulin-dependent type 2 diabetes mellitus, controlled arterial hypertension, and asymptomatic bilateral hallux valgus, presented to the Emergency Department of our institution after suffering an inversion trauma while descending a step. She reported pain, edema, and an inability to stand or walk. On examination, she had pain on palpation of the dorsum of the foot, spontaneous toe movement, and a symmetrical palpable foot pulse. No deformities or open injuries were observed. She underwent anteroposterior and lateral radiographs of the right ankle, which revealed asymmetry at the tibiofibular junction and loss of tibial joint congruity (Figures 1 and 2).

Based on these findings, a CT scan was requested, revealing a displaced anterolateral Tillaux-Chaput tubercle fracture, rotated in a shear pattern, and a simultaneous displaced Volkmann's posterior malleolus fracture. These fractures were classified as Rammelt type III and Bartoníček type II, respectively (Figure 3).

This injury pattern resulted in a bimalleolar equivalent fracture with syndesmotic instability due to an extension of the joint notch. It was decided to proceed with open reduction and internal fixation.

The patient provided written informed consent for surgery. Intravenous antibiotic prophylaxis and spinal anesthesia were administered. After asepsis and antisepsis, the patient was positioned in a lateral decubitus position. A posterolateral approach to the distal tibia was performed, with dissection by planes, opening of the crural fascia, identification and protection of the sural nerve, and dissection between the flexor hallucis longus medially and the peroneal tendons laterally. The Volkmann's malleolus fracture was reduced and fixed with two cannulated screws and a washer, achieving stabilization. The patient was then repositioned to a supine position for an anterolateral

approach to the distal tibia. Dissection by planes was carried out, identifying and protecting the sensory branch of the superficial fibular nerve. The Tillaux-Chaput fracture was then exposed, the articular surface was reduced, and fixation was performed using a 2.7 mm L-plate with 2.4 mm screws, achieving reduction and stabilization of the fragment.

Figure 1. Anteroposterior radiograph of the left ankle. Asymmetry of the anterolateral malleolus contour (blue arrow).

Figure 2. Lateral radiograph of the left ankle. Displaced anterior tibial bone fragment (blue arrow).

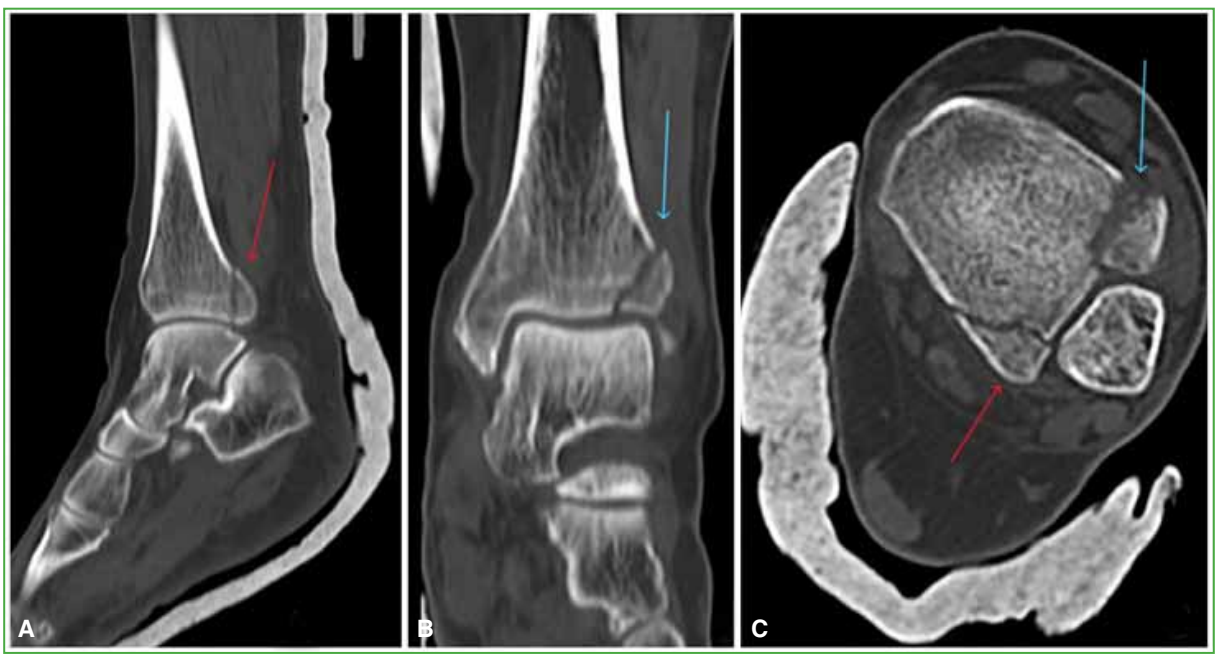

Figure 3. Computed tomography of the left ankle. **A.** Sagittal section showing a posterior malleolus fracture (red arrow). **B.** Coronal section showing an anterolateral malleolus fracture (blue arrow). **C.** Axial view showing simultaneous fractures of the Volkmann fragment (red arrow) and the Tillaux-Chaput fragment (blue arrow), with involvement of the fibular notch.

The patient was discharged with a Robert Jones bandage. Active mobility exercises, analgesic management, and thromboprophylaxis were prescribed for 15 days, with no weight bearing allowed. In the second week, the surgical wounds were examined, and she began a physical therapy program with progressive weight-bearing using crutches. Full weight-bearing was authorized at six weeks.

After 12 months, fracture healing was confirmed (Figures 4 and 5), and the patient resumed her usual activities. Her American Orthopedic Foot and Ankle Society (AOFAS) score was 91, and her Olerud-Molander functional scale score was 95 (Figure 6).

Figure 4. Left ankle radiographs at 12-month follow-up. **A.** Anteroposterior view, showing no intra-articular material. **B.** Lateral view, demonstrating complete healing of both Volkmann and Tillaux fractures, with congruent tibiotalar reduction.

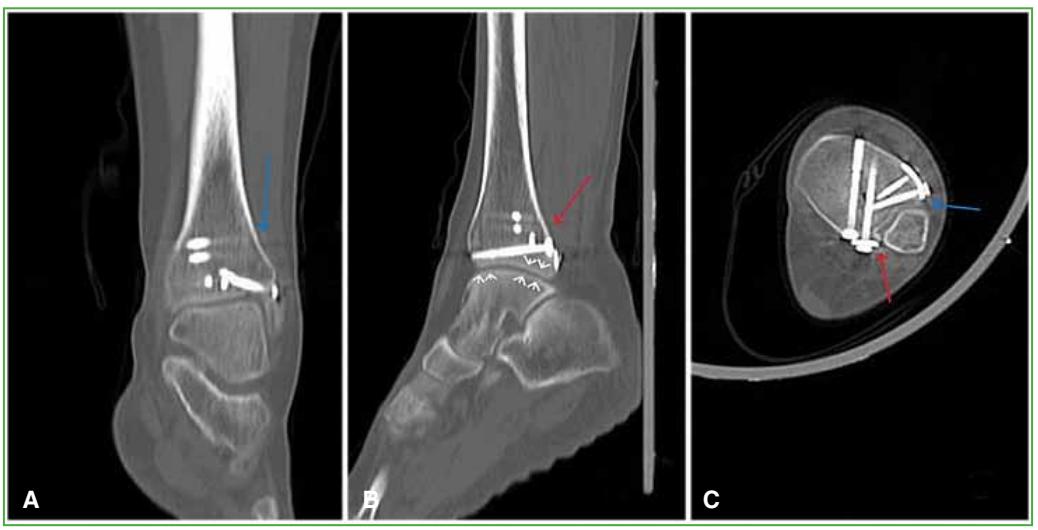

Figure 5. Computed tomography of the ankle at 12 months. **A.** Complete union of the Tillaux-Chaput fracture (blue arrow). **B.** Adequate healing of the Volkmann fracture (red arrow), with slight narrowing of the tibiotalar joint space (white arrowheads). **C.** Concentric reduction of the fibula within the fibular notch. Stable internal fixation of the Tillaux-Chaput (blue arrow) and Volkmann (red arrow) fractures.

Figure 6. Clinical and functional assessment at the end of follow-up. **A-C.** Lateral, posterior, and anterior views showing adequate plantar flexion. **D.** Anterior view demonstrating the absence of malalignment.

Approval was obtained from the Ethics Committee of Clínica Antioquía for the publication of clinical data and images.

DISCUSSION

The concept of ring injuries in ankle trauma suggests that injuries occur sequentially, akin to a clock, without "skipping" anatomical structures. If a discordance is found, it is likely that an occult injury has been overlooked or that the injury mechanism has been misinterpreted. The predictive concordance of this model is 96%.[11] Consequently, bone and ligament stabilization of unstable ankle injuries reduces the need for trans-syndesmotic fixation in up to 83% of cases.[12]

However, ankle trauma can also present with injury patterns that do not follow the rule, manifesting in unusual ways—such as the combination of anterolateral Tillaux-Chaput fractures with posterior Volkmann's malleolus fractures. There are very few publications on these injuries. We conducted a literature search in databases such as PubMed, Embase, Cochrane, Google Scholar, and LILACS, covering the period from 1964 to 2024, in both Spanish and English. Over these 60 years, only a few case reports have been published (Table).[13-16]

Thus, we present our case as a rare bimalleolar equivalent fracture: Volkmann and Tillaux in an adult, with no other associated injuries. This represents the eighth reported case in the literature over the past six decades. Reduction and fixation of both bony components were performed, successfully restoring the stability of the distal tibiofibular ring. The patient demonstrated favorable clinical and radiological evolution, achieving functional recovery and complete fracture healing.

Table. Literature review with case reports.

Study	Number of patients	Diagnosis	Treatment	Follow-up/Evolution
Kose et al.[13] (2016)	2	Displaced Tillaux fracture >2 mm and non-displaced Volkman fracture	Tillaux fracture fixation with a compression screw and a washer. Without fixation of the posterior malleolus.	6-14 months/complete consolidation AOFAS: 100 in both cases
Mansur et al.[14] (2019)	1	Tillaux and Volkmann lesion in a patient with Maisonneuve lesion.	Fixation of each of the components: one-third tubular plate, one full threaded screw, two anterolateral cannulated screws	12 months/pain-free AOFAS: 100
Pérez et al.[15] (2021)	1	Displaced Tillaux fracture >2 mm and non-displaced Volkmann's fracture	Tillaux fracture fixation with cannulated screws. Without fixation of the posterior malleolus.	6 months/adequate radiographic evolution AOFAS: not reported
Rammelt et al.[16] (2022)	4	Displaced Tillaux's fracture and Volkmann's fracture	The type of fixation is not reported	Follow-up/AOFAS: not reported

AOFAS = *American Orthopedic Foot and Ankle Society Score*.

The main limitation of our study is that it consists of a single case with only 12 months of follow-up. There are no large case series or published guidelines to establish standardized management protocols. However, based on our experience, we can infer that anatomic reconstruction improves clinical and radiological outcomes in patients with similar injuries in the future.

CONCLUSIONS

The continuous expansion of the literature suggests that anatomical reconstruction of ankle injuries—through reduction and fixation of each bony component, particularly around the syndesmosis—achieves better functional and radiological outcomes than simply restoring syndesmotic stability using rigid or flexible syndesmotic trans-fixation methods.

In cases of ankle trauma, it is essential to remember that the ankle is a dynamic and functional structure. The presence of a malleolar fracture, and indirectly a ligamentous injury (such as syndesmotic widening), is not merely an isolated event but is often part of a broader spectrum of injuries. These must be thoroughly evaluated using radiographs and CT scans to assess fragment size, involvement of the incisura, gaps, step-offs, or occult fractures.

Conflict of interest: The authors declare no conflicts of interest.

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