

Case Reports and Series

Posterior Tibial Tendon Rupture Associated With Anterolateral Distal Tibial and Medial Malleolar Fracture and a Novel Pattern of Tibiofibular Syndesmotic Injury: A Case Report and Review of the Literature

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ARTICLE INFO

ABSTRACT

Level of Clinical Evidence: 4

Keywords:

acute posterior tibial tendon repair

acute posterior tibial tendon rupture

ATFL avulsion fracture

Tillaux-Chaput

Wagstaffe fracture

A posterior tibial tendon (PTT) rupture associated with ankle fractures is a very rare condition. Ankle pronation and external rotation (PER) movement are the typical traumatic mechanism. This injury is frequently overlooked preoperatively. Early diagnosis and treatment are very important to prevent the serious consequences related to functional PTT insufficiency on biomechanics of the foot. Few cases have been described in the literature that highlight the relationship between PTT rupture and PER type ankle fracture with a medial malleolar fracture. We present a case of a complete PTT rupture in a closed atypical ankle fracture in which a medial malleolar fracture was associated with a very large fragment from the anterolateral distal tibia (Tillaux-Chaput fragment) and a concomitant avulsion fracture from the anteromedial portion of the fibula (Lefort-Wagstaffe fragment), with a novel pattern never described before.

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The complete rupture of the posterior tibial tendon (PTT) associated with ankle fractures is a rare frequently overlooked condition that can cause long-term patient disability if not properly treated. Only a few cases have been described in the literature, and there is a constant relationship with pronation-type ankle fractures (1). The diagnosis is often intraoperative, because the presence of pain and edema related to the fracture strongly limit physical examination. Early treatment is very important, because it can prevent the onset of the serious clinical consequence of planovalgus deformity of the foot (2).

We present a case of complete PTT injury associated with an atypical ankle pronation-external rotation (PER) type fracture, with a concomitant

avulsion fracture from the anteromedial portion of the fibula (Lefort-Wagstaffe fragment), in a novel pattern never described before. At our centre, no institutional review board or ethics committee approval is necessary for case report studies, and the patient gave his consent to data collection and anonymous use for scientific and teaching purposes.

Case Report

In May 2019, a 43-year-old man came to our emergency department after a high-speed motorcycle accident. The patient was not able to provide the exact dynamics of the accident and reported direct trauma of the right lower limb against the guardrail. He did not report relevant diseases or previous surgical interventions. On physical examination, the right ankle appeared notably swollen and tender at mobilization and local palpation. There were no skin lesions or neurovascular deficits.

Radiographs showed the presence of a multifragmentary fracture of the right distal tibia (Fig. 1). A computed tomography (CT) scan showed

C. Cataldi and N. Mondanelli contributed equally to this work.

Financial Disclosure: None reported.

Conflict of Interest: None reported.

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Fig. 1. Preoperative anteroposterior and lateral radiographs of the right ankle.

a transverse fracture of the medial malleolus, a partially intra-articular multifragmentary fracture of the lateral surface of the tibia with a modest extension to the distal metaphysis that we considered to be a very large Tillaux-Chaput fragment (Figs. 2 and 3). Furthermore, it showed avulsion fragments from the anteromedial portion of the distal fibula,

similar to Lefort-Wagstaffe fracture (Fig. 4). No suprasyndesmotic fibular fracture was present.

In cases of high-energy trauma, bony injuries are the consequence of mixed direct and indirect mechanisms, and atypical fracture patterns that cannot be reconducted to low-energy classifications may occur.



Fig. 2. Preoperative computed tomography scan of the right ankle, 3-dimensional view.

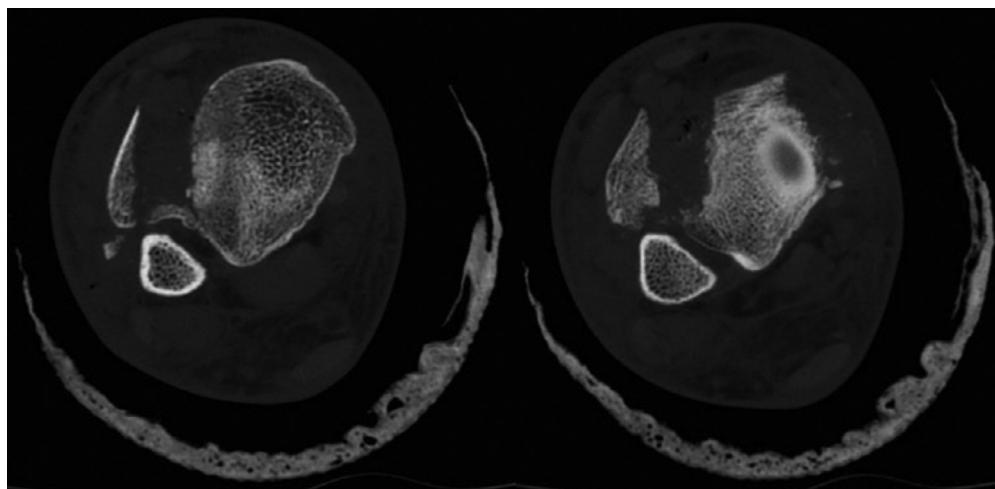


Fig. 3. Preoperative computed tomography scan showing the Tillaux-Chaput fragment, axial view.

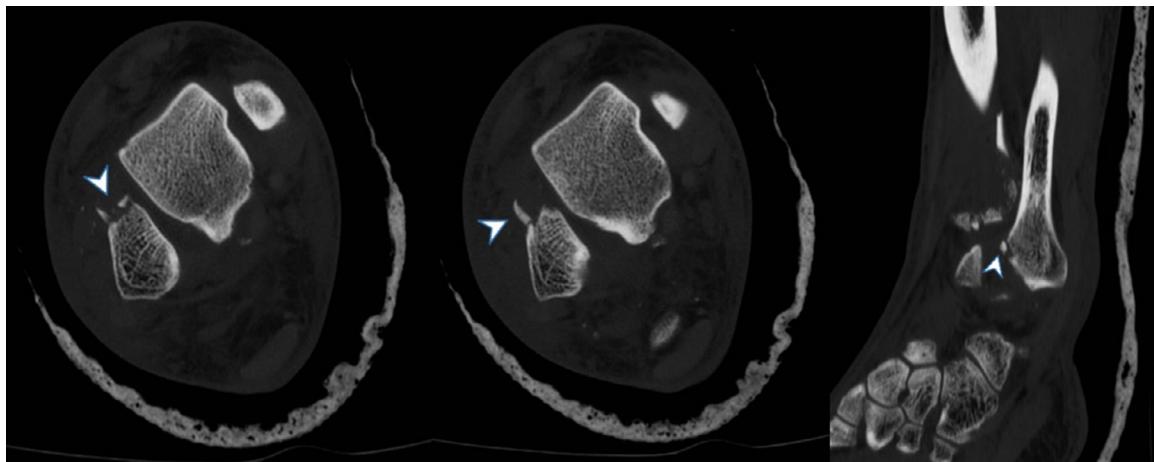


Fig. 4. Preoperative computed tomography scan showing the fragmentation of the anterior tubercle of the distal fibula (arrowhead), axial and sagittal views.

However, the patient suffered only such a local trauma, and only minor comminution was present at the fracture site: we interpreted these as signs of an “intermediate” energy mechanism. Moreover, the patient opportunely wore professional motor boots that contributed to dissipating energy and protecting the ankle. In our opinion, this has to be considered a PER ankle fracture (type II according to Lauge-Hansen classification) associated with a double multifragmentary avulsion fractures of the anterolateral (Chaput’s) tubercle of the tibia and anterior (Wagstaffe’s) tubercle of the fibula.

A provisional neutral position plaster splint was made, and the patient was hospitalized for subsequent open reduction and internal fixation (ORIF). He underwent surgery 4 days after the traumatic event, when edema was reduced. Patient was positioned supine under spinal anesthesia, a pneumatical tourniquet (P 250 mmHg) was inflated at the thigh, and fluoroscopic control was used during surgery. As a first step, an anterolateral approach to the distal tibia was performed; the superficial peroneal nerve that lies subcutaneously was identified and protected, the extensor retinaculum was incised, and the anterior compartment tendons were retracted medially, finally exposing the anterolateral distal aspect of the tibia. A small arthrotomy was performed to explore and irrigate the ankle joint and to assess articular reduction. Reduction was obtained with a large pointed reduction forceps applied percutaneously, and a temporary Kirschner wire was used to stabilize the fragment. An antigliding buttress plate was considered unnecessary because of the multiplanarity of the fracture line (with intrinsic stability after interfragmentary compression, in our opinion) and the comminution of the apex of the fracture, which was, moreover, quite posterolateral and would be difficult to reach with a plate. Definitive fixation of the Tillaux-Chaput tubercle fragment with one 4.0-mm partially threaded cannulated screw (Rondò, Citeffe; Calderara di Reno, Bologna, Italy) was performed. A second screw was inserted from antero-proximal-medial to postero-distal-lateral to fix the larger of the comminuted fragments at the apex of the Tillaux-Chaput fragment. Subsequently, a medial approach through a longitudinal incision was performed for ORIF of the medial malleolus. During surgical exploration, a full-thickness lesion of the saphenous vein and a complete rupture of the PTT, 2.5 cm proximally to the apex of the medial malleolus, were detected (Fig. 5). The injured tendon was not interposed into the fracture or into the tibiotalar joint. We first reduced and fixed the medial malleolus with a single screw (we opted for a single screw because cast immobilization for 6 weeks for PTT repair was anticipated). As there were no obvious signs of a tendon degenerative pathology, a direct end-to-end modified Kessler tendon repair with nonabsorbable monofilament (nylon) 3-0 sutures was performed, and the retinaculum was repaired with absorbable braided 2-0 sutures.

Considering the double disruption of AITFL from both the tibia and the fibula, the syndesmosis was considered unstable; the PER and hook tests under fluoroscopic control confirmed the instability of the ankle mortise, and a transsyndesmotic screw was inserted through a small stab incision. We used a 4.0-mm partially threaded cannulated screw without applying compression, as we already had such a screw on the back table.

The ankle was then immobilized in a splint for 3 weeks in slight supination and flexion to reduce tension on the sutured PTT, and weightbearing was not allowed. Afterward, the patient maintained a new splint in neutral position for an additional 3 weeks, and toe-touch weightbearing (15 kg) was allowed. Radiographs were obtained at 3 (Fig. 6), 6, and 12 weeks postoperatively. As the syndesmotic lesion was osseous and not ligamentous, we removed the transsyndesmotic screw at 6 weeks, and patient began active and passive range of motion (ROM) exercises of the ankle and subtalar joint, associated with progressive weightbearing as tolerated, and proprioceptive and eccentric exercises.

Hardware removal was performed at 7 months after surgery, on request of the patient, even though he had no related symptoms. At 11 months, the patient showed complete recovery of his own activities and complete ROM of foot and ankle. He was able to walk without any pain, and no clinical signs of PTT insufficiency were detected. The



Fig. 5. Intraoperative view of the ruptured posterior tibial tendon.



Fig. 6. Postoperative (3 weeks) anteroposterior and lateral radiographs.

patient reached a Foot and Ankle Outcome Score of 95% (symptoms + stiffness subtotal 89%, pain subtotal 94%, function—daily living subtotal 99%, function—sports and recreational activities subtotal 95%, quality of life subtotal 94%).

Discussion

The PTT is the most anterior and largest tendon of the medial side of the ankle. It is a powerful plantarflexor of the ankle and supinator of the foot and participates in the stability of the plantar arch. The most frequent pathologies affecting this tendon are represented by chronic tendinopathy with tenosynovitis and enthesopathies, with dislocation and instability, and eventually progressive or acute rupture. Among them, the most frequent lesion is the progressive “chewing gum” lesion in a setting of chronic tendinopathy, which typically occurs in overweight women >50 years old with valgus flatfoot (3). Acute injuries in the presence of a healthy tendon are rare events. The presence of some comorbidities (advanced age, diabetes, chronic corticosteroid therapies, rheumatoid arthritis, connective tissue diseases, obesity, or hypertension) can be a risk factor for rupture (4).

Lesion of the acute posterior tibialis (intratendinous or at the muscular tendinous junction) associated with ankle fractures is a very rare occurrence, and only few cases have been described in the literature (5). The typical traumatic mechanism is represented by a pronation movement associated with an external rotation of the ankle (PER type mechanism, according to Lauge-Hansen classification system), although such a lesion can also occur with a direct blunt trauma in the medial region of the ankle (1).

This injury is frequently overlooked, with possible severe long-term consequences such as acquired flatfoot deformity if a proper intraoperative tendon exploration is not performed; diagnosis is usually intraoperative, and high suspicion must be maintained until it is ruled out. Anamnestic and clinical signs that may suggest the presence of PTT lesion associated with the fracture have been described: PER traumatic mechanism, excessive edema of the soft tissues on the medial aspect of the ankle, irreducibility of the fracture or dislocation, and the presence of “bone flakes” detached from the distal medial metaphysis of the tibia (1–6). It is not unusual to find the interposition of the distal stump of the injured PTT into the fracture or, in cases associated with dislocation, into the ankle joint (7). Sometimes, intraoperative diagnosis can be difficult because the tendon stumps, particularly the proximal one, can appear proximally retracted (7).

The early diagnosis of this lesion is of primary importance, because chronic functional PTT insufficiency causes loss of the

medial longitudinal support of the plantar arch, with a progressive planovalgus deformity of the foot that is responsible for pain and disability. Acute treatment (direct suture or tenodesis on the flexor digitorum longus tendon) is considered the treatment of choice and is associated with better outcomes compared with delayed treatment (1).

In this case of a complete PTT rupture, the patient did not present with comorbidities or risk factors for tendon degeneration. The traumatic mechanism was probably represented by a PER mechanism of the ankle associated with an axial load with the foot extended (forced dorsiflexion, to cause the big Tillaux-Chaput fragment) and direct trauma. The diagnosis of PTT lesion was intraoperative, no interposition of the PTT into the fracture or into the joint was found, and acute end-to-end tendon repair was performed.

Analyzing the literature, we found only a few articles concerning total PTT rupture in association with ankle fractures (1–25). The first article was published by Giblin in 1980 (6). Afterwards all cases described of PTT rupture were related with pronation-type ankle fracture in which the medial malleolus was involved. The first case without medial malleolar fracture was described by Monto et al in 1991 (11). A PTT rupture associated with a closed tibial fracture is extremely rare. The only 2 cases present in the literature are reported in the articles by Jarvis and Cannada (24) in 2012 (complete lesion of nonreparable PTT with direct suture associated with an extra-articular fracture of the distal tibia) and by Korovessis et al (25) in 1991 (complete lesion of the PTT and of the flexor digitorum longus tendon associated with extra-articular fracture in the distal third of the tibia).

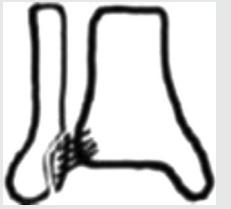
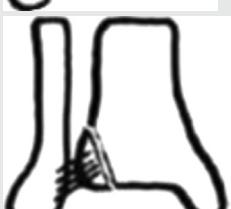
In our case, the PTT rupture was associated with an unusual ankle fracture. We tried to classify this fracture, according to Lauge-Hansen classification, a PER type II fracture with a medial malleolar fracture and a very large Tillaux-Chaput fragment. PER fractures are typically due to low-energy trauma, but the mechanism can be the same in high-energy impacts (even if with additional force vectors). CT scan also showed the presence of multiple avulsion fractures from the anteromedial side of the fibula due to the traction of the AITFL. In the literature, the incidence of AITFL avulsion fractures ranged from 10% to 12.4% of ankle fractures and was subdivided according to the Wagstaffe classification system in 3 types (28). Park et al in 2002 (27) and Birnie et al in 2019 (28) modified this classification with 2 added types of AITFL avulsion fractures.

The peculiarity of the fracture we described in this article is the presence of a double disruption of the anterior syndesmotic complex (bone-AITFL-bone) from both the tibial and the fibular side. This fact explains the residual instability of the tibiofibular syndesmosis after ORIF of the large Tillaux-Chaput fragment and justifies the need for a transsyndesmotic screw. In the AITFL avulsion fracture classifications (30), a double avulsion fracture is described only in association with a transsyndesmotic fracture of the fibula (type 5 according to Birnie classification). In this case, there was no fibular fracture, and so we can hypothesize the existence of a type 6 of AITFL avulsion fracture, which has never been described before. Thus the AITFL avulsion fracture classification system, initially proposed by Wagstaffe in 1875 (26), completed by Park et al (27) in 2002, and recently (2019) modified by Birnie et al (28), could be updated as in the Table, with a type 6 pattern in which there is not any other fibular involvement (or infra-, trans-, or suprasyndesmotic).

In conclusion, PTT injury associated with ankle fractures is a very rare occurrence, and its diagnosis is very difficult. Acute recognition and treatment of these injuries prevents significant foot deformities that involve pain and disability. An open approach to the medial malleolus may guarantee direct visualization of the tendon and, in our opinion, has to be preferred to percutaneous reduction and fixation when a PTT lesion is suspected. Moreover, this article describes

Table

Remodified Anterior Inferior Tibiofibular Ligament (AITFL) Avulsion Fracture Classification System

1	Displaced avulsion fracture of the distal end of the fibula ("isolated Wagstaffe fracture")	
2	Type 1 with a fracture of the distal fibula	
3	Displaced avulsion fracture from the tibia by the AITFL ("isolated Tillaux-Chaput fracture")	
4	Type 3 with a fracture of the distal fibula	
5	Displaced avulsions fractures of the anterior tubercles from both the tibia and the fibula with a fracture of the distal fibula	
6	Displaced avulsion fractures of the anterior tubercles from both the tibia and the fibula without a fracture of the distal fibula	

Types 1 to 3 were proposed by Park et al in 2002 (29); types 4 and 5 by Birnie et al in 2019 (30); and type 6 is the novel pattern we describe. For all types, subtypes include A (fragment size < 5 mm) and B (fragment size ≥ 5 mm).

a rare ankle fracture, and we underline the particularity of the double avulsion fracture of the anterior tubercles from both the tibia and the fibula without a fracture of the distal fibula, proposing a type 6 AITFL avulsion fracture that has never been described before. Further investigations are needed for a full understanding of this traumatic mechanism to increase diagnostic and therapeutic possibilities.

References

- Wardell RM, Hanselman AE, Daffner SD, Santrock RD. Posterior tibialis tendon rupture in a closed bimalleolar-equivalent ankle fracture: case report. *Foot Ankle Spec* 2017;10:572–577.
- Bernstein DT, Harris JD, Coscolluela PE, Varner KE. Acute tibialis posterior tendon rupture with pronation-type ankle fractures. *Orthopedics* 2016;39:e970–e975.
- Lhoste-Trouilloud A. The tibialis posterior tendon. *J Ultrasound* 2012;15:2–6.

4. Formica M, Santolini F, Alessio-Mazzola M, Repetto I, Andretta A, Stella M. Closed medial malleolar multifragment fracture with a posterior tibialis tendon rupture: a case report and review of the literature. *J Foot Ankle Surg* 2016;55:832–837.
5. Jasqui-Remba S, Rodriguez-Corlay RE. Muscular tendinous junction rupture of the posterior tibial tendon after closed bimalleolar ankle fracture. *BMJ Case Rep* 2016. pii:bcr2015214028.
6. Stein RE. Rupture of the posterior tibial tendon in closed ankle fractures. Possible prognostic value of a medial bone flake: report of two cases. *J Bone Joint Surg Am* 1985;67:493–494.
7. West MA, Sangani C, Toh E. Tibialis posterior tendon rupture associated with a closed medial malleolar fracture: a case report and review of the literature. *J Foot Ankle Surg* 2010;49: 565.e9–e12.
8. Giblin MM. Ruptured tibialis posterior tendon associated with a closed fracture medial malleolus. *Aust N Z J Surg* 1980;50:59–60.
9. Kelbel M, Jardon OM. Rupture of tibialis posterior tendon in a closed ankle fracture. *J Trauma* 1982;22:1026–1027.
10. De Zwart DF, Davidson JSA. Rupture of the posterior tibial tendon associated with fractures of the ankle. *J Bone Joint Surg Am* 1983;65:260–262.
11. Schaffer JJ, Lock TR, Salciccioli GG. Posterior tibial tendon rupture in pronation external rotation ankle fractures. *J Trauma* 1987;27:795–796.
12. Søballe K, Kjaersgaard-Andersen P. Ruptured tibialis posterior tendon in a closed ankle fracture. *Clin Orthop Relat Res* 1988;231:140–143.
13. Monto RR, Moorman CT, Mallon WJ, Nunley JA. Rupture of the posterior tibial tendon associated with ankle fracture. *Foot Ankle* 1991;11:400–403.
14. Burton PD, Page BJ. Fracture of the neck of the talus associated with a trimalleolar ankle fracture and ruptured tibialis posterior tendon. *J Orthop Trauma* 1992;6: 248–251.
15. Ebraheim NA, Wong FY. Simultaneous fracture of the ankle and talus associated with ruptured tibialis posterior tendon. *Am J Orthop (Belle Mead NJ)* 1995;(Suppl):22–24.
16. Bos M, Lusskin R. Acute disruption of the posterior tibial tendon associated with open-fracture dislocation of the ankle. *Foot Ankle Int* 1997;18:823–826.
17. Penney KE, Wiener BD, Magill RM. Traumatic rupture of the tibialis posterior tendon after ankle fracture: a case report. *Am J Orthop (Belle Mead NJ)* 2000;29:41–43.
18. Mallick S, Faleme A. Traumatic rupture of the tibialis posterior tendon after closed ankle fractures: a report of two cases. *Eur J Orthop Surg Traumatol* 2001;11:137–139.
19. Sharma H, Meredith AD. Concomitant traumatic rupture of the tibialis posterior tendon with a closed complex ankle fracture. An uncommon injury, which can easily be overlooked. *Foot* 2004;14:35–37.
20. Madhusudhan TR, Rangan A. Tibialis posterior tendon injury associated with a closed medial malleolus fractured: a case report. *Inj Extra* 2006;37:193–195.
21. Uzel AP, Massicot R, Delattre O, Augourd S. Traumatic rupture of the tibialis posterior tendon after ankle fractures: three cases and a review of the literature. [Article in French]. *Rev Chir Orthop Reparatrice Appar Mot* 2006;92:283–289.
22. Ceccarelli F, Faldini C, Pagkrati S, Giannini S. Rupture of the tibialis posterior tendon in a closed ankle fracture: a case report. *Chir Organi Mov* 2008;91:167–170.
23. Ermis MN, Yagmurlu MF, Kilinc AS, Karakas ES. Irreducible fracture dislocation of the ankle caused by tibialis posterior tendon interposition. *J Foot Ankle Surg* 2010;49: 166–171.
24. Karabila MA, Azouz M, Mhamdi Y, Hmouri I, Kharmaz M, Bardouni A, Lahlou A, Mahfoud M, Berrada MS. Traumatic rupture of the posterior tibial tendon occurring during a closed fracture of the ankle: report of a case. [Article in French]. *Pan Afr Med J* 2015;22:371.
25. Krishna SV, Pilar A, Pai SN, Issac T. Traumatic rupture of posterior tibial tendon following closed supination-adduction ankle fracture: a case report. *JBJS Case Connect* 2016;6:e75.
26. Jarvis HC, Cannada LK. Acute tibialis posterior tendon rupture associated with a distal tibia fracture. *Orthopedics* 2012;35:e595–e597.
27. Korovessis P, Spastris P, Katsardis T, Sidiropoulos P. Simultaneous rupture of the tibialis posterior and flexor digitorum longus tendons in a closed tibial fracture. *J Orthop Trauma* 1991;5:89–92.
28. Wagstaffe WW. An unusual form of fracture of the fibula. *St Thomas Hosp Rep* 1875;6:43.
29. Park JW, Kim SK, Hong JS, Park JH. Anterior tibiofibular ligament avulsion fracture in Weber type B lateral malleolar fracture. *J Trauma* 2002;52:655–659.
30. Birnie MFN, Van Schilt KLJ, Sanders FRK, Kloen P, Schepers T. Anterior inferior tibiofibular ligament avulsion fractures in operatively treated ankle fractures: a retrospective analysis. *Arch Orthop Trauma Surg* 2019;139:787–793.