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Review

POSTEROMEDIAL TIBIAL PLATEAU: OSTEOCHONDRAL AVULSION FRACTURE REVIEW

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ABSTRACT

Fractures of the posteromedial tibial plateau are infrequent, for this reason also their clinical description and their treatment is poorly represented in the literature. Only six cases in the literature describe the avulsion fracture of the posterior medial tibial plateau at the insertion of the semimembranous muscle. The mechanism of injury, described in the various articles, however, does not appear univocal, as well as the type of treatment. The analysis of the literature revealed the need for adequate imaging and stable surgical synthesis, in order to obtain an optimal functional recovery.

1. Introduction

This review was made in order to clarify the mechanism of this rare type of lesions of the posteromedial tibial plateau, which diagnostic investigations are to be preferred, and which are essential in order to ensure correct diagnosis and optimal surgical treatment, with the aim of optimal restoration of the anatomy and joint function of patients [1]. Fractures of the tibial plateau are in constant progression. They affect an elderly population suffering from a number of comorbidities, but also a young population increasingly practicing high-risk sports [2]. Surgical treatment is necessary because, since there is a dislocation of the fragment from its natural lodging, after its detachment, the common therapies with growth factors aiding adjuvant healing and prp (platelet-rich plasma) cannot give benefits [3,4,5]. Patients with this type of injury are young non-osteoporotics, therefore treatment with antiresorptive drugs or osteoblast activators is not indicated [6,7]. Avulsion of the posteromedial tibial plateau is extremely rare in adults [8]. A fracture with bone avulsion of the neglected semimembranous insertion results in a non-union of the fragment to the tibial plateau. There are only six studies in the literature that describe the avulsion fracture of the posteromedial tibial plateau at the insertion of the semimembranous, moreover the hypothesized mechanisms and treatments used are different [9].

2. Review

Yao et al. was the first to document the avulsion fracture of the posteromedial tibial plateau upon insertion of the semi-membranous [10]. Subsequently Vanek J documented the event and as Yao himself, with the association of anterior cruciate ligament rupture (ACL) [11]. Chan et al. reported in a case series, 4 cases in a series of 10 patients with ACL tear and concluded that the medial postoperative avulsion fracture was a consequence of ACL rupture. All 3 of these authors, therefore, observed that this type of injury occurred in the event of an ACL rupture or in the case of injury to the posterior horn of the medial meniscus or its laceration or capsular meniscus separation. These 3 authors, however, while sharing the type of lesion responsible, did not share the mechanism of injury, in fact Yao et al. and Chan et al. claimed that the responsibility for the injury is an external valgus rotational force, while Vanek, who led studies on cadaver in addition to its clinical case, indicated an injury mechanism of force in external rotation in varus, cadaveric studies, regarding the mechanics of the femoral tibial lesions as fundamental to understanding the mechanisms of action [12,13].
There are 3 studies in the literature that indicate, instead, the integrity of the anterior cruciate ligament and a rupture of the posterior cruciate ligament (PLC).

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Al Humadi et al. reported a case of avulsion fracture of the posteromedial tibial plateau associated with PCL rupture and of the posterior horn of the medial meniscus [14]. Khoshnoodi et al. also reported an avulsion fracture of the posteromedial tibial plateau associated with PCL rupture, with injury to the posterior horn of the medial meniscus and capsular meniscus laceration [15]. Rakesh et al also describe the rupture of the posteromedial tibial plateau without involvement of the ACL, while they also highlight the rupture of the PCL. The ACL was intact in all 3 of these studies. These attributed the injurious mechanism to a valgus hyperextension force for this combination of lesions to occur. In the latest case report published in literature, Caggiari et al. showed that there were no associations with ACL rupture or a meniscal lesion with the posteromedial tibial avulsion fracture. In this case the traumatic mechanism was due to a collision with another player on the supporting leg, during a change of direction, for this reason the hypothesized mechanism is valgus external rotation [16].

In all cases, present in the literature were performed radiographs, computed tomography, and magnetic resonance imaging. The semimembranous has multiple insertions through tendon extensions, or expansions, to the medial tibial condyle (anterior, direct and lower arms), the posterior oblique ligament (capsular arm), and the posterior articular capsule and the arched ligament (oblique popliteal ligament). The first 3 extensions are closely connected to the tibial collateral ligament, inserting itself deep into it. The main expansion is inserted on the infraglenoid tubercle of the posteromedial tibial plateau. Other attachment sites include the tibia under the medial collateral ligament, the posteromedial capsule, the oblique popliteal ligament, and the superficial fibers of the medial collateral ligament [17,18,19]. The main site of avulsion in our case was the main or direct site of the rear attack tibial tubercle [20]. Chan only talks about magnetic resonance imaging in his study and Caggiari et al. performed standard radiographs and computed tomography without magnetic resonance imaging. Vanek says MRI shows aspects that would otherwise not be identifiable and that it is almost impossible to diagnose this lesion from standard radiographs. The non-identification of the lesion would lead to pain, functional limitation and gonarthrosis, with permanent functional limitations leading, if necessary, to the replacement of the joint with a prosthetic implant [21]

The treatments have not been described in Yao's and Chan's cases. In the case of Vanek, arthroscopic surgery with partial meniscectomy was performed. The case of Al-Humadi shows images very similar to those of the case of Caggiari (Figure 1a and 1b).

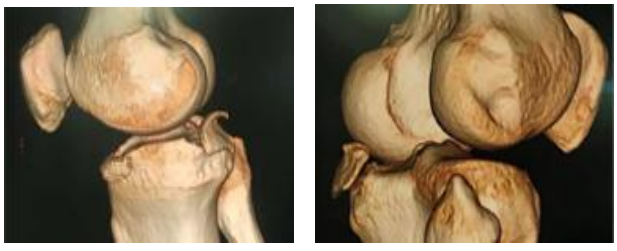

Figure 1a. Caggiari case: CT images delineating the displaced fragment. The displaced fragment has rotated 90° in the sagittal plane.

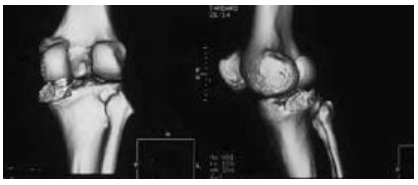

Figure 1b. Al Humadi case: CT images delineating the displaced fragment. The displaced fragment has rotated 90° in the sagittal plane.

Al-Humadi treated the lesion with the patient in prone position. A tourniquet was placed around the proximal thigh but was not used. A posterior curvilinear incision was started laterally approximately 5 cm proximal to the joint line, and medial to the biceps femoris tendon, and then carried obliquely across the popliteal fossa [22,23]. The sural nerve was identified and protected. The fracture was reduced anatomically. Definitive fixation was achieved with two 3.5 mm lag screws placed from posterosuperior to anteroinferior to gain compression across the fracture site. The medial meniscus and the capsule were repaired with interrupted simple #1 Vicryl sutures. In Khoshnoodi's case, the avulsion fracture of the posteromedial tibial plateau mediated by the semimembranous tendon was identified and was reduced and fixed with a locking compression plate and screws, with the meniscal repair of posterior horn of medial meniscus. In Rakesh's case, the patient was under general anesthesia and was positioned prone and high thigh tourniquet was applied but not inflated. The Lobenhoffer approach was used to expose the fracture site [24,25]. The semitendinosus was sutured to the fragment, subsequently the fragment was derotated and repositioned in the original housing and stabilized with etibond sutures, the stability of the fragment was also guaranteed by the margins of the crater that welcomed it. Two small fragments (3.5mm) partially threaded cancellous screws with spiked washers were inserted below the junction of the inferior border of the osteochondral fragment and the inferior crater wall. Screws were not passed through the fragment to provide compression owing to the small size of the bony fragment. In the Caggiari et al. case, surgery was performed under general anesthesia. The patient was placed in the supine position with a high thigh tourniquet not inflated. They opted for direct and open surgery access, without any arthroscopic surgery time, since the injury was a true articular bony lesion [26,27,28]. A posteromedial approach to the knee was performed through a curved incision from medial femoral epicondyle to the posteromedial tibial border with the knee slightly flexed. After fascia incision, the conjoined medial knee tendons (pes anserinus) were identified and exposed and the articular capsule was dissected between menisci and tibial plateau rim. The avulsed fragment was de-rotated and reduced in its original position without reattachment of semi membranous fiber to obtain good stability in all directions after repositioning the fragment in its anatomical position. The stability of the osteochondral piece was excellent on the axial planes due to the intrinsic stability ensured by the subchondral surface. Stability in the sagittal plane was not appropriate due to the line of strength of the semimembranous muscle remaining during knee flexion. Therefore, they used bone reduction forceps and a periosteal elevator to push down the torn fragment to its original position. After reduction with 2 K-wires, they synthesized the fracture with 2 HCS screws (2.4 × 3.0 mm), directed super-inferiorly from lateral to medial, regardless of the impedance of the distal femoral condyles.

The anteromedial depression fracture was reduced with 3 HCS screws (3 × 36 mm; 2.4 × 30 mm; 2.4 × 30 mm) inserted through the same surgical approach. The posterior joint capsule was sutured with Vicryl # 1 simple interrupted stitches. Post-operative treatment has been different in the cases and some have been more detailed in describing it [29]. Yao had not mentioned the treatment. The authors did not use the intra-articular injection of PRP, growth factors or hyaluronic acid from the postoperative period up to 6 months after surgery [30]. This choice is probably due to the pathogenetic mechanism and the treatment applied. In the articles examined, there is no mention of the use of heparin therapy, although correct heparin therapy is essential in order to avoid thrombo-embolic episodes, when immediate loading is not allowed on the operated limb [31,32,33,34,35,36]. Chan does not describe either surgical treatment or post-operative treatment. Vanek says the symptoms settled well after operation and the patient reported adequate stability of the knee. About post-operative treatment Khoshnoodi indicates that course was uneventful. Al-Humadi held the knee in 20 degrees of flexion with a hinger knee brace. At four months postoperative follow-up, the patient has returned to pre-operative function with a knee range of motion of 0 to 120 degrees, also in Rakesh's study, the knee was immobilized in 20 ° of flexion and a hinged range of motion brace was applied. The post-operative course was uneventful; fracture united radiogically within 12 weeks. At two years after surgery, he had a full ROM of the knee with no subjective symptoms of knee instability. In the case described by Caggiari, post operatory period was normal. At 12 weeks after surgery, an X-ray evaluation showed complete healing of the fracture. At 6 months follow up, the patient had no pain or knee anterior instability with a negative posterior drawer test at the physical examination.

3. Discussion

This case series has collected several cases on an uncommon type of fracture, which is the avulsion fracture of the posteromedial tibial plateau, as well as comparing the lesion mechanism described in the various cases, the diagnostic procedure followed by the various authors, the surgical technique applied to treat the lesion and the postoperative performed with the final results. We believe that osteosynthesis is necessary from these, above all by evaluating the excellent clinical results obtained. Traumatologists must carefully evaluate this unusual fracture pattern, as it can be underestimated

to clinical or imaging examination. Any failure diagnosis and consequently a non-treatment of fracture will lead to chronic pain and functional limitation due to joint incongruity.

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