TREATMENT OF FRACTURES OF THE TIBIAL PLATEAU: THE ROLE OF ARTHROSCOPIC ASSISTANCE

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ABSTRACT

We present our experience in the treatment of fractures of the tibial plateau with arthroscopic assistance. Between January 1997 and September 2001, we evaluated 23 patients with fractures of the tibial plateau. After their clinical and radiological evaluation, we included 17 patients in this study. Fractures were classified using the Schatzker classification. 14 patients were treated with arthroscopic reduction and percutaneous fixation, while 3 patients underwent open reduction and osteosynthesis with platelets under arthroscopic control. The arthroscopic technique allows for a better articular visualization, decreases dissection of the tissues, and allows for an adequate diagnosis and treatment of the associated lesions. Arthroscopic reduction and percutaneous fixation can be considered the treatment of choice in a select group of fractures of the tibial plateau (Schatzker I and III).

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1. Introduction

Fractures of the tibial plateau area relatively frequent pathology, accounting for approximately 1% of total fractures, and 8% of fractures in the elderly. According to the different statistical series, the external tibial plateau is the most affected in 55 - 70% of cases, while the internal plateau comprises 10 to 23%, and between 10 - 30% of the cases are bilateral. The goal in the treatment is to achieve an alignment that is correctly aligned, painless, stable, and with an arch of mobility suited to the needs of the patient. Given the wide variety in these types of lesions, it becomes difficult to standardize a therapeutic protocol. Although orthopedic treatment has good results in non-displaced, low energy fractures, and especially in elderly patients, there is a consensus that the optimal function of a joint depends on a stable congruence of the articular surfaces, allowing a balanced transmission of loads through them. Therefore, open surgical treatment has gained popularity in cases of displaced, high energy fractures and in young patients requiring a restoration of the joint anatomy, followed by a firm stabilization, to allow for early mobilization. But while open surgical treatment has been widely accepted in recent years, it has not been free from complications or limitations. Extensive approaches are usually required to expose and reduce the fracture that often increases tissue devascularization. In addition, an arthrotomy and anterior meniscal deinsertion often must be performed, increasing the morbidity of the affected area. Other injuries frequently associated with these fractures, such as meniscal, ligamentarias, and osteochondral, can hardly be evaluated and solved through these open-surgical approaches. Considering all of this, assistance with arthroscopic techniques can offer important benefits in the treatment of some of these fractures due to the minimal approach, which allows for congruent joint restoration with direct visibility. Arthroscopic techniques also allow for the diagnosis and treatment of associated pathologies during the same surgical procedure. This article presents our experience with the treatment of these fractures with arthroscopic assistance performed on our patients in the Orthopedics and Traumatology unit at the University of Perugia.

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2. Methods

Study Population
17 patients with 17 closed fractures of the tibial plateau with a fracture displacement greater than 2 mm, all operated under arthroscopic control, were included in this study. Patient age ranged from 32 to 81 years old, with a mean of 66 years and a predominance of women (ten cases) over men (seven cases). The same surgeon operated on all of the patients. The post-operative evolution ranged from a minimum of 9 months to a maximum of 53 months (with an average of 31 months.) The exclusion factors in this study included patients with exposed fractures and/or polytrauma, associated vascular or neurologic lesions, fractures with severe in tegumentary lesions, or fractures that were surgically operated on 15 days post-injury (six cases). Fractures were grouped according to the Schatzker classification. The surgical protocol for fracture types I, II and III (14 cases) consisted in reduction and osteosynthesis with cannulated screws with washer or plate and screws (in cases of great comminution or osteopenia) under arthroscopic assistance (1,2). For fracture types IV, V and VI (3 cases), reduction and osteosynthesis with plate and screws under arthroscopic assistance was performed. After surgery, patients were rehabilitated following the same schedule of early mobilization and delayed loading, according to clinical and radiological evolution. Patient outcome was monitored by a Delamarter post-operative follow-up and follow-up record.

The final results were grouped according to the following scale: 90-100 excellent result, 80-89 good result, 70-79 regular result, and less than 70 bad result.

Surgical Technique
Surgery was performed with the patient in dorsal decubitus under spinal or general anesthesia. The patient was positioned with the knee flexed at 90°. First, ischemia of the injured limb, with a pneumatic cuff at the thigh root, was performed. The typical procedure for conventional arthroscopy involves preparing the surgical fields, but in these cases, the fields in the contralateral anterior superior iliac spine were also prepared for the bone graft. Before beginning surgery, possible ligament injuries were carefully evaluated while the patient was under anesthesia. Surgery began with the arthroscopic examination of the knee (3). Three routine portals were performed: anterolateral and anteromedial for visualization, perfusion fluid, and instrumental and superointernal or superoexternal for aspiration of the fluid and detritus of the joint (sewer system). After performing a copious joint wash (eliminating hemarthrosis and free osteochondral fragments) lasting approximately 5 minutes, the existing intra-articular lesions were assessed. For meniscal lesions, sutures were performed if the lesion was peripheral, while partial meniscectomy was performed if suture conditions were not present. The osteochondral lesions were treated with mesenchymal stimulation techniques, while the reconstruction of crossed ligament lesions was deferred to a later, second surgical time. Once the fracture line was identified (location, dimensions, comminution, displacement of the fragments, etc.), treatment began. For sinking fractures, a metaphysioseal bone window (approximately 8 cm below the joint line ipsilateral to the fracture) was created through which ablunt impactor (double layered at 90°) was inserted, and then proceeded to reduce the sunkenfragments by gentle strokes under arthroscopic vision. (The tibial anterior cruciate ligament guide was not used to locate the area of injury, since our impactors were bent and not cannulated.) The healthy border of the cartilage and the lower face and free edge of the meniscus were used to reduce and repair the tibial plateau. As the sinking was corrected, the arthroscopy was used to verify whether or not any bone fragments were hypercorrect, reducing them with the probe or a curette. After the reduction, the existing bone defect in the tibial plateau was filled with bone graft obtained from the iliac crest of the patient, inserting it through the bony window made in the tibia. Arthroscopic control was used simultaneously when impacting the graft to verify that the fragments of the fracture did not move, and that the bone graft did not migrate in the joint. In the case of shear fractures, a longitudinal approach on the affected plate was implemented (avoiding the opening of the joint capsule and the meniscal deinsertion), through which the sheared fragments were deimpacted and elevated (4,5). Simultaneously, and through a laminar chisel or gouge scopus, the fractured articular fractures were disintegrated under arthroscopic vision, collaborating in the reduction maneuvers. Afterwards, osteosynthesis was performed depending on the characteristics of the fracture that was dealt with. If cannulated screws with were used, the placement was percutaneous close to the joint line, to support them, protecting the sinking of the fragments (type III fractures), or performing compression of the sheared fragment (some type I and II fractures). The plate with screws was used in fractures with a shear component, with important comminution, displacement or osteopenia of its fragments.

The position of the screws was controlled by an image intensifier. Arthroscopic assistance aided in verifying that the graft did not migrate into the joint. Lastly, evaluation confirmed that fracture fragments were not displaced when performing knee flexion-extension movements after osteosynthesis. Suction drains were routinely used, leaving them in place based on their flow for 24-48 hours. The operated limb was immobilized with a Robert Jones bandage that was withdrawn within 48 hours in order to begin active and passive rehabilitation exercises.

3. Results
Patients grouped according to fracture type using the Schatzker classification were distributed as follows: Group I - 3 cases, Group II - 7 cases, Group III - 4 cases, Group IV -1 case, Group V - 2 cases, Group VI - O cases. The causes of fracture were: Falls from tripping at own height - 9 cases (2 cases of fracture types I, four type II, and three type III); Transit accidents - 3 cases (One case type II, one type III, and one type V); Sports accidents - 2 cases (one case type I and one case type V) Height falls - 2 cases (both cases type II); Work accidents: 1 case (1 case type IV, run over by machinery).Associated soft tissue injuries included: Five meniscal lesions ipsilateral to the fracture (all in the external tibial plateau), four of which were treated with partial meniscectomy and the fifth, which presented a peripheral meniscal detachment, was sutured; 6 degenerative lesions of the internal meniscus (5 in fractures with involvement of the external plateau, and the sixth in a fracture with involvement of the medial tibial plateau);Numerous osteochondral lesions (grades 3 and 4 of the Outer-bridge classification) in both femorotibial compartments (6-8). In all cases, techniques of mesenchymal stimulation, regularization, perforations and abrasion of the lesion bed were performed. Regarding ligamentous lesions, the most frequent was the medial collateral ligament injury (7 cases).
This lesion was evaluated routinely during the immediate and remote post-operative period, and did not require surgical treatment in any of the cases. Of these lesions, two cases were associated with shear fractures of the external plateau, and five were associated with mixed lesions (shear-sinking of the external saucer). One lesion of the anterior cruciate ligament was identified, which was treated in a bloodless manner (the patient was 57 years old, with sedentary habits and at 19 months post-surgery did not report symptoms of instability). No lesions of the external collateral ligament or posterior cruciate ligament were identified.

Regarding post-operative complications, there was one case of subacute infection in a patient with a mixed fracture of the external tibial plateau and osteosynthesis with plaque and screws. The patient required another surgery to remove the implant and was treated with antibiotics with good clinical evolution (9,10). The complications were due to premature loading of the leg (19 days after surgery), which resulted in a partial loss in the reduction in a patient with psychiatric pathology. Currently (at 21 months post-surgery), he presents a score of 67 points, which is considered a poor final result. Patients did not present consolidation delays, pseudarthrosis, or compartmental syndromes.

Regarding rehabilitation, in all cases, isometric exercises of the quadriceps and twin muscle pump exercises were implemented immediately after the surgery. At 48 hours post-op, active and passive knee flexion-extension exercises were started, seeking to obtain a mobility arc for the first month of: 0° to 90°. This rehabilitation was performed in sixteen patients, while it was delayed until the ninth week for the seventeenth patient due to psychiatric reasons. Loading, assisted with Canadian canes, was delayed until clinical and radiological parameters of bone consolidation were obtained (11). In the seventeen treated patients, a complete final extension of the joint was obtained, and while flexion was variable, in all cases, the 90° flexion was exceeded.

From the analysis of the results of the pre- and post-operative assessment table, the following data was collected: Excellent results (90-110 points) - 3 cases (1 case I, 2 cases type III); Good results (80-89 points) - 9 cases (2 cases type I, 4 type II, 2 type III, 1 type V); Regular results (70-79) - 4 cases (3 cases type II, 1 case type IV); Bad result (<70 points) 1 case (type V).

4. Discussion

The fractures of the tibial plateau constitute a heterogeneous group of lesions and their treatment must be defined taking into account not only the characteristics of the fracture, but also the age and general condition of the patient, their activity level, the associated existence of polytrauma, etc. It is known that anatomical reduction helps prevent loss of mobility and delays degenerative joint changes. However, there are still controversies in the treatment of many of these fractures, mainly given the potential complications of open surgery. In recent years, the use of arthroscopy has been extended to the treatment of these fractures, helping to bridge the gap between surgical and non-surgical treatment by providing the advantages of direct visualization, anatomical reduction, and rigid percutaneous fixation with minimum exposure, without the complications of open surgery.

When analyzing the literature and our cases, we observed that, although in all cases the arthroscopy facilitated the reduction of direct vision and the diagnosis of associated lesions, type III fractures were especially indicated for arthroscopy, since pure collapses do not require direct approaches on the fracture line to be reduced and stabilized. In these cases, the arthroscopy gives a direct vision of the obtained reduction that is far superior to that granted by an image intensifier. Likewise, in type I fractures (frequent in the young population) that do not present significant osteopenia or comminution, the reduction can be achieved through a small extraarticular approach, and subsequent percutaneous osteosynthesis. Another advantage of arthroscopy in such lesions is the possibility of diagnosing and repairing meniscal deinsertions that are frequently present.

Regarding the use of the bone graft, the scope of its use is to fill in the bone defects produced by the compression mechanism of the fracture (in fractures with a mechanism of sinking), to collaborate in its stabilization, and to facilitate the consolidation. Bone-grafting was utilized on fourteen of the seventeen operated patients (it was not only used in type I fractures). Fowble reports that bone graft contribution has decreased when using the arthroscopic method, decreasing post-operative morbidity (12). We consider that the biological contribution depends fundamentally on the characteristics of the fracture and on the quality and quantity of existing bone capital, and not on the implementation of the arthroscopic method. Arthroscopy allowed for an adequate control of the location of the intra-articular fragments, as well as the confirmation of absence of bone graft or free osteochondral fragments at the articular level. It also allowed us to observe fracture stability after osteosynthesis was completed.

Soft-tissue injuries associated with tibial plateau fractures are common, but their incidence and severity are generally overestimated. Several studies indicate an overall lesion frequency of about 35% to 50%. In 1994, Vangsness studied 36 patients with fractures of the tibial plateau undergoing arthroscopic evaluation, and found that 47% of the patients had meniscal injuries (13-20). Of the 17 lesions found, 13 were on the lateral meniscus, five lesions were peripheral (one in bucket handle). He also diagnosed 3 radial lesions and 5 complex lesions that required meniscectomies. All four medial meniscal injuries were associated with Hohl type IV fractures, and required meniscectomies. He also found a significant association between the meniscal injury and the severity of the injury: of the 25 fractures requiring internal reduction, 64% had a meniscal injury, whereas only 9% of them had a meniscal compromise, treated in a non-invasive manner. Given the high percentage of meniscal injuries, Bennett stresses the importance of arthroscopy in the treatment of these fractures, especially in type I and II, given the frequent interposition of the meniscus in the fracture line. This author also found the meniscal lesion as the second most frequent cause of associated lesion: 20% of the cases. In all of their published cases, the meniscal injury always settled on the fracture side. In our statistics, dividing the population according to age group, we observed that in all patients younger than 40 years old (3 cases with type I, II and V fractures) there were lesions of the external meniscus, requiring two meniscectomies (1 radial lesion and 1 buccal loop lesion) and 1 meniscal suture (meniscal deinsertion). Ligament injuries, according to the different studies, occur in approximately 20% of fractures of the tibial plateau, and although they can occur in any type of fracture, they occur more frequently in shear fractures or in those with mixed mechanism. Their treatment is still a matter of discussion. Although there is a consensus that joint instabilities caused by ligament injuries or defects, and/or bone deformity cause poor results, there is still no consensus at the time for ligament repairs. Some authors support the need for ligament repair concomitantly with the fracture to obtain greater post-surgical stability and thus a satisfactory end result. Meanwhile, other authors do not consider repair necessary until the fracture is healed and the final stability of the knee is evaluated (21-30).
In our study, the ligament injury most frequently suspected before surgery was that of the medial collateral ligament, but the examination performed under anesthesia prior to reduction and osteosynthesis. However, after the fixation, the semilunar maneuvers were frequently negativized, indicating that in these cases the movements by the fracture lines generated instability. On the other hand, it has been difficult to evaluate collateral ligament injuries when there is a fracture of the tibial plateau. Martin has suggested assessing the medial opening space by applying a valgus force. This space should not be exceeded by 10 mm, since otherwise could cause a lesion of the medial collateral ligament. However, we agree with Moore, who maintains that there are other variables that alter medial space increase in addition to the lesion of this ligament, such as variations by radiographic magnification, ligament laxity, degree of knee flexion at the moment of exam, etc. On the other hand, the sinking or shearing of the fracture also alters the varus-valgus angulation of the knee. In cases of bone avulsion, we prefer to surgically treat acute lesions of the anterior cruciate ligament. Special care should be taken in type IV fractures requiring osteosynthesis with plaque, avoiding their placement in the perforation site of the tibial tunnel. With regard to osteochondral lesions, arthroscopic assistance allowed us to diagnose and repair 13 degrees III-IV injuries in 11 patients. Of these 13 injuries, 10 of them were in the femoral-tibial compartment contralateral to the fractured saucer, so open surgery would not have made it possible to diagnose and treat.

When analyzing the post-operative complications, the most important was a subacute infection, which required removal of the implant and antibiotic treatment. In our study, we did not have compartmental syndromes. In the literature, there are few reported cases associated with fractures of the tibial plateau (31-40). We know that the existence of an intra-articular bone injury added to the damage of the joint capsule predisposes the patient to this complication. It is also known that this complication increases its frequency with the use of infusion pumps. To reduce the risks, we performed arthroscopy without a pump and with an important outflow of liquids through a third portal. We agree with Fowble, who reports the best functional and cosmetic results in cases of closed reduction under arthroscopic control, attributing it to a better visualization and therefore definition and reduction of the fracture. This method also allows for an adequate diagnosis of meniscal, ligamentous, and osteochondral lesions (44-54), frequently associated with these fractures, with the possibility of repairing some of them in the same operative act. On the other hand, by avoiding extensive arthrotomies or meniscal de-insertion, and by properly eliminating hemarthrosis and osteochondral detritus, post-operative morbidity, hospitalization time, and optimization of rehabilitation are reduced, allowing for a rapid recovery of mobility with low pain.

References


