

Preliminary experience in the arthroscopically assisted treatment of tibial plateau fractures

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Summary. *Background and aim of the study:* Fractures involving the tibial plateau make up 1% of all fractures. Treatment can take advantage of various techniques, including arthroscopically assisted surgical reduction. This procedure is certainly viable for Schatzker III fractures and, in some cases, for Schatzker II. The use of the arthroscope makes possible a smooth reduction of the fractured bone, decreasing the risk of post-traumatic osteoarthritis, and also allows to diagnose and, if necessary, also treat the associated intra-articular lesions, which often are not highlighted during the classical preoperative investigations. *Methods:* In the last year we have operated with this technique 8 of the 22 cases of fracture of the tibial plate that have come to our emergency Department. Using the Schatzker classification, we performed an arthroscopically assisted reduction to treat type II and III fractures. The surgical operations involved a first arthroscopic phase, to assess intrarticular damage (bone, cartilage, ACL, PCL, menisci), a second phase for possible treatment of intrarticular lesions and reduction of fractures under arthroscope or open osteosynthesis. Finally, a last arthroscopic check was performed. *Results:* We obtained excellent results, as we were able to always have a fracture reduction of less than 1 mm, while clinically all the patients could have an early and almost complete functional recovery after only 2 months. *Conclusion:* The arthroscopically assisted technique could be an effective way to address the anatomical reduction of tibial plate fractures, but must only be used in the indicated cases. (www.actabiomedica.it)

Key words: tibial plate fracture, arthroscopically assisted reduction, Schatzker classification, fracture reduction

Introduction

Tibial plateau fractures are not particularly frequent and constitute about 1% of all fractures (1). Often they involve sports subjects, as they are more exposed to high-energy trauma (2). In elderly people, however, the incidence of this lesion rises to 8% and is usually linked to low-intensity traumas, which act on a weaker bone (3, 4).

In most cases, the traumatic mechanism leading to this type of fractures provides for an important distortive trauma in which there is a combination of valgus and compression forces, which cause the impact of the lateral femoral condyle on the lateral tibial

plate, causing a fracture with the sinking of the bone fragment. Less frequently, this injury can be caused by varus and compression trauma (2, 3, 5). There may then be factors that increase the chance of having these injuries, such as advanced age, osteoporosis and other comorbidities (3, 6). In these cases, even the compression force alone may be sufficient to cause a tibial plateau fracture (3).

The main classifications of tibial plate fractures are the one proposed by the AO and the one described by Schatzker (7-9).

The classification of the AO foresees 3 main groups of fractures:

Type A: extra-articular fractures;

Type B: partially articulated fractures, further divided into B1 (pure split), B2 (pure depression) and B3 (split-depression);

Type C: articular fractures, further divided into C1 (simple articulations, simple metaphyseal), C2 (simple articulations, multifragmentary metaphyseal) and C3 (multifragmentary articulations).

In the Schatzker classification, however, the fractures are grouped into 6 categories based on number and type of fragments resulting from the trauma. The first 3 types typically concern low energy trauma, while the others usually derive from high energy traumas:

I) Split fracture of the lateral condyle: resulting from a valgus trauma with axial force; typically in young subjects in which, thanks to the presence of a more resistant cancellous bone, there is only a fracture, without the compression of the fragment.

II) Split-compression fracture of the lateral condyle: in which the same type of trauma, however applied to a bone affected by osteoporosis, also produces the crushing of the articular surface with the sinking of the cartilaginous component inside the cancellous bone.

III) Pure compression fracture of the lateral condyle: here the force mainly involved is the axial one, which creates a pure sinking of the articular surface.

IV) Fracture of the medial plateau: resulting from varus traumas with axial force; fragment compression may also be present.

V) Fracture of both condyles: axial force acting on a fully extended knee; fragment compression may also be present.

VI) Complex bicondylar fracture with diaphyseal extension: high energy trauma causing a complex fracture in which the two tibial plates are separated by the diaphysis.

The main indication for arthroscopic assistance for the treatment of fractures is for type III ones according to the classification of Schatzker (5), but it is also possible to use it for type II fractures, provided that there is no excessive opening of the cortical bone.

The use of the arthroscopic assisted reduction technique for other fractures is inadvisable, as there is the risk of dealing with compartment syndrome (3, 5). Furthermore, for type II fractures with a breached cortical surface, if we want to use this technique for

reduction, we need to work with low pressures in the arthroscope.

The aim of the study is to evaluate if arthroscopy can be a valid solution in the treatment of some tibial plateau fractures.

Materials And Methods

In the year 2017, 22 tibial plate fractures came to our attention, at the Orthopedics and Traumatology Department of Piacenza (Italy). The patients were males in 68% cases (15) and females in 32% (7). The patient's age at the time of surgery ranged from 36 to 69 years, with an average of 47.4 years. The average weight at the time of the operation was 78.4 Kg. From the radiographic images and, for some cases, also from CT images, we could divide them according to the Schatzker classification and were 2 type I fractures, 5 type II fractures, 3 type III fractures, 4 type IV fractures, 2 type V fractures and 6 type VI fractures.

We treated with arthroscopic assistance all type III fractures and also all type II fractures, because we had not cases with large cortical involvement, reaching a total of 8 cases (Fig. 1). Of these, 6 cases involved male patients and 2 female patients, with an age at the time of the operation between 36 and 53 years, and an average of 44.2 years. The average weight at the time of the operation was 84.6 Kg.

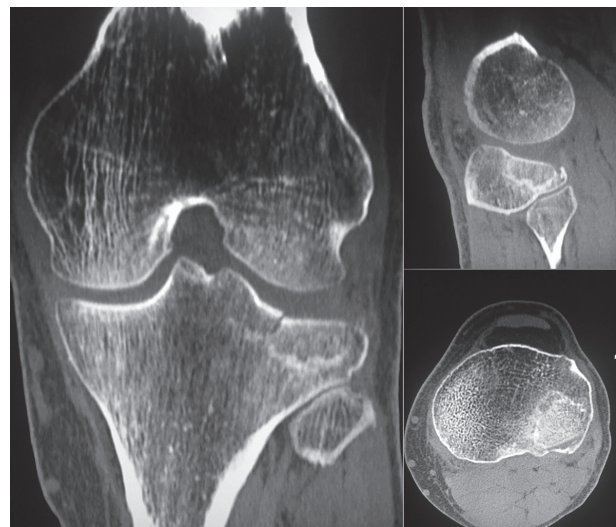


Figure 1. Pre-operative CT scan

For the surgery, we placed all the patients in supine decubitus on an operating table. A circumferential leg holder was applied to support the traumatized leg's thigh, allowing the surgeon to freely move the limb, both in flexion-extension and varus-valgus movements. A pneumatic tourniquet was placed at the proximal part of the thigh, which was inflated at the beginning of the surgery. The contralateral limb was held in the flexion-abduction position, while a c-arm was placed on the side of the patient. Distally to the tourniquet, a sterile field was set up. Through a standard two portals arthroscopy (anterolateral and antero-medial) it was possible to drain the hematoma and to wash the intra-articular cavity, after which, always through arthroscopy, we could clearly analyze the fracture and also check the state of the other joint structures (Fig. 2). If no other lesions were found, we can carry on with the tibial plate fracture treatment. Otherwise, the surgeon could possibly treat the concurrent intra-articular lesions (especially the meniscal lesions), before proceeding with the treatment of the fracture. In 2 cases we performed external meniscal suture.

The fracture was then arthroscopically analyzed. We proceeded by restoring the articular surface, using an tool to lift up the sunken bone fragment (Fig. 3) and through the arthroscope we looked at the reduction. Once we saw that the fragment had returned to the original anatomical position (Fig. 4), a synthetic bone graft was used to fill the gap that had formed.

Then, we passed to percutaneous or open osteosynthesis. In 3 cases we used the percutaneous treatment, inserting two cannulated screws of 7.3 mm; in 5 cases, instead, we did an open surgery with inserting a

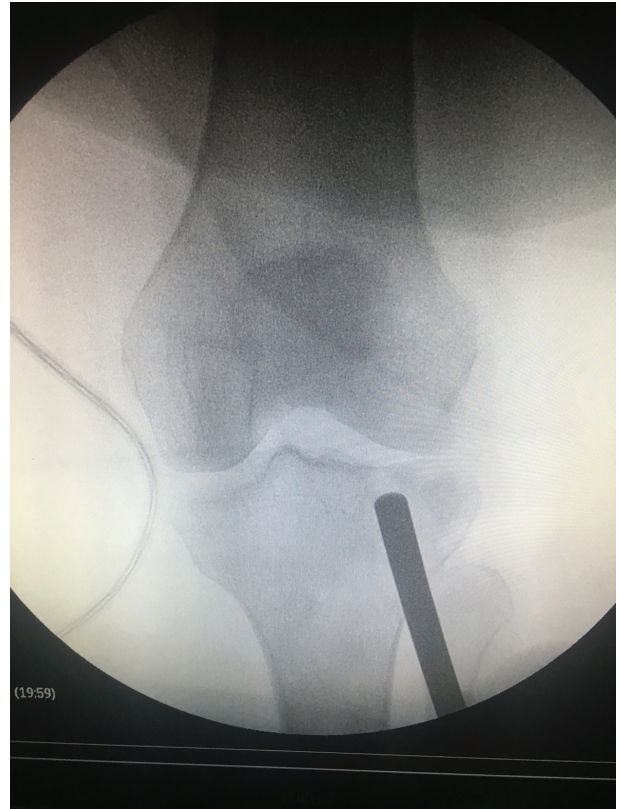


Figure 3. Intraoperative image of the tibial plate fracture's reduction

plate through a hockey stick incision, which was then fixed with screws.

At the end of the synthesis, after the last check with the c-arm, an additional arthroscopy was performed to verify the correct restoration of the tibial anatomy. Then, we moved on to the final phase, with the removal of the tourniquet, the profuse washing of

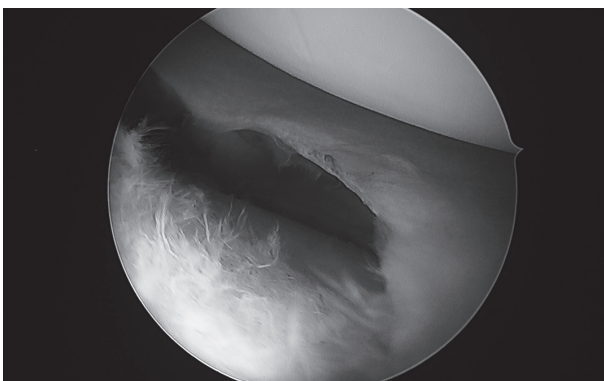


Figure 2. Arthroscopic view of the tibial plate fracture

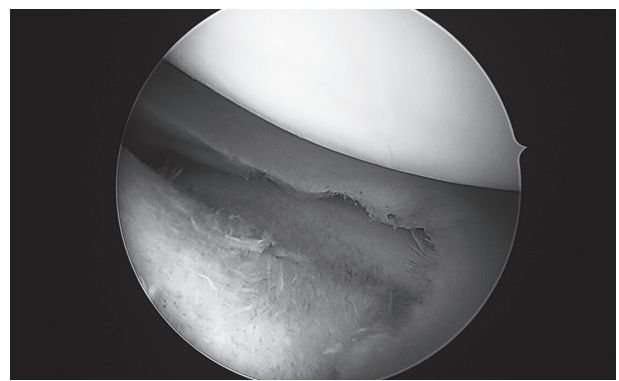


Figure 4. Arthroscopic result of the reduction

the joint cavity, the insertion of a drainage, the skin suture and, finally, the dressing.

The post-operative period was characterized by an early mobilization with flexion-extension exercises, to avoid the excessive stiffness of the joint. The load was not permitted for the first 4 weeks, after which an overflowing load was allowed in the next 3 weeks, and finally, the total load was progressively recovered.

During the resumption of the load, a DonJoy type brace could be used to avoid varus-valgus stress.

Results

The results achieved through arthroscopically assisted reduction were very good, both from the anatomical and clinical point of view. The arthroscopic view allowed us to evaluate the quality of the reduction in direct vision, which is not possible in the other treatments, and we could verify that we have obtained smooth anatomical reductions of less than 1 mm in all 8 cases treated, a result that is very difficult to achieve and check with other techniques. Moreover, thanks also to the rehabilitation protocol we have used, the excellent quality of the anatomical reduction obtained in the operating room has remained good over time, as demonstrated by the radiographic checks during the follow-up (Fig. 5).

Clinically, on the other hand, all 8 patients respected the rehabilitation time, and after 12 months from the surgery they all managed to obtain a flexion of at least 130° without pain (Fig. 6). But the most important thing is that after only 2 months the functional recovery was already almost complete, witnessing that, actually, the quality of the reduction is related to the clinical result.

At one year after surgery, during the control visit, all patients operated for tibial plate fracture were evaluated with the Knee Society Score (Table 1). We stratified the results obtained according to the category of fracture, and it was found that, for both the Knee score and the Funtion score, the highest scores were obtained from patients with type III fractures (total score 96), type II (total score 95) and type I (total score 93). Lower scores, however, were recorded by patients with type IV fractures (total score 90.5), type V (total score 87) and type VI (total score 84.5)

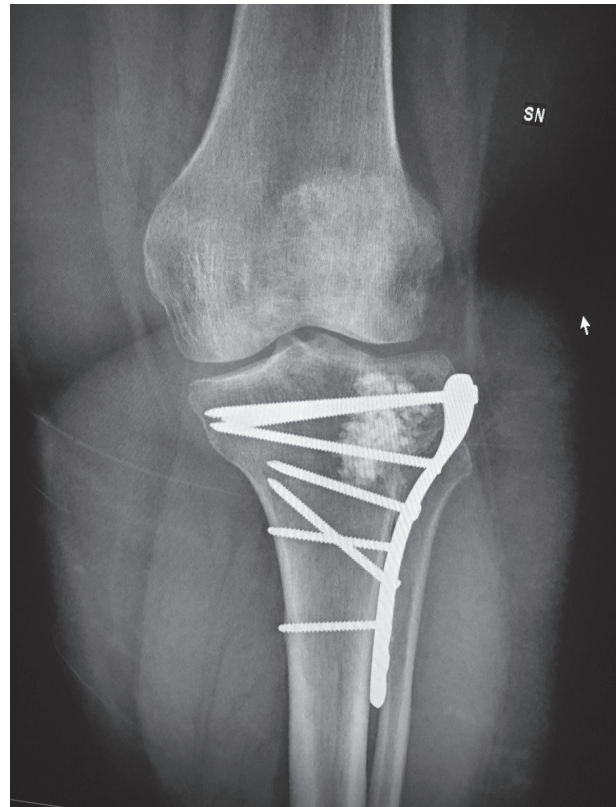


Figure 5. Post-operative radiography at 2 months



Figure 6. Post-operative result at 2 months. 120° flexion

Discussion

In the treatment of tibial plate fractures, two problems can arise: post-traumatic osteoarthritis and the non-diagnosis of co-occurring intra-articular lesions (2).

Table 1. Knee Society Score, 1 year after surgery

SCHATZKER CLASSIFICATION	KNEE SCORE	FUNCTION SCORE	TOTAL
I	90,0	96,0	93,0
II	92,0	98,0	95,0
III	94,0	98,0	96,0
IV	89,0	92,0	90,5
V	86,0	88,0	87,0
VI	82,0	87,0	84,5

Post-traumatic arthritis depends essentially on the quality of the reduction, consequently only being very accurate in the anatomical reconstruction of the joint we have the possibility to decrease the risk of incurring this long-term complication. Especially in Schatzker fractures type II and type III, the main problem that the surgeon must face is the collapse of the injured fragment that can cause a deformity of the articular surface and cause an altered mechanical functioning. Consequently, if the correct anatomy of the tibial plate is not restored, filling the empty space resulting from the compaction of the bone fragment, the joint will not be able to return to its normal status. The goal that the surgeon must pursue is that of a smooth anatomical reduction (2) of less than one millimetre and in any case not more than 2 millimetres.

The non-diagnosis of co-occurring intra-articular lesions derives from the fact that often a Magnetic Resonance Imaging to study meniscus, ligaments and capsule is not performed, and open surgery does not allow the precise diagnosis of these injuries nor even less their repair.

Arthroscopy can solve both these problems because the main advantages of its use are related to the possibility of optimally restore the anatomy of the tibial plateau, clearly see the intra-articular lesions and repairing them (3, 10). In addition, arthroscopic assisted reduction guarantees lower invasiveness than the ORIF (open reduction internal fixation) technique (2). A possible evolution of the technique could involve the use of a kyphoplasty balloon to lift the bone fragment that was sunk and also to firmly support it with the injection of an osteoconductive material (tricalcium phosphate), a synthetic bone or cement. This technique, which we have recently tested, allows us to be even less invasive and not to resort to large incisions, even if we want to wait for longer follow-ups before making final judgments.

Conclusion

Our clinical experience suggests that the arthroscopically assisted technique could be an effective way to address the anatomical reduction of tibial plate fractures, allowing us to perfectly restore the patient's anatomy with an optimal clinical outcome, avoiding both the risk of post-traumatic arthrosis and of excessive joint stiffness. This technique, therefore, offers significant advantages compared to the ORIF, but must only be used in the indicated cases.

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