Case report

High energy trauma with complex fracture of the right tibial plateau, compartment syndrome and infection in a professional freestyler motorcyclist

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Summary. High-energy tibial plateau fractures are complex lesions that may be associated with extensive soft tissue damages and severe complications, such as compartment syndrome and neurological injuries. This case report interests a professional motocross freestyler with complex tibial plateau fracture associated with compartment syndrome and partial common peroneal nerve impairment which complicated with a dehiscence of the surgical wound and infection after plate and screws fixation. One year later, despite the complexity of the fracture, the gravity of the soft tissue lesions and subsequent complications, the patient healed. This satisfactory result depended on the correct management in terms of type of treatment and timing.(www.actabiomedica.it)

Key Words: Knee; Tibial plateau; Fracture; Soft tissues; Fixation

Introduction

High-energy tibial plateau fractures are complex lesions that are often associated with extensive soft tissue damages and severe complications such as compartment syndrome and neurological injuries. The consequences of the severity of the injury and of an inadequate treatment can be seriuos and accompanied to unsatisfactory results. In this context it is important the correct timing of surgery, that inevitably adds further traumatism to soft tissues, thus augmenting the possibility of wound complication, especially if open reduction and internal fixation (ORIF) is performed (1).

For this reason, in the preoperative planning it is also important the distinction of tibial plateau fractures into complex and simple that allows to identify the more serious or potentially serious injuries, whose treatment is more difficult and more frequently characterized by complications. Zeltser in accordance with Schatzker (2) considers type IV, V and VI fractures as complex. Type V (fractures of the medial and lateral hemiplates without metaphyseal involvement) and VI (fractures of the two hemiplates with associated metaphyseal involvement) are consequent in most cases, above all in young patients, of high-energy traumas and for definition are multi-fragmented. Also type IV fracture (medial hemiplate fracture), although not multi-fragmented, generally derives from high-energy traumas and their typical mechanism (stress in varus) can cause strain injuries of the common peroneal nerve.

Optimal treatment of the tibial plateau fractures is still open to debate and a wide choice of methods can be used (ORIF, minimally invasive plate osteosynthesis, arthroscopically assisted fixation, external fixation); open reduction with internal fixation seems to be the best therapeutic option in complex fractures. In any case the goal of treatment is to obtain limb axis restoration, joint stability and accurate intra-articular reduction, avoiding further soft tissue damages (3,4); obtaining these aims is not simple and it requires excellent soft tissue handling and fracture reduction skills to avoid iatrogenic complications (5-10).

This case report refers of a professional motocross freestyler with complex tibial plateau fracture with compartment syndrome and partial impairment of the common peroneal nerve which complicated with a dehiscence of the surgical wound and infection of plate and screws.

Case report

A 32-year-old male, motocross freestyler, arrived at the emergency department of another hospital after an high-energy motorcycle accident with the diagnosis of complex fracture of the right tibial plateau (Figure 1) associated with acute compartment syndrome and partial impairment of the common peroneal nerve. The patient's only comorbidity was ulcerative rectocolitis. Colleagues performed in emergency a posterior and lateral fasciotomy, positioned the limb in transkeletal traction to the heel and applied a plaster cast. When 2 days later the patient arrived at our hospital (Figure 2), he had an ipomotility of the active dorsal extension of the foot and toes and a partial loss of sensibility of the dorsum of the foot.

A Computed Tomography CT scan with 3D reconstructions (Figure 3) was performed in order to study the characteristics of the fracture and to correctly plan osteosynthesis; according to Schatzker this fracture was classified as type VI (2). A bridging external fixator from the femur to the tibia was applied.

The patient underwent definitive fixation two weeks after trauma, thus allowing the soft tissues to heal. An isolated medial surgical approach was performed. Lateral and posterior surgical access were not executable due to the presence of the fasciotomy which were simultaneously closed. Multi-fragmented displaced fracture of the proximal tibial epiphysis associated with bone loss (Figure 4) was synthesized with ORIF with plate and screws. A cadaveric femoral head graft was positioned in order to fill the bone loss and to increase the stability of the fixation (Figure 5).

After surgery, the patient presented intermit-

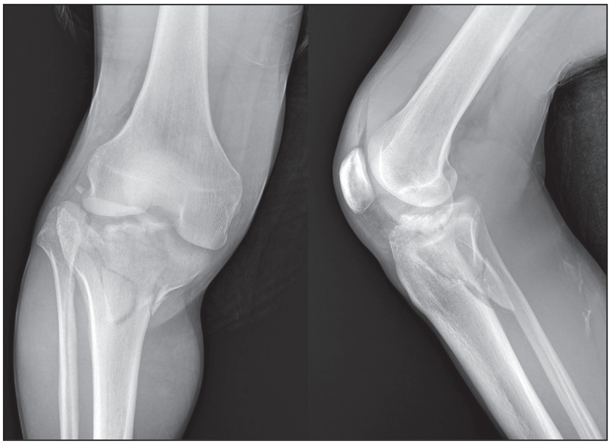

Figure 1. Pre-operative radiographs.

Figure 2. Clinical views 2 days after fasciotomy.

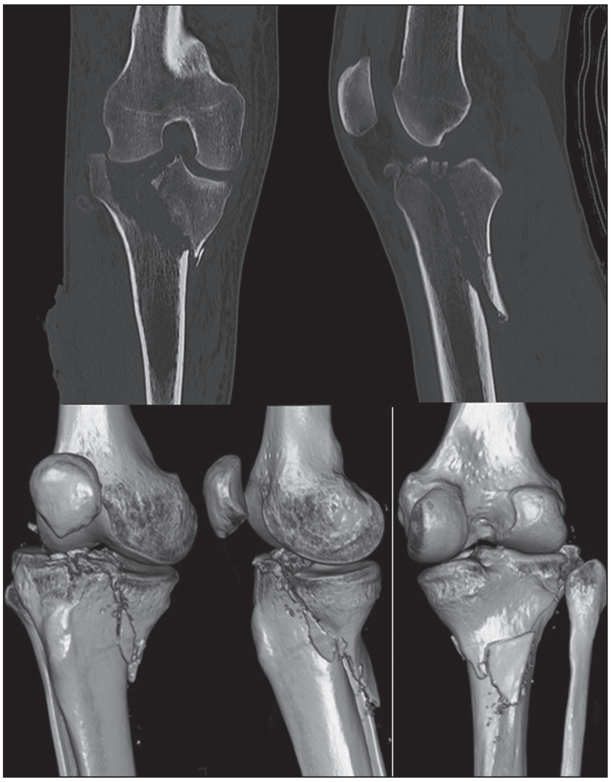

Figure 3. CT scans with 3D reconstruction.

tent fever and raised white blood cells; uro- and blood culture and pharyngeal swab were performed (results negative for ongoing infections). The surgical wound initially appeared normal but its condition progressively worsened (Figure 6), with dehiscence and serum-purulent secretion. Ten days after surgery, culture swabs were performed from the exudate of the surgical wound. The culture test report demonstrated the infection with Staphylococcus Aureus Methicillin Resistant. At the same time magnetic resonance imaging excluded the presence of abscess collections.

On the basis of the antibiogram, specific antibiotic therapy was started as prescribed by the infectious disease specialist. In the following days two surgical wound debridements were performed as well as hyperbaric therapy. These treatments were associated with plate and screws removal which was done 35 days after definitive fixation (Figure 7).

Figure 4. Intra-operative view which shows the bone loss.

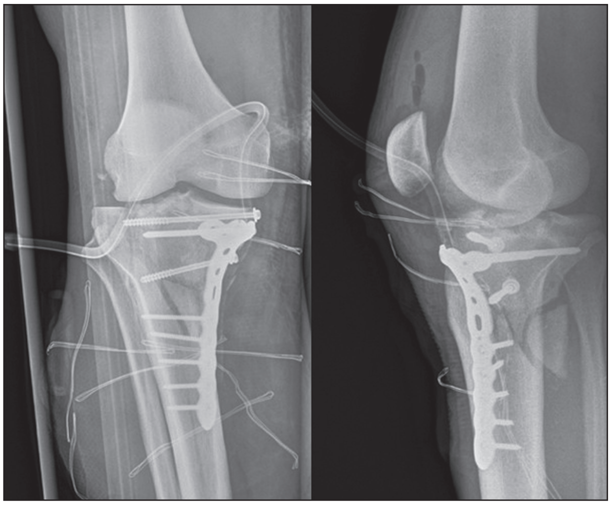

Figure 5. Post-operative X-rays following ORIF with plate and screws and bone graft.

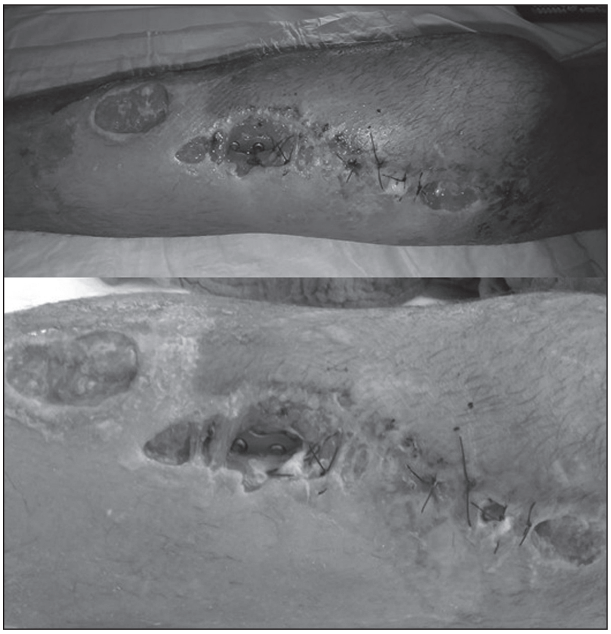

Figure 6. Dehiscence of the surgical wound.

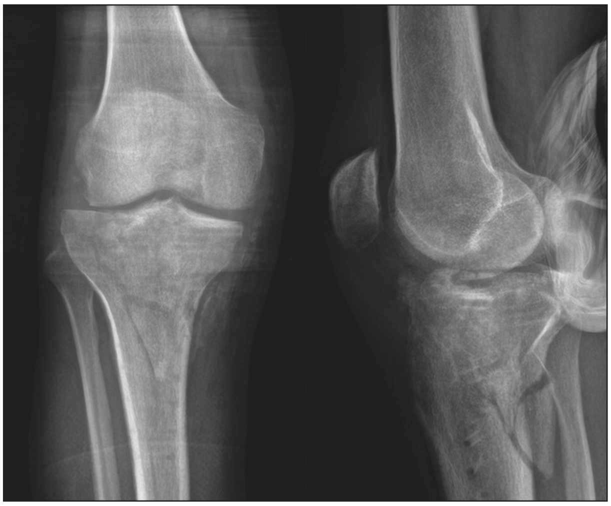

Figure 7. X-rays after removal of plate and screws.

The patient was discharged from the Hospital 2 weeks following the last surgery with a brace blocked at 30 degrees of flexion for another 2 weeks, a Codivilla splint and specific oral antibiotic therapy. During the following weeks the brace was progressively unlocked and the patient continued with assisted physiotherapy. Partial weight bearing was allowed 2.5 months after ORIF. Nowadays, the patient has obtained full load and he has started again his sporting activity. The inflammation indexes have progressively improved until normalization, as well elettromyographic findings.

X-ray controls performed 12 months after trauma demonstrated good graft osteointegration and fracture healing (Figure 8) with restoration of normal range of motion (ROM) (Figure 9).

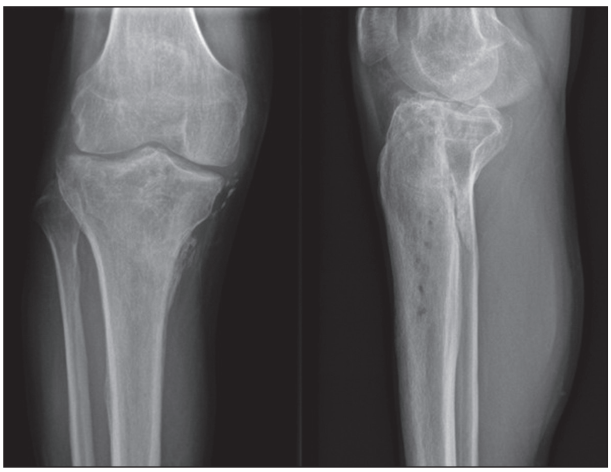

Figure 8. X-rays 12 months after trauma.

Figure 9. Clinical view 1 year after trauma.

Discussion

Tibial plateau fractures are common and can be due to high- or low energy traumas and can affect young adults or third-age patients (11-13). They represent 1% of all fractures (14). Their incidence progressively raised over the years mainly due to the increase of road, sports and work accidents and of high energy traumas (15).

The anatomy of the tibial plateau combined with high energy trauma produce complicated injury patterns with involvement of metaphysis, articular comminution and, frequently, with loss of integrity of the soft-tissue envelope (16). The severity of the trauma may also produce associated disruption of primary and secondary knee stabilizers (17,18). In a 2010 study, Stannard et al. reported an incidence of torn ligaments following tibial plateau fractures, as high as 85% and 79% in type V and VI respectively (17). Furthermore, this type of injury is also becoming more and more prevalent in the elderly, as consequence of low energy falls and osteoporosis (19). In such cases, soft tissue damage arises from the delicacy of the skin.

For these reasons complex fractures of the tibial plateau (Schatzker type IV, V and VI) are considered severe lesions even for experienced surgeons.

In 1916 Sever (20) was the first to describe three cases of condyle tibial fractures. Since then, numerous publications and case studies have been reported and all agree that the consequence of the severity of the trauma and of an inadequate treatment can be serious (21-25).

Soft tissue problems in fractures around the knee is of crucial importance. One should think that the fracture will not change but soft tissue will. In high-energy traumatisms, fractures should be considered as “substantial soft-tissue injuries with a broken bone inside” (12,26). As consequence, compartment syndrome can be a devastating complication of such traumas and its incidence can vary from 17% to 18.7% in closed and open fractures respectively (12). In particular, Schatzker V and VI fractures have a notoriously high incidence of compartment syndrome that can reach 30.4% for type VI in some studies (27,28) and are often accompanied by peripheral nerve lesions.

In this context it is very important the correct timing of surgery that inevitably adds further traumatism to soft tissues; therefore, the management in the early stages of treatment should focus on preventing their further injury while waiting to repair definitively the fracture (12). The optimal temporizing treatment in initial damage control is spanning external fixation (29). Spanning external fixators reduce fracture fragments via ligamentotaxis, along with providing pain relief and a stable environment for soft tissue healing, as well as early mobilization of the patient.

It is also important the distinction of tibial plateau fractures into complex and simple that allows to identify the more serious or potentially serious injuries, whose treatment is more difficult and more frequently characterized by complications.

CT is of great value for determining the location and magnitude of the joint depression, enabling greater precision of preoperative planning, while 3D reconstructions provide an estimation of metaphyseal bone loss, of articular comminution and joint depression. The importance of CT evaluation was best demonstrated through the identification of postero-medial and postero-lateral shear fractures as a distinct subtype of complex bicondylar tibial fracture prone to be missed by antero-posterior radiograph (30).

Optimal treatment is still open to debate. Non-operative management has historically been the preferred treatment for such fractures. However, surgery is now the preferred method of treatment for displaced fractures (31). A wide choice of fixation techniques can be used (ORIF, minimally invasive plate osteosynthesis, arthroscopically assisted fixation, external fixation) but open reduction with internal fixation seems to be the best therapeutic option in complex fractures (Schatztker IV,V,VI). In any case the goal of treatment is to obtain limb axis restoration, joint stability and accurate intra-articular reduction, avoiding further soft tissue damages (3,4). One of the major concerns of traditional ORIF in tibial plateau fractures is the wound infection, especially in high-energy tibial plateau fractures, in which deep infection and wound dehiscence is described in up to 87.5% of cases (31,32). For minimizing this complication the use of minimally invasive osteosynthesis and a ring fixator (EFMO) has been advocated. Despite EFMO is usually related to a worse articular reduction results reported are encouraging. A randomized study comparing ORIF versus EFMO in type C fractures showed that EFMO was associated with less blood loss, fewer unplanned re-operations and a shorter hospital stay without differences in 2 years functional results between groups (33). A recent review by McNamara comparing ORIF and EFMO did not find enough evidence to ascertain the best method of fixation but he concluded that current evidence does not contradict the idea of the best results obtained when using limited exposures to treat these fractures (34).

Furthermore, arthroscopy-assisted minimal invasive surgery is now an attractive option among available surgical treatments. The advantages are direct visualization of intra-articular fractures, more accurate reduction, reduced morbidity in comparison with arthrotomy, possibility to diagnose and treat associated meniscal and ligamentous injuries and removal of loose fragments (31,35,36). Arthroscopic assisted treatment has been widely accepted as a safe method for the treatment of Schatzker I–IV fractures, but still remains controversial regarding V and VI injuries for several authors (37-39) because of the high danger of iatrogenic compartment syndrome from fluid extravasation even though its occurrence is reported extremely rarely in the literature (38,40).

This case report summarizes all it has been explained in this discussion (high-energy trauma, complex fracture, compartment syndrome, nerve impairment and wound infection). Despite all these negative variables, the result was satisfactory. Authors believe that this positive outcome depended on the precise management of the lesions both for the therapeutic strategy and for its correct timing.

Conclusions

High-energy tibial plateau fractures are complex lesions that may be associated with extensive soft tissue damages and severe complications. The success of their treatment depends on the precise surgical procedure and on its correct timing. Soft tissues evaluation is as important as bone care. Minimally invasive techniques may improve results.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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Received: 10 October 2020
Accepted: 20 November 2020
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