FRACTURES OF TIBIAL SPINES IN THE PEDIATRIC AGE: REVIEW

Daras Ballester, Álvaro; SalomTaverner, Marta

:

Objective of the review: *Despite the fact that tibial spine fractures are rare, their importance should be taken into account due to their proximity to the proximal tibial physis, as well as their relationship with the insertion of the anterior cruciate ligament, one of the most important stabilizers of the knee. This review aims to synthesize the concepts about the diagnosis, management and prognosis of these lesions described by the most up-to-date literature.*

Novel concepts: *the current literature describes the existence of different treatment modalities, both conservative and surgical, without determining clear differences between them in the long term. However, criteria are established to guide their treatment based on the characteristics of the patient and the fracture.*

Abstract: *Tibial spine fractures in children are rare injuries.*
Generally, it is the symptoms and the lesion mechanism that make us suspect these fractures, and the definitive diagnosis is achieved with imaging tests, sometimes requiring CT or MRI. Regarding the treatment of these fractures, there is no clear consensus, due to the great variety of therapeutic options, but it can be affirmed that the treatment of choice for displaced fractures is surgical reduction and fixation.

Corresponding Author

INTRODUCTION

Fracture-avulsion of the tibial spine is a rare injury (approximately occurs in 3 out of in children every 100,000 children per year), it accounts for around

2% of all knee injuries in the childhood, and its incidence peaks between 8 and 14 years of age (1-8)

Among the main causes of these injuries we found the accidents sports, generally bicycle falls. Usually, the mechanism of injury is the same as that which produces an injury to the Anterior Cruciate Ligament (ACL) in an adult patient: rotation of the tibia with respect to the femur and forced hyperextension of the joint.

(1,2).

Most of the time the lesion occurs in the area of the anterior intercondylar eminence (with a frequency of 10:1 compared to the posterior one) (1-7).

.

These fractures can be associated with ligamentous injuries (Anterior Cruciate Ligament ether Ligament Collateral Medial preferably) and meniscals, so in the initial evaluation they should be assessed and discarded, since if they go unnoticed they can cause laxity or residual instability in the long term(1-7). .

SURGICAL ANATOMY

The intercondylar eminence is the region of the proximal surface of the tibia that lies between the tibial plateaus. Inside it, we find a anterior eminence (between the anterior poles of both menisci) and a posterior one (1)

.

Furthermore, within the eminence intercondylar we find two tuberosities or spines (medial and lateral).

At its distal insertion, the ACL presents two fascicles (anterior and lateral), which are respectively inserted in the anterior zone of the medial tibial spine and in the

anterior horn of the medial meniscus. For his

On the other hand, the PCL does not insert on the tibial spines, but just posterior to the tibial eminence (1) (Figure 1).

In the immature skeleton, the surface of the intercondylar eminence lies

covered entirely by cartilage(1) .

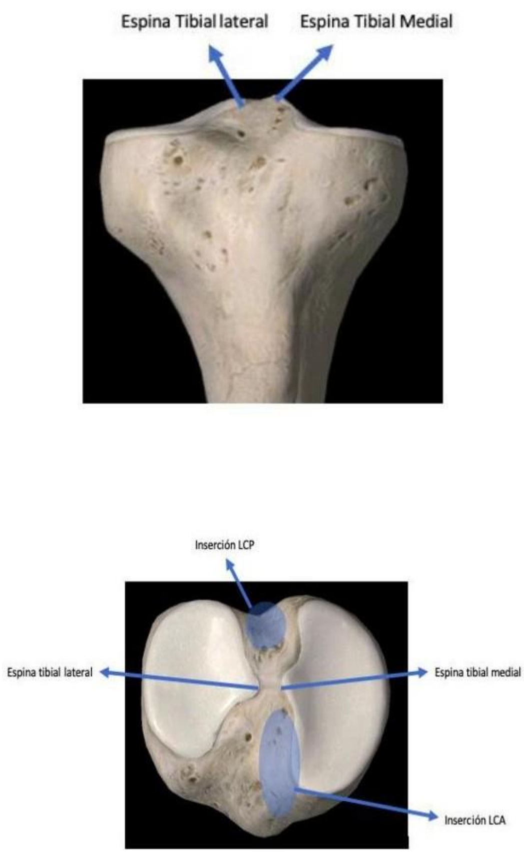

Figure 1: anatomy of the intercondylar eminence, where we can see the ACL and PCL insertions referenced.

In the immature skeleton, the tibial spine is weaker than the ACL, since it is not completely ossified, so the same overload that can cause an isolated ACL lesion in an adult can cause failure of the ACL in a child. subchondral spongy bone, producing avulsion of the tibial spine (1-5) (Figure 2).

Due to this same mechanism of action, a percentage of 29 to 35% of medial meniscus entrapment has been described under the avulsed fragment, which can make it difficult to reduce it (1,2). .

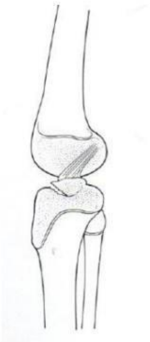

Figure 2: As the tibial spine is weaker than the ACL, the mechanism of injury that would produce an ACL injury in the adult may result in avulsion of the tibial spine.

CLASSIFICATION

The most widely used classification is the one proposed by Meyers and McKeever in 1959, based on the degree of displacement, and later modified by Zaricznyj(1-3,8,9) (Figure 3):

TYPE I: minimally displaced fracture.

TYPE II: displacement of the anterior third is observed, producing a “hinge” type lifting of the fragment.

TYPE III: a complete separation of the fragment is observed.

TYPE IV (added later by Zaricznyj): like type III but with rotation of the fragment or significant comminution.

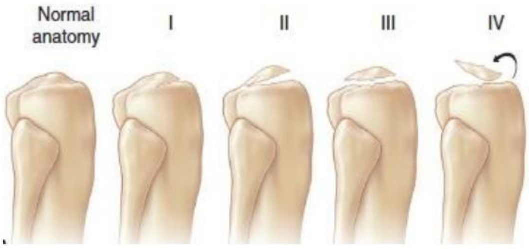

Figure 3: Meyers classification and Mckeever, modified by Zaricny(1)

CLINICAL EVALUATION

In general, we will find a patient who presents, after a mechanism of torsion of the tibia on the femur with extension of the Associated knee, significant pain at the knee level, which limits the range of active and passive flexion and extension and makes it impossible to load the affected limb. Therefore, the patient will refuse to walk. It is very typical to find an attitude of semiflexion of knee, and attempts at passive extension will produce intense pain.

It is also common to find effusion articular, which, in the case of evacuating arthrocentesis, will basically consist of hemarthros(1,2,8) .

As for the maneuvers to assess joint stability, they will be difficult to perform in the acute moment, but it may be useful, in a first exploration, to rule out the injuries that are most frequently associated with this type of fracture, which are the injury at the level of the MCL and ACL (1-8).

EXPLORATIONS COMPLEMENTARY

The first imaging test that will offer information will be the simple anteroposterior and lateral X-ray of the knee, it being easier to observe this type of lesions in the lateral projection (Figure 4). On occasions, the avulsed fragment may be composed mainly of non-ossified cartilage and a thin ossified fraction, so the injury may be underestimated or even go unnoticed. Another useful radiological projection is the anteroposterior projection with inclination parallel to the tibial articular surface(1-4,8,9) .

It is important to note that if the physical examination suggests a collateral ligament injury or a physeal fracture, it may be stress or overload tools X-rays under sedation, although this point is currently in controversy, in fact, this type of surgery is not performed at our center. of imaging tests, considering MRI to be more useful and less aggressive.

The realization of Tomography Computed (CT) can be useful to broaden the diagnostic study and classify the fracture, especially if the degree of displacement cannot be clearly assessed on the lateral radiograph, to carry out adequate surgical planning in cases of displaced fractures, as well as to assess joint congruence after closed reduction in type II fractures (1,2,6,8)

.

As already mentioned, another useful diagnostic test is MRI.

Magnetic (MR), which can be of great value to identify possible associated soft tissue injuries, preferably in patients with non-displaced fractures that are not going to undergo surgical intervention, as well as to identify purely cartilaginous fragments that may go unnoticed on radiographs or CT (1,2,6,8)

.

to)

b)

Figure 4: Anteroposterior (a) and lateral (b) radiographs in a patient with tibial spine fracture. The lateral projection shows the fracture more clearly.

TREATMENT

The therapeutic decision is based on the type of fracture according to the Meyers and McKeever(1-12) classification .

Type I: in this type of fracture, in which displacement of the fragment is minimal, the treatment of choice is orthopedic, through the placement of a closed ischiopedic cast in knee extension. Prior to immobilization, it is important to drain the hemarthros, if this

It exists to reduce pain and favor the knee extension position. Regarding the full extension or not of the knee, there is controversy in the literature, since there are authors who defend immobilization in full extension (1,6,8) since this position allows contact between the femoral condyles and the avulsed fragment. , which , will help to maintain the reduction of the fracture, and

others defend immobilization at 10-20º knee flexion to promote correct ACL tension and avoid posterior laxity(2,8) .

After immobilization, follow-up is usually done every 2 weeks until removal cast at 6 weeks.

Type II: are those fractures in which we find an anterior displacement of the fracture. In the face of these fractures, the initial treatment, described at the time by Meyers and Mckeever, is orthopedic,

by closed reduction by a knee hyperextension maneuver, having previously performed an evacuating arthrocentesis, and immobilization using an ischiopedic cast in extension or slight knee flexion (following the principles of type I fractures).

However, it is possible to not obtain a correct reduction by closed maneuvers or that there is a subsequent displacement of the fracture, generally due to interposition of the intermeniscal ligament or the anterior horn of the medial meniscus, for which reason in In these cases, reduction would be indicated. open or arthroscopic treatment of the fracture and subsequent immobilization with a closed cast in knee extension or slight flexion. The results described are similar for the two types of treatment.

Follow-up of this type of fracture is very similar to Type I, and it is noteworthy that, on occasions, it may be convenient to perform a control CT to assess the correct reduction, and an MRI may even be considered to rule out injuries. meniscal or ligamentous

associates.

Type III and IV: these are fractures in which there is a significant displacement of the fragment. Closed reduction is not usually effective in these cases, so an open reduction of the fracture is chosen, which allows cleaning of the hematoma and possible chondral debris, as well as inspection of the anterior horns of the menisci and removal of the menisci. meniscus if it is interposed and preventing reduction of the fragment.

The main controversy regarding the surgical treatment of these fractures is whether it is more convenient to

performing surgery (arthrotomy) or open arthroscopic surgery. Results have been reported in the literature excellent for both procedures, the results being equivalent between they.

However, there are disadvantages described for and each of the procedures, having described, for example, a lower rate of surgical complications, hospitalization time and postoperative pain in patients undergoing arthroscopy (1,2,7,8,10- 12), as well as lower rates of arthrofibrosis in patients undergoing arthrotomy, since it has been seen that there is a greater risk of arthrofibrosis according to the time that elapses from the injury to the intervention, and normally, patients wait less time if they are operated by arthrotomy(2,4,7,8,9,12) .

In addition, within surgical treatment, there are also two procedures described for fragment osteosynthesis: cannulated screws or transosseous sutures; Satisfactory results have been described for both options.

After osteosynthesis, immobilization is performed for 4 weeks.
Several authors defend the mobilization early from 4 weeks to avoid arthrofibrosis(4,5,6,7,8,12) .

Next, we proceed to describe both surgical techniques described:

Arthrotomy: A small anteromedial parapatellar approach is usually performed. An inspection of the joint is carried out, which allows the evacuation of the hematoma formed and the chondral remains, as well as the reduction of the
fragment. Subsequently, the osteosynthesis technique is performed, which may vary depending on the characteristics of the patient or avulsed fragment:

In young children, it is common to find a voluminous fragment composed mainly of cartilage, so after reduction it is possible to choose to synthesize the fragment by means of a peripheral suture.
absorbable directly on the bed fractured.

In the adolescent or if we find a smaller fragment and greater bone consistency, the atroscopic suture option is very attractive: it consists of intertwine a non-absorbable suture to through the distal portion of the ACL, performing a Krakow-type suture, and extracting it through the avulsed fragment of the tibial spine itself. Next, from an anteromedial entry point on the tibial metaphysis, two holes are drilled obliquely directed towards the medial bed of the tibial epiphysis (in a distal-proximal direction), carefully avoiding the physis. Next, the fragment is repositioned in its bed, extracting the sutures through the bone tunnels made and tying on the anteromedial aspect of the tibial metaphysis (Figure 5).

In skeletally more mature patients, where the integrity of the physis is not as much of a concern, and where the osteochondral fragment is of sufficient size (>1cm), the tibial spine can be fixed with a metaphysically directed minifragment screw. This technique requires an adequate osteochondral fragment and a sufficient width of the epiphysis so as not to damage the physis (Figure 6).

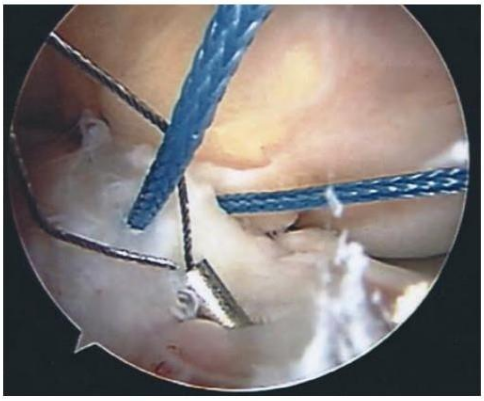

Figure 5: Krakow-type suture at the distal level of the ACL, passing the sutures through the bone fragment and tunnels and tying on the anteromedial aspect of the tibial metaphysis.

Figure 6: cannulated screw osteosynthesizing the osteochondral fragment.

Arthroscopy: the portals used usually they are the anteromedial and the anterolateral. Once the joint, it is important to locate the intermeniscal ligament and anterior horn of the medial meniscus and displace them to avoid their interposition at the fracture site. The use of an 18-gauge needle allows maintenance of retraction of the intermeniscal ligament. The reduction of the fracture will be performed using the probe explorer and the palpator hook (Figure 7). Next, the osteosynthesis of the fragment will be carried out (following the same principles of osteosynthesis described in the open technique), with the following considerations:

Osteochondral fragments larger than 1cm with good bone component: osteosynthesis using a cannulated screw 20mm, placed in such a way that it does not affect the physis (same technique as with arthrotomy). The screw head should be within the substance of the LCA to avoid impingement in extension (Figure 8).

It must be taken into account that the placement of a transphyseal screw in skeletally immature patients requires the removal of osteosynthesis material in 3 months to avoid physeal closure and recurvatum deformities.

Fragments smaller than 1cm: the method of choice is the use of sutures, following the technique described in the "arthrotomy" section (Figure 5).

Figure 7: arthroscopic reduction of the fragment.

Figure 8: osteosynthesis arthroscopic through cannulated screw.

AVULSIONS DUE TO LCP START

These are rare injuries, and treatment depends on the degree of displacement (1):

Non-displaced lesions: immobilization in ischiopedic cast for 6 weeks.

Minimally displaced lesions: there is controversy regarding treatment

orthopedic by cast immobilization or open reduction and internal fixation.

Displaced lesions: open reduction and immobilization fixation internal. Subsequently with plaster for 4 weeks.

In these cases, it has also been described similar results between the performance of arthrotomy (posterior approach) either arthroscopy. Regarding internal fixation, it can be done with a cannulated screw if the fragment is large enough or by sutures if the fragment is small.

PROGNOSIS AND COMPLICATIONS

The prognosis for these fractures is generally good, especially if an anatomical reduction of the fracture is achieved. Most patients recover excellent joint balance, and 85% of patients are able to perform activities with a high functional demand (1)

.

Still, there are certain complications stand out:

In some studies a complete lack has been detected, preferably in type II and III fractures, of extension

due to fragment interposition, although normally these are deficits of less than 10º. In case of producing a lot of symptoms, the poorly consolidated fragments can be excised and the ACL reinserted(1,2,8,9) .

Arthrofibrosis is the second most frequently observed complication, generally due to excessive immobilization time, and there are reported rates of up to 60% of patients with a loss greater than or equal to 10º of joint range.

(2,3,9,12).

Another complication seen in some studies is the sensation of knee instability, it has been described that up to 64% of patients complained of anterior instability(1,3) .

There are studies that describe that up to 74% of patients offer a small increased laxity in the maneuver Lachman regarding the contralateral knee. However, very few patients will report symptoms(1,2,8,12) .

The laxity may be due to inadequate reduction of the fragment, resulting in lack of ACL tension.

Complications derived from undiagnosed MCL ruptures or concurrent physeal injuries (1)

.

BIBLIOGRAPHY

Riccio, A.I., Wilson, P.L., Wimberly, R.L. Disorders of the neck. In: JA Herring, Tachdjian's Pediatric Orthopedics. 5th Edition. Texas: Elsevier Saunders; 2014 (pp: 1442-1447).

Adams, A., Talathi, N., Gandhi, J., Patel, N., &Ganley, T. (2018). Tibial Spine Fractures in Children: Evaluation, Management, and

Future Directions. The Journal of Knee Surgery, 31(05), 374–381.

Bogunovic, L., Tarabichi, M., Harris, D., & Wright, R. (2014). Treatment of Tibial Eminence Fractures: A Systematic Review. Journal of Knee Surgery, 28(03), 255–262.

Watts, C.D., Larson, N., Milbrandt, T.A. (2016). Open versus arthroscopic reduction for tibial eminence fracture fixation in children. Journal of Pediatric Orthopedics, 36:437-439.

Momaya, AM, Read, C., Steirer, M., & (2018). R. Outcomes after Estes, arthroscopic fixation of tibial eminence fractures with bioabsorbable nails in skeletally immature patients. Journal of Pediatric Orthopedics B, 27(1), 8–12.

Scrimshire, A. ., Gawad, M., Davies, R., & George, H. (2018). Management and outcomes of isolated pediatric tibial spine fractures. Injury, 49(2), 437–442.

Osti, L., Buda, M., Soldati, F., Del Buono, A., Osti, R., & Maffulli, N. (2016). arthroscopic treatment of tibial eminence fracture: a Systematic review of different fixation methods. British Medical Bulletin, 118(1).

Shin, Y.-W., Uppstrom, TJ, Haskel, JD, & Green, DW (2015). The tibial eminence fracture in skeletally immature patients. Current Opinion in Pediatrics, 27(1), 50–57.

Gans, I., Baldwin, KD, & Ganley, TJ (2013). Treatment and Management Outcomes of Tibial Eminence Fractures in Pediatric patients. The American Journal of Sports Medicine, 42(7), 1743–1750.

Bomar, JD, & Edmonds, EW (2016). Surgical Reduction and Fixation of Tibial Spine Fractures in Children. JBJS Essential Surgical Techniques, 6(2), e17.

Ganley, TJ, & Brusalis, CM (2016). Surgical Reduction and Fixation of Tibial Spine Fractures in Children. JBJS Essential Surgical Techniques, 6(2), e18.

Vander Have, KL, Ganley, TJ, Kocher, M. S., Price, CT, & Herrera-Soto, JA (2010). Arthrofibrosis after Surgical Fixation of Tibial Eminence Fractures in Children and adolescents. The American Journal of Sports Medicine, 38(2), 298–301.