

Surgical treatment of anterior iliac spines fractures: our experience

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Abstract. *Introduction:* Iliac spines fractures represent 4% of all pelvic ring fractures and affect more frequently young people with open growth physis. These lesions are usually the consequence of an indirect avulsion trauma due to a sudden and forceful contraction of the muscles that take their origin on these structures. The treatment can be conservative or surgical according to the size and the amount of the dislocation of the fragment. The aim of this study was to evaluate the outcomes of surgical approach of these fractures. *Materials and methods:* Between 2002 and 2010, 9 patients with fractures of anterior iliac spines were surgically treated. All patients, after an average follow up of 48 months, were evaluated clinically with the Non-arthritic Hip Score (NAHS) and radiographically in order to detect their consolidation. Complications related to the fracture and its treatment were analyzed. Time between trauma and return to sport performance (RSP) was recorded. *Results:* Mean NAHS was 98 points and RSP averaged 82 days. In 2 cases a transient meralgia paresthetica was observed. In 2 other cases follow-up radiographs showed asymptomatic hyperostosis around the iliac spines. *Conclusion:* The treatment of iliac spines fractures is mainly conservative. When fragment size is bigger than 2 cm and is dislocated of more than 2 cm surgical treatment is indicated. We recommend a fixation with metallic screws in order to obtain a more stable fixation and an earlier recovery especially in high demanding patients. (www.actabiomedica.it)

Key words: anterior iliac spines, avulsion, fracture, apophysis, growth plate

Introduction

From the anatomical and structural point of view the margins of the ileum have poor bone density. On the contrary the acetabulum and sacroiliac region, where the lines of force are higher, are characterized by a superior bone density. Cunningham and Black demonstrated the existence of a lower trabecular density in the marginal areas of the pelvis even before the skeleton is solicited by loading forces. This explains why the iliac spines offer less resistance to tensile forces (1).

The iliac spines are apophyses of the pelvis, secondary centers of ossification that appear during adolescence and fuse between 15 and 25 years of age (2, 3). In particular, the anterior superior iliac spine (SIAS) begins ossification and fuses permanently with the iliac bone respectively at 15 and 19 years of age. The anterior inferior iliac spine (ASIS) instead begins ossification around the age of 14 and ends permanently about 2 years later (4-6).

The sartorius muscle and the tensor fascia latae originate from SIAI. The direct (main) bundle of the rectus femoris originates from the SIAS and the

indirect from the superior margin of the acetabular. Each muscle acts both at the level of the coxo-femoral joint and of the knee level and, in relation to the position of the limb, is susceptible of increasing loads during muscle contractions (7).

Few studies in the literature describe these particular fractures/avulsions and their consequences in young athletes during growth (1, 2-6). Their incidence is underestimated because often the symptoms are not significant. Recent studies attest their incidence at 4% of all fractures of the pelvis (8, 9) and at 1.4% of all fractures of the athletes (10). This latter datum is likely to increase as adolescents begin sports activities at an earlier age than previously and more aggressively.

They are more common in males than females (13:1) (11) as consequence of the earlier fusion of the growth plates in the former, and their greater muscle masses (12-15).

The pathogenesis of fractures of the iliac spines is multifactorial (16-18). In the majority of cases these lesions are the result of avulsion traumas with the hip extended and the knee flexed and derive from sudden and intense contractions of muscle groups that originate on these structures (19), as it happens in many sports such as football, rugby, athletics and gymnastics. Less frequently they are consequent to intense and repeated submaximal strains (20-22), that may favor the development of apophysitis which result in bone fragmentation considered as stress fractures (23,24). Even more rarely the pathogenetic mechanism is a direct blow at the level of the spines.

On the other hand, in adults, these avulsions, which are much rarer, are due to the same mechanisms, although in these cases the physician has always to exclude in the differential diagnosis a pathologic fracture caused by a primary or secondary bone tumor (25).

The treatment of fractures of superior iliac spines can be conservative or surgical depending on the size of the major axis of the fragment detached and the extent of its dislocation.

The purpose of this study was to evaluate the results of surgical treatment in 9 patients affected by fracture/avulsion of the superior iliac spines in adolescents and young adults.

Materials and methods

Between 2002 and 2010, at the Orthopaedic Clinic of the University Hospital of Parma, 9 avulsion fractures of the anterior iliac spines were surgically treated [6 of the SIAS (Figure 1 and 2) and 3 of the SIAI (Figure 3 and 4)].

Seven patients were male and 2 females. The mean age was 16 years (range 12-22). In 5 cases the avulsion affected the right side and in 4 the left side. All patients reported an acute indirect trauma during their sporting activities (7 during soccer match and 2 during athletics) with the hip flexed and the knee extended. In particular, the onset of painful symptoms in soccer players was consequent to a kick to the ball in 3 cases and to the ground in 4, to sudden muscle contractions during the jump (1 high jumper) or departing of running (1 runner).

Two patients described chronic pain associated with weakness in the weeks before trauma that increased during exercises.

One patient, in addition to pain, reported paresthesias in the anterolateral area of the thigh presumably due to a compression of the lateral femoral cutaneous nerve determined by the avulsed fragment.

The clinical diagnosis was confirmed by an anteroposterior radiographic view of the pelvis in 4 cases. In 5 cases additional x-ray projections (oblique) were necessary. In 5 patients a computed tomography (CT) was also performed in order to better quantify the size of the fragment and the extent of its dislocation. With the same aim 2 cases (the youngest of the case series) underwent magnetic resonance imaging (MRI).

Surgical treatment was indicated when the extent of dislocation was greater than 2 cm and when its major axis was more than 2 cm. The type of fixation was chosen after intraoperative evaluation according to Di Giovanni's classification (26), which divides these lesions in fractures that interest the osseous part of the apophysis or in avulsions that interest only the cartilaginous growth plate of the apophysis.

Fixation devices that were implanted were metallic screws (3.5-4.5 mm of diameter) associated to washer in 5 cases (Figure 2 and 4), absorbable screws in 3 and Kirschner wires in one. All patients operated had a mean period of 30 days of immobilisation without weight



Figure 1. Right SIAS avulsion fracture in a soccer player of 17 years of age; preoperative x-ray and 3D CT



Figure 2. Fracture after consolidation at follow-up of 48 months (fixation with screws and washers)

bearing. In 2 out of 9 patients, a leg spica cast with the hip in 30° of flexion was applied because the fixation obtained was considered unstable (1 case treated with absorbable screws and 1 with kirschner wires).

For all patients, the period of immobilization was followed by five weeks of progressive passive and active physiotherapy of the limb with a gradual recovery of flexion, external rotation and abduction, and protected walking. At the end of this period, according to the symptoms of each patient, a gradual resumption of athletics until full return to sports was allowed.

All patients, with a mean follow-up of 48 months (range 24-120), were evaluated clinically using the NAHS (27) and radiographically in order to verify the consolidation of the fracture. The complications related to the injury and their treatment and RAS were also analyzed.

Results

The average score of the NAHS was 98 points (range 93-100). All patients returned to sports activities after an average period of 82 days (range 70-102). All fractures consolidated. The two patients, in whom it was applied the cast, poorly tolerated this type of immobilization. In two patients meralgia paresthetica was observed. In one case this clinical finding was present before surgery, thus suggesting toward a diagnosis of conflict between the nerve and the avulsed fragment. The disappearance of symptoms 40 days after surgery confirmed this suspicion. In the second patient these symptoms appeared in the postoperative period



Figure 3. SIAI avulsion fracture in an athlete of 19 years of age; preoperative x-ray and 3D CT

and resolved spontaneously 6 months postoperatively. In two patients the radiographs at follow-up showed an exuberant bone formation around the physis that did not require any additional treatment (one patient treated with Kirschner wires and one treated with resorbable screws). Fixation devices had to be removed



Figure 4. X-ray at follow-up of 36 months. The fracture is consolidated without hyperostosis after fixation with metallic screw

in 2 cases as consequence of impingement with soft tissues respectively after 8 weeks (Kirschner wires) and 1 year (screws). In the 3 cases in which absorbable screws were implanted, radiographs at follow-up have always shown their complete resorption.

Discussion

The incidence of fracture-avulsion of the anterior superior iliac spines is underestimated because symptoms are often not significant and, because of this, are considered as simple muscular or tendinous injuries. Recent studies attest their incidence to 4% of all fractures of the pelvis and to 1.4% of all fractures of the athletes (8-10). This latter datum is expected to increase as consequence of the more intensity and as earlier beginning of sport's activity (22, 23).

These lesions usually affect young athletes in which growth plates have not yet been fully fused

and the pathogenetic mechanism which is involved is often related to an indirect avulsion trauma derived from sudden muscle contractions with the hip flexed and the knee extended. This attitude of the limb is typically assumed in some sports such as when shooting in football, in the deadlift in the high jump and at the start of the speed disciplines of athletics, as also observed in our series. Normally, the history and the description of the trauma, the acute onset of pain in the hip / groin during sports activities associated with positive radiographic findings are sufficient to make the diagnosis of iliac spines fractures. If these fractures are clinically suspected but are not shown on x-rays (28) it is useful to perform a CT scan. This examination, possibly with 3D reconstruction, is also useful in order to analyze the fractured fragment, to better plan the osteosynthesis as well as for the differential diagnosis with a fracture of the secondary ossification center of the superior rim of the acetabulum (28). Usually MRI is not performed although in younger patients may be useful to better quantify the cartilaginous part of the fragment. Furthermore, as an alternative, ultrasound can help in the study of myo-tendinous structures whose injury may be associated with the avulsion (29) and for early identification of those cases of chronic apophysitis that may predispose to these fractures (30).

The treatment of anterior iliac spines detachments is generally conservative and is based on the concept that the affected limb should be at rest with the muscle bellies interested in detension. In order to achieve this, it is usually sufficient bed rest for 4 weeks followed by a period of about 5 weeks of progressive physiotherapy (22, 31-34).

This conservative treatment generally allow a complete functional recovery in a period varying from 2 to 5 months, even if in the literature are reported complications such as hyperostosis of the bone callus, chronic tendinopaties, meralgia paresthetica and nonunion, which may require subsequent surgical treatment (35-38).

For these reasons, in selected cases of patients with high functional demands and with a bone fragment in its major axis greater than 2 cm and displaced more than 2 cm, surgical treatment is indicated (1-9, 16, 39 - 42), thus allowing a more stable osteosynthesis,

a more rapid functional recovery and a reduced period of immobilization.

The selection of the fixation device is variable and Di Giovanni's classification is certainly useful to define this choice (26).

A screw fixation is indicated in cases of solitary bone fragments that extend to the osseous part of the apophysis. Alternatively, in pure or mixed detachments or in comminuted fractures transosseous osteosynthesis with absorbable sutures or other devices is described (36, 43). In these cases, however, the stability of the fixation is less, often immobilization is more prolonged and the possibility of hyperostosis is greater.

In this series, 8 of 9 lesions (8 avulsion fractures in the classification of Di Giovanni) were synthesized with screws (5 with metallic screws and 3 with absorbable screws).

Despite the satisfactory results at follow-up of these 8 patients the authors believe that, if surgical treatment with screws is indicated, metallic screws are preferable, thus providing a more stable fixation avoiding in cooperative patients a postoperative immobilization in a cast or brace.

The absorbable screws have the undoubted advantage of not having to be removed but often do not ensure the same stability in the synthesis and may sometimes not be reabsorbed, thus causing a type "foreign body" inflammatory reaction (44).

This is confirmed in this series in which the removal of the screws was necessary in 2 patients treated with metallic screws and never in patients treated with absorbable screws. In addition 1 out 3 patients treated with absorbable screws, as consequence of the instability of the synthesis, needed a postoperative immobilization in a cast for 30 days and another developed a hyperostosis around the physis.

In another case of pure cartilaginous detachment osteosynthesis was achieved with Kirschner wires. Also in this patient, despite the result at follow-up was satisfactory, the osteosynthesis was considered unstable and necessitated the application of a post-operative plaster cast that probably favored the development of an exuberant callus.

For all these reasons, the authors believe that, in the case of pure cartilaginous detachments or in cases of multifragmented fractures, in which a valid primary

stability is not obtainable, it is better to perform the osteosynthesis with absorbable sutures, which do not require a second removal, and always immobilize the hip semiflexed in an orthopedic brace, that is better tolerated by the patient.

The surgical treatment involves general risks inherent in any operative procedure (such as infection) and specific related to the approach used (1-9, 16, 39-42), such as meralgia paresthetica derived from a lesion of the lateral femoral cutaneous nerve that we observed in only one case and that resolved spontaneously after 6 months.

All 9 patients operated achieved a satisfactory functional recovery as demonstrated by NAHS at follow up and return to sports participation was complete at an average time of 82 days after surgery. These results, however similar to others in the literature (39-42), confirm the validity of surgical treatment in these selected cases of fractures of the anterior iliac spines.

Conclusions

Fractures of the anterior superior iliac spines are steadily increasing due to the earlier and more intense sports activity in which children and adolescents are involved.

The treatment is in most cases conservative. When the fragment is larger than 2 cm in its major axis and dislocation exceeds 2 cm surgical treatment is indicated. Whenever possible it is preferable to fix the fragment with metallic screws.

It is recommended that all pediatricians, sport physician and athletic trainers identify the specific situations that may predispose these injuries. The primary and secondary prevention is based on specific exercises which will enable the muscular structures to respond gradually to intensive and progressive strains.

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