

# Comparison of conservative against surgical treatment of anterior–superior iliac spine avulsion fractures in children and adolescents

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## Abstract

**Purpose** Avulsion fracture of the anterior–superior iliac spine is an uncommon injury. It is mostly seen in adolescent sprinters, distance runners and soccer players. Most cases are unilateral. We present a cohort of patients and the strategy for their treatment.

**Methods** During the period 2005–2012, we treated 23 (19 male, four female) patients with an average age of 15.1 years (4–17). Ten patients with minimally displaced fractures were treated conservatively, and 13 patients with greater fragment dislocation were treated surgically. All patients underwent the standardised rehabilitation protocol. We evaluated range of motion (ROM), X-ray six weeks and one year postoperatively, length of bed rest, return to activity and complication rates (infection, heterotopic ossification).

**Results** All patients returned to sports at the preinjury level. Surgically treated patients showed faster recovery and better compliance with rehabilitation protocols. The time interval for X-ray union was comparable between groups, as was full recovery. There was no deep infection; however, there were five minor heterotopic ossifications, none of which required further treatment.

**Conclusion** We emphasise that the indication for surgical treatment is mainly determined by the grade of fragment displacement and the patient's sporting activity. Although long-term results were comparable between treatment methods, surgery carries the risk of higher complication rates and the need for osteosynthetic material extraction.

**Keywords** Avulsion fracture · Anterior–superior iliac spine (ASIS) · Apophyseal injury · Treatment strategy

## Introduction

An anterior–superior iliac spine (ASIS) avulsion fracture is an uncommon injury in adolescent athletes. It is usually caused by sudden strain on the sartorius muscle or the tensor of the fascia lata during the starting phase of running or jumping [1–4]. Sports with the highest risk of this injury include running, soccer and ice hockey. Although there are different treatment options, there are no specific treatment guidelines in the literature. One option is conservative therapy comprising bed rest with the affected lower extremity positioned with the hip and knee in flexion to ensure minimal tension of muscles attaching to the ASIS [5–7]. Conservative therapy is generally accepted for minimally displaced fractures in younger children [3, 5, 8, 9]. Surgical therapy, consisting of open reduction and fixation with a lag screw, is usually reserved for patients with greater dislocation of the bony fragment and older active adolescents. The aim of our study was to evaluate difference in clinical and radiographic outcomes of both methods to help in the decision-making process regarding therapy in adolescent patients with and avulsion fracture of ASIS.

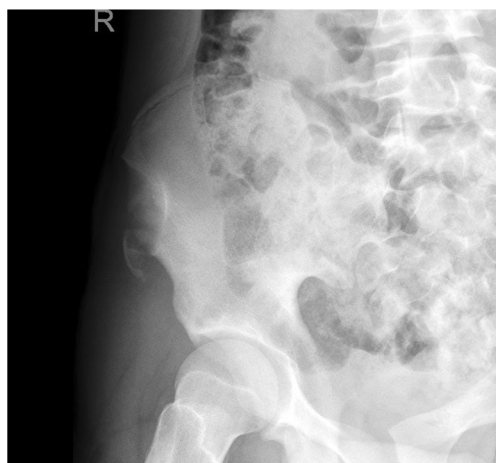
## Materials and methods

During 2005–2012, 23 patients with ASIS avulsion fractures were treated in our department: 19 boys and four girls, with a mean age of 15.1 years (four to 17 years). The diagnosis was supported by clinical findings, mechanism of injury, and anteroposterior/axial X-ray (Figs. 1 and 2a). The injury was sport related in all cases; 13 patients were treated surgically and ten conservatively.

The injury occurred at the beginning phase of running in 14 patients, five had a football injury (kicking motion), two were ice-hockey players with uncontrolled hip/thigh motion when skating and two were basketball injuries that occurred during jumping.

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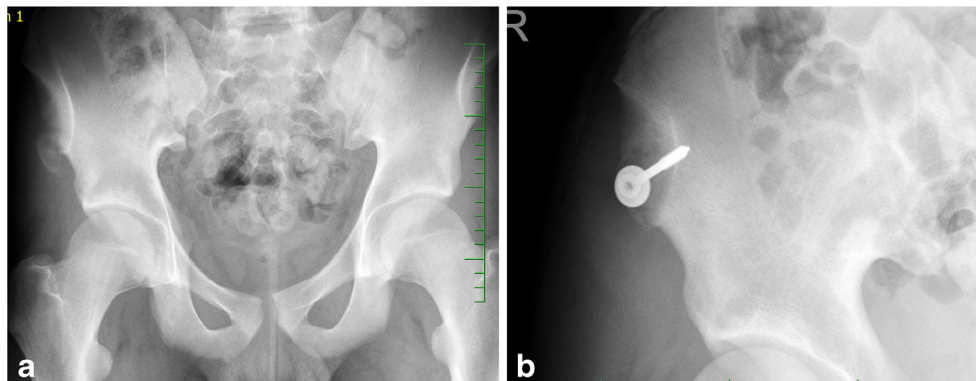


**Fig. 1** Axial X-ray view of avulsion fracture of the anterior–superior iliac spine (ASIS)

Conservative treatment consisted of bed rest, with the affected hip at 70–90° flexion for the first three weeks, with symptomatic treatment of pain and soft-tissue oedema. After three weeks, physiotherapy and ambulation with crutches was begun, determined by X-ray findings. Partial weight bearing using crutches was indicated until six weeks from injury, when an X-ray check was performed, and gradual full weight bearing with restricted running, jumping and sports was allowed (Fig. 2b). Sprinting and full participation in sports activity was allowed six months after the injury.

Surgical treatment consisted of open reduction and lag screw with washer fixation using the the standard anterior approach; if the fragment was rotationally unstable, an additional K wire was used. Postoperatively, symptomatic pain and soft-tissue oedema treatment was begun, and ambulation using crutches and partial weight bearing began three days postoperatively. Partial weight bearing was permitted for four weeks; after six weeks, full weight-bearing was allowed; sports were allowed three months postoperatively. Extraction of osteosynthetic materials was performed six to 12 months postoperatively.

**Fig. 2** **a** Preoperative X-ray of avulsion fracture of the anterior–superior iliac spine (ASIS). **b** Postoperative X-ray after open reduction and internal fixation (ORIF)



Follow-up was 12 months from injury in all 23 cases. X-rays were performed one week, six weeks, three months and one year after the trauma to evaluate radiographic results. Range of motion (ROM) and the visual analogue scale (VAS) for pain score were recorded at two and six weeks and three and 12 months. We also recorded the presence of heterotopic ossifications, wound infection and other complications, including neurologic deficits, at the final visit. Results of both groups were compared and statistically evaluated (Table 1).

## Results

All 23 patients completed the follow-up. Radiographic findings provided evidence that open anatomic reduction leads to better and faster bone healing. In the surgically treated group, ten of the 13 patients showed signs of good healing and fragment integration at six weeks, whereas only five of the ten patients in the conservatively treated group showed the same signs of healing. The remaining conservatively treated patients still showed signs of the fracture line at six weeks. This difference was significant ( $p=0.05$ ). All patients had the same level of bone healing and fragment integration at the one year follow-up. No nonunion was found on clinical examination and X-ray.

The VAS score was comparable between groups for the entire follow-up period, with minor differences at two weeks caused by the surgical wound; however, the difference was not significant. ROM was greatly influenced by the treatment method. In the surgically treated group, full range of motion (ROM) (compared with the contralateral hip) was achieved at six weeks in ten of the 13 patients; in the conservatively treated group, full ROM was achieved in three months in eight of the ten patients. One year postoperatively, no patients had restricted ROM. Mean bed rest for surgically treated patients was seven days (two to ten days) and for conservatively treated patients 24 days (14–28 days). Mean time to return to full activity was 16 weeks (four to 24 weeks) for the surgically treated group and 17 weeks (12–28 weeks)

**Table 1** Results for both groups

|                        |                       | 1 week     | 6 weeks         | 3 months       | 12 months     |
|------------------------|-----------------------|------------|-----------------|----------------|---------------|
| Conservative treatment | X-ray healing         | 0/10 (0 %) | 5/10 (50 %)     | 9/10 (90 %)    | 10/10 (100 %) |
|                        | Full ROM <sup>a</sup> | 0/10 (0 %) | 4/10 (40 %)     | 8/10 (80 %)    | 10/10 (100 %) |
|                        | VAS score             | 2.5±0.5    | 1.3±0.64        | 0              | 0             |
| Surgical treatment     | X-ray healing         | 0/10 (0 %) | 10/13 (76,9 %)  | 12/13 (92,3 %) | 13/13 (100 %) |
|                        | Full ROM <sup>a</sup> | 0/10 (0 %) | 10/13 (76,13 %) | 13/13 (100 %)  | 13/13 (100 %) |
|                        | VAS score             | 3.5±0.84   | 1.7±0.6         | 0.3±0.46       | 0             |

ROM range of motion

<sup>a</sup> Compared with the contralateral hip

for the conservatively treated group. This difference groups was statistically significant ( $p=0.05$ ).

Seven patients participated in professional-level sports; all others played amateur sports. Five professional athletes were treated surgically and two conservatively; all returned to the preoperative level of sports activity. One surgically treated patient in the amateur group had to abandon his sport activity due to pain and restricted movement (12.5 %); two in the conservatively treated group had to modify their activity for the same reason (25 %).

We recorded no deep infection in the surgically treated group, but there were two patients with prolonged wound healing and three who developed keloid scars. None of these complications needed to be actively treated. Heterotopic ossifications were recorded in two patients in the surgically treated group and three in the conservatively treated group. None of these required surgical treatment; however, ossification in the surgically treated group were removed during screw extraction. Transient hypesthesia and pain of the lateral femoral cutaneous nerve innervation area was found in three patients in the conservatively treated group as a result of prolonged hip-joint flexion during the initial stage of treatment, with a persistence of soft tissue swelling; all spontaneously resolved after six weeks. In the surgically treated group, five patients suffered skin hypesthesia around the scar, with spontaneous recovery at the final follow-up.

## Discussion

Avulsion fracture of the ASIS is an uncommon injury, accounting for only 1.4 % of injuries to the hip and pelvis [1, 2, 5, 6, 10]. It is mostly seen in competitive adolescent athletes and mostly in sprinters, distance runners and soccer players [5–7, 9]. During adolescence, the iliac crest is the weakest component of the pelvic ring, and sudden muscular contraction that occurs in the beginning phase of the gait during running or springing can result in avulsion of the attached pelvic apophysis. Contraction of the sartorius and tensor fascia lata muscles against the tilted pelvis is usually responsible

for the injury [1]. The avulsed fragment is usually displaced distally and laterally [2]. Rosenberg discovered that a greatly displaced fragment may easily be mistaken for avulsion of the anterior–inferior iliac spine [3].

MRI examination is a sensitive method for evaluating this injury when X-ray findings are inconclusive [10]; it also evaluates injury to soft tissue around the hip and muscles of the thigh. It is also important in differential diagnosis of rare bone tumors, which may simulate clinical findings of an avulsion fracture [11].

Avulsion fractures of the ASIS without neurological symptoms can be treated conservatively [5, 6, 8]. Conservative treatment is traditionally two to three weeks of limited activities and walking, with partial weight bearing using crutches [1, 2, 4–6, 10], and provides good clinical results. Severely displaced fragments may cause compression of the lateral cutaneous nerve, causing meralgia paraesthetica [3, 7]. These cases are primarily indicated for surgical intervention [3]. The displacement of the fragment >3 cm should be also considered for open reduction [4, 10]. As this is a rare injury, few studies compare outcomes of conservative vs. surgical treatment [1, 5, 6]. In our cohort of patients, we found no evidence that either treatment method provides significantly better results over the other at the final outcome. Irreversible neurologic deficit was not recorded in our patients, but there were cases of dysesthesia and pain in the lateral thigh in the conservatively treated group due to positioning of the hip in flexion.

## Conclusion

Avulsion fracture of the ASIS is a rare injury. According to our results, conservative and surgical treatments both provide similar clinical results at one year of follow-up after injury. The main advantage of conservative treatment is that there is no need for repeated anaesthesia and only a minimal risk of infection. Surgically treated patients achieve full ROM sooner, and full weight bearing and exercise may be started earlier, compared with conservatively treated patients based on X-ray evidence of healing. Both treatment options produce very

good clinical results. Surgical treatment is the preferred option in competitive athletes and patients with greater fragment dislocation, whereas conservative treatment provides sufficient and good clinical results for the majority of noncompetitive sporting adolescents.

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**Conflict of interest** None.

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