Arthroscopic Treatment of a Displaced Nonunion of the Anterior Inferior Iliac Spine Causing Extra-articular Impingement

MOTOI SHIBAHARA, MD, PhD; YASUO OHNISHI, MD, PhD; EISABURO HONDA, MD; DEAN K. MATSUDA, MD; SOSHIUCHIDA, MD, PhD

abstract

This report describes a case of nonunion of an anterior inferior iliac spine (AIIS) apophyseal avulsion fracture with resultant subspine impingement combined with symptomatic femoroacetabular impingement (FAI). A 16-year-old male soccer player presented with a 6-month history of right groin pain exacerbated by kicking and running. The patient was diagnosed with a displaced nonunion of the AIIS apophysis avulsion fracture causing secondary extra-articular impingement beyond cam-type FAI by physical examination and radiological findings. The authors performed arthroscopic AIIS decompression, with concurrent FAI correction and labral repair and capsular closure. At 4 months after surgery, a radiograph and a computed tomography scan showed complete bony union of the AIIS apophyseal nonunion. Modified Harris Hip Sore and Nonarthritic Hip Score improved from 74.8 and 61, respectively, to 100 for both at final follow-up. The effectiveness of arthroscopic decompression of the AIIS as part of a comprehensive minimally invasive surgery including FAI correction and labral repair resulted in complete union of the AIIS and pain-free return to sport and bony union. [Orthopedics. 2017; 40(4):e725-e728.]

A

vulsion fractures of the anterior inferior iliac spine (AIIS) apophyses are common injuries in pediatric and adolescent athletes. Because the origin of the straight head of the rectus femoris is the AIIS, violent contraction of this muscle during activities such as running, jumping, or kicking may cause an avulsion fracture. A recent study reported AIIS extra-articular impingement against the distal femoral neck with excessive distal and/or anterior protrusion and that AIIS impingement can be developmental or the result of prior AIIS avulsions.

Hip arthroscopy has been used as an effective surgery for the assessment and treatment of acetabular labral tears with femoroacetabular impingement (FAI). A recent study revealed that AIIS impingement combined with FAI can be treated by hip arthroscopy. Matsuda and Calipusan published a case report of an adolescent athlete with an AIIS avulsion fracture with subsequent distal protruding malunion who was successfully treated with hip arthroscopy including arthroscopic “spino-plasty.” However, to the current authors’ knowledge, extra-articular impingement resulting from nonunion of an AIIS apophyseal avulsion fracture combined with FAI has not been reported. The authors present the clinical and radiographic findings and the arthroscopic treatment of a patient with...
displaced nonunion of the AIIS causing extra-articular impingement.

**CASE REPORT**

A 16-year-old male soccer player presented with a 6-month history of right groin pain exacerbated by kicking and running and refractory to nonoperative treatment, including nonsteroidal anti-inflammatory drugs and physiotherapy. He attempted to return to soccer, but his groin pain increasingly worsened. He had no previous significant medical history and no evidence of trauma to the hip or symptoms from the lumbar spine or contralateral hip. On physical examination, he had tenderness over the right groin region. Hip range of motion was limited to 90° of flexion, 20° of flexed-hip internal rotation with a positive anterior impingement sign, and 30° of external rotation.

An anteroposterior pelvic radiograph showed nonunion of the AIIS protruding distally at the level of the apex of the femoral head (Figure 1A). The lateral center edge angle was $29^{\circ}$ with a cephalad crossover sign suggesting focal pincer impingement. The false profile view showed anterior distal protrusion of the AIIS avulsion protruded distally. Arrows indicate AIIS (C). Magnetic resonance arthrography showed extensive labral tearing. Arrow indicates labral tear (D).

Figure 1: Anteroposterior radiograph of the pelvis showing the malunion of the anterior inferior iliac spine (AIIS) extending distally below the level of the acetabular rim. Arrow indicates AIIS (A). False profile view showing excessive anterior distal protrusion of the AIIS (B). Anterosuperior (left) and posteroinferior (right) 3-dimensional computed tomography scans showing the hypertrophic nonunion of the AIIS avulsion protruded distally. Arrows indicate AIIS (C). Magnetic resonance arthrography showing extensive labral tearing. Arrow indicates labral tear (D).

The patient was diagnosed with a displaced nonunion of the AIIS apophysis avulsion fracture causing secondary extra-articular impingement beyond cam-type FAI.

**SURGICAL TECHNIQUE**

Supine hip arthroscopy was performed on a traction table. The anterolateral portal and mid-anterior portal were established. Interportal capsulotomy was performed. Perilabral focal synovitis was visualized at the level of the AIIS. An anterosuperior labral tear was treated with labral refixation after limited acetabuloplasty of the anterosuperior rim (Figures 2A-B). The anterosuperior capsule was undercut with a shaver and a radiofrequency probe in the area of the AIIS to expose the rim and the AIIS. Decompression of the inferior AIIS was performed using a motorized round burr via the mid-anterior portal (Figure 2C). After releasing traction, a dynamic impingement test in hip abduction showed significant cam impingement. Femoro-pelvicplasty was performed with confirmed eradication of ongoing FAI and subsynovial impingement (Figure 2D). Finally, capsular closure was performed to stabilize the joint as previously described. Postoperative radiograph and computed tomography scans showed complete bony union of the AIIS apophyseal nonunion (Figure 3).

**Postoperative Rehabilitation**

The patient was placed in a brace for 3 weeks to protect the hip and limit abduction and rotation. Gentle passive range of motion exercise was initiated during the first week, under the supervision of a physiotherapist. The patient remained non-weight bearing during the first 4 weeks. Active hip flexion was limited during phase I (the first 4 weeks) to minimize the risk of hip flexor tendonitis. From week 4 to 5, weight bearing gradually increased, and the patient was liberalized to full weight bearing at 8 weeks postoperatively. With improved mobility, stability, and proprioception, the patient began running and us-
ing a resistance stationary bike at 3 months postoperatively. Endurance strengthening and agility drills commenced at 4 months when a radiograph confirmed complete union of the AIIS avulsion.

The patient returned to soccer 4 months postoperatively without pain and discomfort. Preoperative modified Harris Hip Score and Nonarthritic Hip Score improved from 74.8 and 61, respectively, to 100 for both at final follow-up.

**DISCUSSION**

This report presents the first known case of an AIIS nonunion with subspine impingement that was successfully treated with arthroscopic inferior osteoplasty of the inferior protruding region with resultant bony union.

Most AIIS avulsion fractures occur with an extension movement of the hip joint with the knee flexed during running, turning, and kicking activities.1,7 Avulsion of the AIIS apophysis is usually related to hip hyperextension and knee flexion while attempting to kick a ball, which prompts maximum exertion of the rectus femoris tendon.7 Repetitive hip flexion and internal rotation can cause nonunion of an AIIS avulsion fracture. The authors believe the current AIIS fracture displaced during an avulsion mechanism, causing the distal protrusion with resultant symptomatic subspine impingement. The nonunion was caused by repetitive micromotion from ongoing abutment with the proximal femur. However, another possible mechanism might be a preexisting type 3 AIIS (with developmental distal protrusion) that initially fractured via a mechanical conflict without displacement, with resultant nonunion from ongoing repetitive micromotion. Either pathomechanism might cause the patient’s history of acute pain, subspine impingement, and distal protruding AIIS with nonunion.

Although conservative management can provide satisfactory outcomes for avulsion fractures of the AIIS,8-10 the course of treatment varies, ranging from 3 weeks to 4 months.7 If conservative management fails, surgical intervention is indicated. Generally, surgery has been proposed for the minority of patients with displacement of greater than 2 cm, symptomatic nonunion, and bony hypertrophy.11 Several reports have described that open reduction and internal fixation can provide excellent results.12 On the other hand, exostosis resection has also had good results, with a full range of hip motion if symptomatic impingement was clearly significant.13 An-
terior inferior iliac spine impingement has been increasingly defined as a source of hip pain.\textsuperscript{14} Larson et al\textsuperscript{2} noted that hip dysfunction in patients with a prominent AIIS was most likely related to impingement, occurring between an AIIS prominence and the anterior aspect of the femoral neck when the hip was flexed to more than 90°.

The current patient also had symptomatic intra-articular pathology, including cam FAI and labral tearing, in addition to subspine impingement and nonunion of the AIIS. Concurrent FAI and labral pathology in the setting of subspine impingement has been previously described.\textsuperscript{3,14} Preoperative and intraoperative findings distinguished AIIS impingement from FAI. The authors observed specific findings, including groin pain with straight hip flexion and tenderness over the AIIS on physical examination, excessive anterior and distal extension of the AIIS on false profile view, and sclerosis of the margin of the AIIS on anteroposterior view. Arthroscopic findings also confirmed focal synovitis at the level of the prominent AIIS. However, the authors were not able to detect reactive changes at the anterior distal femoral neck. It is likely that this patient had components of subspine and femoroacetabular impingement contributing to his symptoms and both were simultaneously and successfully addressed with hip arthroscopy.

Untreated or residual AIIS impingement is also an important predictor of revision hip arthroscopy in patients with FAI.\textsuperscript{14,15} Therefore, it is recognized that symptomatic AIIS impingement not responding to conservative measures should be considered for arthroscopic AIIS decompression.

Hip arthroscopic surgery provides an attractive and less invasive alternative to more open approaches. Matsuda and Calipusan\textsuperscript{3} reported a similar case showing that arthroscopic decompression of the AIIS was effective in the treatment of the AIIS malunion concomitant with FAI. Unlike that case, the current case had nonunion of the AIIS. The authors performed arthroscopic decompression of the AIIS, labral repair, and cam osteoplasty to reduce impingement, promoting successful healing of the nonunion proximal to the decompressed area. The authors surmise that by eradicating ongoing AIIS impingement, the nonunion was relieved of repetitive abutment and micromotion, enabling spontaneous bony union without internal fixation.

Although one may question whether labral repair was required with confirmed detachment only at the 3-o’clock rim position, limited proximal labral takedown was performed during focal acetabuloplasty with subsequent refixation. Because the 3-o’clock position has the smallest acetabular safety angle and the lowest depth of the drilling with higher risk of iatrogenic chondral penetration,\textsuperscript{16} the authors opted for suture anchor fixation at the 2-o’clock position, which enabled successful labral reattachment without acetabular chondral violation.

Advantages of this less invasive approach are a shorter recovery time and the ability to assess and treat concurrent intra-articular pathology. Disadvantages of this approach are complications specific to arthroscopic surgery, including, but not limited to, traction-related injury.

Limitations of this study included only one case and short-term follow-up. Further studies are needed to determine the optimal treatment for AIIS nonunion in the setting of subspine impingement.

**CONCLUSION**

Arthroscopic AIIS decompression, with concurrent FAI decompression and labral repair when indicated, is a minimally invasive surgery. It can provide clinical benefit and bony union for patients with protruded nonunion of the AIIS.

**REFERENCES**


