



# Subspine Impingement

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Femoroacetabular impingement is typically described as occurring between the femoral head-neck junction and the acetabular rim and secondary to pathomorphologic osseous changes in these areas. Extra-articular sources of femoroacetabular impingement have been increasingly recognized and treated. One of the more commonly described sources has been subspine impingement, the mechanical conflict between the anterior inferior iliac spine (AIIS) and the distal femoral neck. The etiologies of AIIS pathomorphology include apophyseal avulsions of the AIIS, rectus femoris avulsions with ossification, overcorrection after periacetabular osteotomy, and developmental. Patients often present with groin pain with deep hip flexion. Cadaveric studies have noted a reproducible bare area on the inferior aspect of the AIIS, and a corresponding footprint of the direct head of the rectus femoris measuring  $2.2 \times 1.6$  cm on average. Arthroscopic decompression of the AIIS has been performed with good short-term outcomes and significant improvement in end terminal range of motion.  
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## Introduction

Femoroacetabular impingement (FAI) has been well described over the past decade, with most of the literature focused on the evaluation, diagnosis, and treatment of cam- and pincer-type FAI.<sup>1-8</sup> As advances in hip preservation surgery have occurred, there has been the recognition of other sources of impingement beyond the femoral head-neck junction and the acetabular rim. There has been an increased awareness of extra-articular patterns of impingement, such as trochanteric-pelvic, ischiofemoral, and anterior inferior iliac spine (AIIS) or subspine hip impingement that can also restrict terminal hip range of motion and elicit pain.<sup>9-15</sup> Subspine impingement is an example of extra-articular impingement that may occur in a subset of patients and has been increasingly treated since the original description.<sup>16,17</sup> The AIIS can result in this impingement against the distal femoral neck with hip

flexion. It is important to understand and recognize the anatomy and pathophysiology of this type of extra-articular impingement, as unaddressed sources of osseous impingement are the leading causes for hip arthroscopy failure and need for revision surgery.<sup>18-21</sup> The purpose of this article is to describe the pertinent anatomical structures that are implicated in subspine impingement as well as describe the radiographic identification of the unique source of impingement. Finally, we describe our current technique to surgically address this form of FAI as well as early short-term outcomes that have been reported in the literature.

## Anatomy

The AIIS is a bony eminence located on the anterior and inferior aspect of the ilium, which is typically located proximal the acetabular rim. The AIIS begins as a separate apophysis, and is believed to begin ossification between the ages of 13 and 14 years and fuse with the ilium between the ages of 16 and 18 years.<sup>22</sup> The cranial portion of the AIIS has been classically described to give origin to the direct head of the rectus femoris. The inferior aspect of the AIIS is also thought to be an attachment point of the iliofemoral ligament. The AIIS has also been described to be an important structure to the

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function of the iliopsoas. The iliopsoas groove is located anteromedially and inferior to the AIIS, which is a depression that allows passage of the iliopsoas muscle as it traverses to the lesser trochanter of the femur.

An anatomical study performed by Hapa et al<sup>23</sup> noted that the direct head of the rectus femoris tendon crossed the anterior acetabular rim between the 1:00 and 2:30 positions. The mean proximal-distal distance for the rectus origin footprint on the AIIS was  $2.2 \pm 0.1$  cm (range: 2.1-2.4 cm), whereas the mean medial-lateral distance was  $1.6 \pm 0.3$  cm (range: 1.2-2.3 cm). There was also a consistent area along the anterior and inferomedial aspect of the AIIS that was devoid of any rectus tendon footprint. This “bare spot” measured on average  $0.5 \times 1.5$  cm. Among these 11 cadaveric hips, the mean distance from the most distal extent of the AIIS to the acetabular rim was  $1.9 \pm 0.2$  cm. Another cadaveric investigation noted the mean distance from the medial aspect of the AIIS to the femoral nerve and psoas tendon to be 20.8 and 19.3 mm, respectively.<sup>24</sup>

## Etiology

Subspinous impingement can result from various etiologies. Avulsion fractures of apophyses and spines of the pelvis are usually considered uncommon, and seen primarily in adolescent athletes. This occurs most commonly owing to a sudden, forceful contraction of the attached myotendinous complex. These apophyseal avulsions are usually related to the timing of ossification and fusion to the corresponding location on the pelvis. During the acute injury, the athlete can experience a sudden pain in the location of the avulsion, as well as loss of function of the involved muscle. These fractures may not be visualized acutely should a radiograph be obtained. Once the avulsion has occurred, ossification and closure of the physis

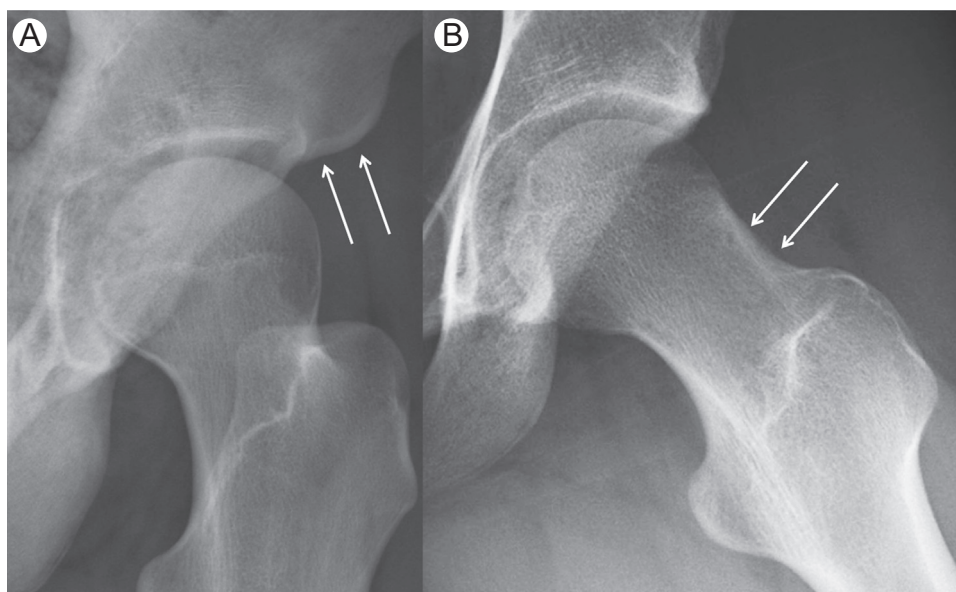
may lead to a distal extension of the AIIS. Similarly the rectus femoris tendon may become partially or fully avulsed off the AIIS and heterotopic bone can form in the area of the avulsion, in continuity with the AIIS. A large study of 203 pelvic avulsion injuries noted that AIIS avulsions are the second most common (22%), with ischial avulsion being the most common (54%).<sup>25</sup>

Treatment of acetabular dysplasia or retroversion with an anteverting periacetabular osteotomy may also result in subspine impingement, especially if overcorrection is performed.<sup>26</sup> During anterior acetabular reorientation, the AIIS is flexed forward with the acetabular fragment and may become a source of extra-articular impingement, especially if the AIIS extends to or beyond the acetabular rim. Some surgeons routinely perform an AIIS decompression at the time of periacetabular osteotomy if prominent or if noted to impinge during intraoperative dynamic assessment. Finally, subspinous impingement due to a developmental etiology and acetabular retroversion may result in impingement along the femoral head-neck junction.

## Physical Examination and Radiographic Evaluation

Patients with subspine impingement typically present with groin pain with flexion-based activity, and may describe a “grinding” sensation anteriorly with flexion and lateral movements. Physical examination may demonstrate limited hip flexion and tenderness to palpation over the AIIS, which can recreate the typical pain.

Radiographic evaluation should include a well-positioned anteroposterior pelvis<sup>27</sup> and false profile radiograph.<sup>28</sup> A recent study by Zaltz et al<sup>29</sup> demonstrated that a variable AIIS morphology may be responsible for the radiographic appearance of a crossover sign, rather than true acetabular



**Figure 1** Radiographic findings of subspine impingement. (A) False-profile radiograph demonstrates cortical thickening (arrows) along the interior aspect of a Type II AIIS. (B) Dunn lateral radiograph demonstrates distal femoral head-neck junction sclerosis (arrows).

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