

# Anatomical Variation of Anteroinferior Iliac Spine and Possible Associated Implications: a Case Report

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## ABSTRACT

**Introduction:** the anteroinferior iliac spine (AIIS), a bony feature of the ilium's anterior extremity, can have variable morphology. These variations were studied by authors who classify them in three more frequent types. It is known that the knowledge of structures and their anatomical relations contribute to comprehend pathologies and execute therapeutic measures. In this sense, the objective of this work is to report and describe an AIIS of atypical morphology and discuss its possible clinical implications and associated conditions from a literature review.

**Case report:** the previously prepared and macerated bone specimen belonging to the collection of the Human Anatomy Laboratory of the Federal University of Uberlândia was photographed, observed and described. The atypicality of the AIIS described is based on the sizable bony projection from the body of the ilium in anterolateral direction, that becomes more evident through the comparison with the contralateral AIIS, which possesses reduced volume.

**Conclusion:** the literature points out that this abnormality can be caused by acute or chronic traumas, result in significative functional impairments and can be associated with the manifestation of hip impingement syndrome. Therefore, depending on the dimensions and irregularities of this bony feature, it is possible that the individual has a significant loss of quality of life, being indispensable the analysis of the peculiarities of each case with regard to the damage and possibilities of health condition improvement.

**Keywords:** Anteroinferior Iliac Spine; Anatomical Variation; Ilium; Pelvic Bones; Hip Joint.

## Introduction

The anteroinferior iliac spine (AIIS) is a bony feature of the anterior extremity of the ilium on the region that is anterosuperior to the acetabulum. Together with part of the acetabular rim, it is the proximal fixation location of the iliofemoral ligament, which composes the joint capsule of the hip. The AIIS also is the location of origin of the rectus femoris muscle, which descends straightly in the thigh, crosses two joints and is capable, thus, of flexing the hip and extending the knee. About the spatial disposition of the AIIS, it is known that it situates itself 4 cm inferiorly to the anterosuperior iliac spine and is immediately lateral to the pelvic cavity<sup>1</sup>. The nervous structure closest to the AIIS is the femoral nerve, which is found about 2 cm medially<sup>1</sup>. Besides that, the lateral circumflex femoral artery, that passes deeply to the belly of the m. rectus femoris, is about 5.7 cm below the AIIS<sup>1</sup>. There are studies that conclude that the AIIS has bigger dimension among the individuals of the male sex and found an average height of 6.4 mm, average width of 11.9 mm and average length of 31.5 mm of this bony feature<sup>2</sup>.

The knowledge of structures and their anatomical relations contribute to the comprehension of pathologies and to the choice and execution of therapeutic measures. In this perspective, the variable

morphology of the AIIS was studied by authors who classify them in three more frequent types<sup>3</sup>. According to such studies, type 1 refers to an AIIS with a smooth surface, with no bony bulges, between its caudal portion and the anterosuperior rim of the acetabulum<sup>3</sup>. The type 2 corresponds to a spatial configuration in which the extension of the AIIS is restricted to the level of the acetabular rim or to the presence of an irregular bony surface from the caudal region of the AIIS to the rim of the acetabulum<sup>3</sup>. The type 3 AIIS is more prominent and projects itself beyond the acetabular boundary<sup>3</sup>. In the same study that attributed this classification, it is reported that the type 1 is the most commonly found in adults of any age, while type 2 has the biggest prevalence among older individuals of the male sex<sup>3</sup>. Other authors also have reported more prevalence of type 1 in both sexes in every studied age group, being that they found 69.87%, 21.61% and 8.52% prevalence of types 1, 2 and 3, respectively<sup>4</sup>. However, some studies present different rates of prevalence or suggest that there is no way of establishing, safely, relations between the different AIIS morphological types and the sex and age variables<sup>2-5</sup>.

Besides, it is known that the types 2 and 3 of the AIIS are more associated with chondrolabral lesions, that is, lesions of the cartilaginous tissue that composes the hip joint and the acetabular labrum<sup>3,6</sup>. Lesions such as

these are associated with the development of symptomatic hip impingement<sup>3-6</sup>. The hip impingement syndrome, characterized by the abnormal contact between femur and pelvis, possesses intra or extra-articular causes that can even coexist<sup>7, 8</sup>. As such, the development of this condition can be associated to abnormalities related to the anatomy of the proximal region of the femur, deepness and angulation of the acetabulum, size and format of the AIIS and the relation of these structures with adjacent ones, and the consequences include pain, functional limitation, degenerative lesions of the cartilage and acetabular labrum, as well as the formation of cysts<sup>7, 8</sup>. The prominent AIIS can be an extra-articular cause of this type of pathology, which is denominated subspine impingement (SSI)<sup>7,8</sup>. The complementary imaging exams most used for the diagnosis of this condition are the anteroposterior profile radiography and Lequesne's false profile, and the computerized tomography with or without tridimensional reconstruction<sup>9</sup>. The space between the AIIS and the acetabular rim serves as accommodation of soft tissues when the hip joint makes the adduction, flexion and internal rotation movements. Therefore, besides morphological types 2 and 3, the hypertrophic AIIS makes it so that this space tends to be limited, which can cause damage by mechanical lesions of regional structures, characterizing the SSI<sup>10</sup>. Some authors obtained results that suggest that people who have SSI associated to type 3 AIIS have more chances of presenting symptoms earlier during life. Nevertheless, having one of the three types of AIIS does not determine, necessarily, the development of hip impingement, for this is a multifactorial condition<sup>11,12</sup>.

Recent studies are utilizing the computerized tomography and software as the main means of two and three-dimensional analysis of the morphology and dimensions of the AIIS and other structures of the pelvic region with the finality of better comprehending the extra-articular pathologies of the hip, since such information is scarce in literature and are of great contribution to treatment proposals of these kinds of ailments<sup>13</sup>. Furthermore, the existence of anatomical variations should be considered, which lack more studies and descriptions, as, currently, the extra-articular sources of hip impingement are receiving a growing interest, including the impingement resulting from prominent AIIS<sup>5</sup>. In that perspective, this work aims to report and describe an AIIS of atypical morphology observed and photographed in a human cadaveric specimen and discuss its possible clinical implications and associated conditions from a literature review.

### Case report

A cadaveric specimen of pelvic bones, previously macerated and prepared, contained in the collection of the Human Anatomy Laboratory of the Federal

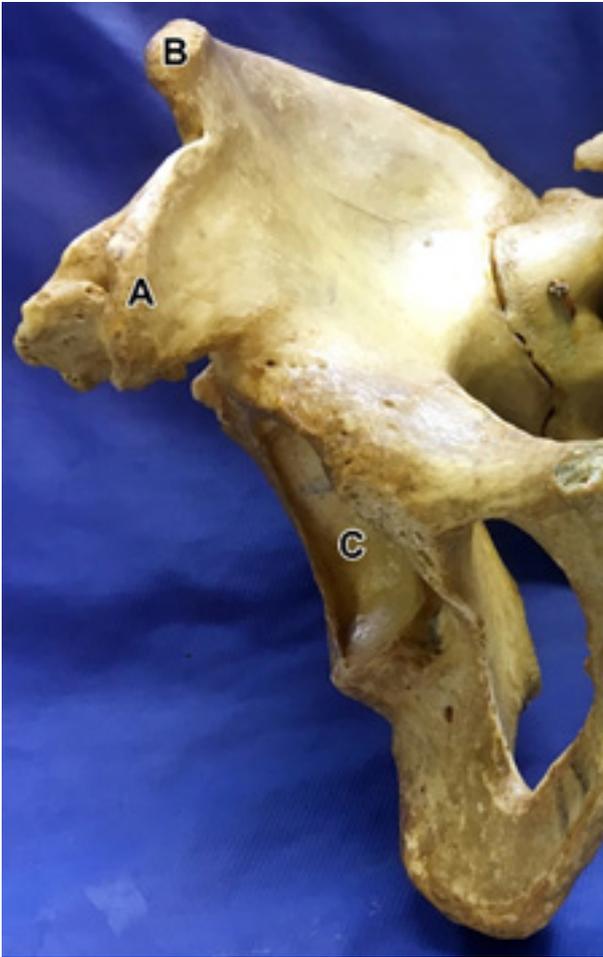
University of Uberlândia was photographed and observed. This specimen presents right AIIS of atypical morphology and size. The right AIIS presents itself with big volume and longitudinal axis in anterolateral direction, in a way that it surpasses the limits of the acetabular rim's contour, as well as possessing the distal extremity with irregular contours (Figure 1 to 4). Still referring to the right side, there is a region on the ilium of relatively smooth surface that extends itself from the proximal extremity of the AIIS to the acetabular boundary, in a way that makes the base of the AIIS not continuous with the acetabulum (Images 3 and 4). That way, the atypicality of this AIIS is based on the sizable bony projection from the body of the ilium in anterolateral direction, that becomes more evident through the comparison with the contralateral AIIS, which possesses reduced volume. The region between the base of the left AIIS and the acetabulum possesses small bony prominences (Figure 1 and 2), which is not considered anomalous, but a common variation described in the literature as an AIIS of type 2 morphological quality.



**Figure 1.** Anterior view of the pelvic bones evidencing (A) right AIIS with altered morphology and (B) left AIIS. Source: photographed by the authors.



**Figure 2.** Anteroinferior view of the pelvic bones evidencing (A) right AIIS with altered morphology, (B) left AIIS and (C) acetabular fossa. Source: photographed by the authors.



**Figure 3.** Anteroinferior view of the right pelvic bones evidencing (A) right AIIS with altered morphology, (B) anterosuperior iliac spine (ASIS) and (C) acetabular fossa.

Source: photographed by the authors.



**Figure 4.** Anteroinferior view of the right pelvic bones evidencing (A) right AIIS with altered morphology, (B) ASIS and (C) acetabular fossa.

Source: photographed by the authors.

## Discussion

Studies and case reports evidence that the prominent AIIS certainly is associated with the bigger chance of occurrence of symptomatic SSI<sup>7-14,15</sup>. Besides being a relatively newly described condition, the hip impingement receives a crescent interest, including the impingement resultant of prominent AIIS, its respective causes and impacts in the quality of life of the patient. The SSI involves the clash between the AIIS and the proximal portion of the femur and can involve the adjacent structures, such as ligaments of the hip's joint capsule, acetabular labrum and the rectus femoris muscle tendon<sup>16</sup>. That way, the unusual size of the AIIS evidenced in the case report can be associated to possible clinical consequences, since the morphology of this structure is directly connected to the hip impingement syndrome. Like other hip ailments, the symptomatic hip impingement associated to the prominent AIIS is cause of pain in the articular region, which can be characterized by the patient as pain with "grinding" sensation initiated or worsened with movements, especially flexion and internal rotation. Besides the pain, the reduction of amplitude

of movements of flexion and internal rotation is also frequently reported<sup>14-17-18</sup>.

The causes of AIIS hypertrophy include congenital abnormalities related to the development of the bones, previous dysplastic hip correction surgery or traumatic cause, which is the most common one<sup>9-11,12</sup>. It is known that, generally, the AIIS whose hypertrophy is of traumatic cause possesses irregular distal extremity and of incisive aspect, which are characteristics compatible with the specimen of this report<sup>10</sup>. The traumas involved in the origin of this morphological atypicality are associated with the fact that the AIIS is a proximal fixation location of the rectus femoris muscle, as this muscle can exert, in acute or chronic way, an excessive tensional force<sup>10-19</sup>. This way, it is possible that a sudden and intense force exerted by the concentric contraction of the m. rectus femoris in the apex of the AIIS causes a fracture by avulsion. Another possibility is that a chronic tension exerted by contraction fragilizes the ossification center of the AIIS in young individuals, allowing the occurrence of this type of fracture<sup>10-19</sup>. Although the diagnosis is easy, in the case this type of trauma isn't soon identified and

treated, in the long term calcifications can be observed between the hip bone and the loose part, which can even be confused with bone tumors in imaging exams<sup>19</sup>. Such avulsion lesion is more frequently described in athletes whose activity requires the execution of kicks, acceleration blasts and quick turns, such as football, races and tennis<sup>7,8</sup>.

In the clinical exam of AIIS avulsion cases, the acute pain in the anterior hip region on the side of the lesion with local inflammation signs is highlighted, being able to be worsened or initiated by the passive hip flexion and palpation<sup>19</sup>. Besides that, the patient presents muscular weakness in the execution of thigh flexion and knee extension in the lower limb ipsilateral to the avulsion<sup>19</sup>. With the aim of providing better quality of life for the patient, the treatment of choice for a symptomatic SSI case can involve different conducts, given the multifactorial characteristic of this condition. Thus, the treatment can be conservative with the prescription of medications for symptomatic alleviation, or there is the possibility of surgical correction with resection of the AIIS prominence, which is more indicated and presents satisfying results<sup>3-20,21</sup>. It is possible that the operatory conduct utilizes arthroscopy as technique, whose results have been already described in literature as satisfying, with pain alleviation, higher mobility and functional recovery of the pelvis<sup>7-14</sup>.

Some authors have documented the arthroscopic approach in 10 male patients with AIIS prominence that extended itself to the level of the superior acetabular boundary, which was confirmed by review of pre-operative tomography scans<sup>3</sup>. Before the surgical

procedure, these individuals presented hip pain refractory to the intra-articular anesthetic injection and other clinical aspects suggestive of extra-articular source of pain<sup>3</sup>. After execution of arthroscopic decompression of the prominence, significant improvements were observed in relation to movement amplitude, function and pain over, at least, one year of follow-up of these patients<sup>3</sup>.

## Conclusion

The case report and the bibliographic review allowed the analysis of the association of the typologies and morphological variations related to the AIIS, as well as the causal relation of the AIIS prominence with the SSI. The analysis and discussion of the aspects found in the literature converge to the idea that the described AIIS's characteristics possibly would be associated to traumatic causes and a clinical condition characteristic of hip impingement syndrome.

At last, depending on the dimensions and irregularities of a prominent AIIS, it is possible that the individual has a significative loss of quality of life, being indispensable the analysis of the peculiarities of each case with regard to the damage and possibilities of health condition improvement. This perspective reinforces the importance of studying and recording the anatomical variations of the pelvic bones and of the respective clinical consequences to improve the knowledge of musculoskeletal conditions of the hip and their anatomical aspects, in addition to assisting in the establishment of therapeutic plans and more precise diagnostic criteria.

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### Mini Curriculum and Author's Contribution

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