Original Article

Prevalence of Radiographic Morphology of Anterior Inferior Iliac Spine in the Thai Population

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Background: Subspine impingement, one of the causes of hip pain, is related to an abnormal morphology of the anterior inferior iliac spine (AIIS). AIIS morphology is evaluated using Hetsroni's classification (types I to III).

Objective: The purpose of the present study was to determine the prevalence of AIIS morphology in the Thai population.

Materials and Methods: The pelvic three-dimensional computerized tomography (3D CT) reconstructions of patients were evaluated retrospectively. The inclusion criterion was an age between 18 and 50 years. The exclusion criteria were hips with a joint-space width less than 3.5 mm, hips with center-edge angles less than 20 degrees, patients with primary or secondary tumors around the hips, and hips with acetabular fractures. A series of four, 3D CT images of each patient, comprising anteroposterior, 30-degree oblique, 60-degree oblique, and lateral views, were independently reviewed by two physicians. Both raters repeated the evaluations after a 2-week interval. The differences between the raters were resolved by consensus.

Results: The 3D CT reconstruction images of 112 hips of 75 patients with an average age of 38.8 years were evaluated. Forty-one patients (55%) were male. The most common AIIS morphology was type II, which was found in 72 hips (64%), followed by type I (40 hips, 36%). There were no hips with type III morphology in this series. There was also no significant difference in the AIIS morphologies of the males and females.

Conclusion: The most common AIIS morphology in the Thai population is type II, followed by type I.

Keywords: Anterior inferior iliac spine, Subspine impingement, Hip impingement, Hip pain, Groin pain

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Hip impingement is caused by repetitive abnormal contact of structures around the hip during motion. The most common type of hip impingement is femoroacetabular impingement (FAI) syndrome, in which abnormal contact between the femoral head-neck junction and the acetabular rim leads to chondrolabral damage and groin pain[1,2]. Subspine impingement is a common extra-articular hip impingement caused by mechanical conflict between the anterior part of the femoral neck and the bony protrusion at the anterior inferior iliac spine (AIIS)[3,4]. This type of impingement usually produces anterior groin pain upon deep flexion of the hip.

An AIIS deformity has been reported to be related to the traction force from the direct head of the rectus femoris muscle, which attaches to the AIIS[5]. In the past, this condition was treated by the open resection of a prominent AIIS[5,6]. With the improvements in arthroscopic instruments and surgical techniques in the past decade, subspine impingement can now be treated with arthroscopic AIIS decompression[4]. In 2011, Larson et al[4] reported 3 cases of patients with subspine impingement who underwent arthroscopic AIIS decompression. One of those cases was a patient who had persistent groin pain after the arthroscopic treatment of FAI and labral refixation; the patient required revision arthroscopic surgery for AIIS decompression. The report by Larson et al raised awareness of the need for physicians to evaluate the AIIS morphology of patients with anterior groin pain.

Hetsroni et al[7] evaluated three-dimensional computerized tomography (3D CT) reconstructions of FAI patients and classified their AIIS morphologies into 3 types, based on the relationship between the AIIS and the acetabular rim. The authors also demonstrated that the AIIS variants that extended to and below the rim were associated with a decrease in hip flexion and internal rotation. This information supported the rationale for considering AIIS decompression for these AIIS variants. However, some studies have reported no differences in the AIIS morphology distribution of the asymptomatic and symptomatic hip impingement populations[8,9].

There is limited data regarding the AIIS morphology

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of the Thai population. The purpose of this study was to evaluate the prevalences of the AIIS morphologies in the Thai population, according to Hetsroni's classification.

Materials and Methods

An evaluation was conducted of the pelvic 3D CT reconstructions of patients aged between 18 and 50 years who had been sent for a CT scan for various reasons. The exclusion criteria were hips with a joint-space width less than 3.5 mm, center-edge angles less than 20 degrees, patients with primary or secondary tumors around the hips, and hips with acetabular fractures. The genders and ages of all of the patients were collected. For each hip, 4 views of the 3D CT reconstruction images comprising anteroposterior, 30-degree oblique, 60-degree oblique, and lateral views were also collected (Figure 1).

Using the 3D CT reconstruction images, the AIIS morphology of each hip was evaluated independently by two investigators, who were an orthopedic surgeon (ST) and a radiology resident (AP). The AIIS morphology was classified into 3 types based on Hetsroni's classification. Type I was defined as the presence of a smooth ilium wall without a bony prominence between the distal part of the AIIS and the acetabular rim. Type II was defined as when either the AIIS extended to the level of the acetabular rim, or there were bony prominences on the ilium wall extending from the distal part of the AIIS to the rim. Type III was defined as the presence of either an AIIS that extended distally to the acetabular rim or a downward spur appearance. The evaluations of the 3D CT reconstruction images were performed independently by both raters, and they were repeated after a 2-week interval to establish the test-retest reliability of each rater. Lastly, the two raters discussed differing results until consensus was achieved.

The homogeneity of the demographic data was calculated by using Chi-square test. The kappa statistic for the intraobserver and interobserver reliabilities were calculated with STATA/SE, version 14 (StataCorp LP, College Station, TX, USA).

Results

The 3D CT reconstruction images of 112 hips of 75 patients with an average age of 38.8 years were reviewed. Forty-one patients (54.7%) were male. The most common AIIS morphology was type II, which was found in 72 hips (64.3%), followed by type I (40 hips; 35.7%); however, type III was not found. Of the 37 patients whose two hips could be evaluated, 10 (27.0%) had different AIIS types on each side. As to gender, there was no significant difference between the males and females for each type of AIIS (Table 1).

As to the interobserver reliability (unweighted kappa), it was moderate at 0.52 (95% CI, 0.34 to 0.70). The intraobserver reliability of the first rater was substantial at 0.71 (95% CI, 0.52 to 0.89), while that of the second rater was almost perfect at 0.95 (95% CI, 0.77 to 1.00). When comparing to the results from consensus, the agreement of the first rater was 84.8% (kappa = 0.67; 95% CI 0.49 to 0.86; $p<0.01$), and the agreement of the second rater was 79.5% (kappa = 0.59; 95% CI 0.42 to 0.77; $p<0.01$), respectively.

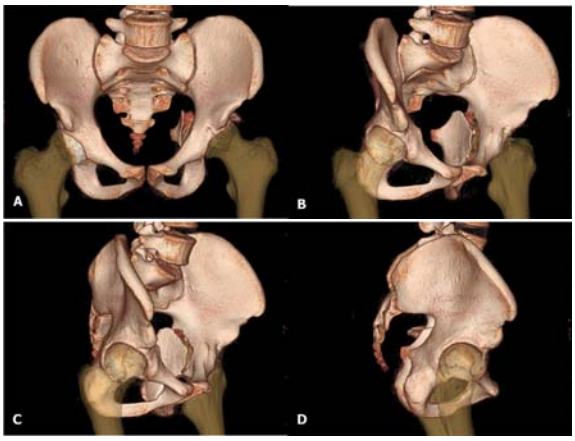

Figure 1. Four views of 3D CT images, comprising anteroposterior view (A), 30-degree oblique view (B), 60-degree oblique view (C), and lateral view (D).

Table 1. AIIS morphology by gender

AIIS morphology	Male (n = 58)	Female (n = 54)	Total (n = 112)	*p*-value
Type I, n (%)	20 (34.5)	20 (37)	40 (35.7)	0.845*
Type II, n (%)	38 (65.5)	34 (63)	72 (64.3)	
Type III, n (%)	0 (0)	0 (0)	0 (0)	

* Test for homogeneity using Chi-square test

Discussion

The important finding in the present study was that the most common prevalence of AIIS morphology in the Thai population is type II, followed by type I. Type III AIIS morphology was not found in this population. In addition, there was no significant gender difference for each type of AIIS variant. Amar et al[10] reported that there was no significant difference in the AIIS dimensions of the two genders and the two sides of the hips, with a normalized height and BMI.

The AIIS locates at the anterosuperior quadrant of the acetabulum[11]. Subspine impingement from an abnormal prominence of the AIIS usually relates to a previous traction injury or hypertrophic change[5,12]. The radiographic AIIS morphology is usually evaluated with Hetsroni's classification, using 3D CT reconstruction images. The prevalences of the AIIS morphologies found in the current and previous studies are summarized in Table 2. Type II morphology, the most common AIIS variant in the present study, was also the most common in some studies[7,8].

Table 2. Prevalence of AIIS morphology compared with the literature

	Population	Country	Prevalence (%)		
			Type I	Type II	Type III
Thienpratharn, et al	Asymptomatic	Thailand	35.7	64.3	0
Hetsroni I, et al	Symptomatic	USA	16.7	73.1	10.2
Balazs, et al	Symptomatic	USA	20.3	78.0	1.7
	Asymptomatic		23.2	75.9	0.9
Yoo, et al	Symptomatic	South Korea	84.8	14.1	1.1
	Asymptomatic		84.6	12.4	3.0
Topcuoglu, et al	Asymptomatic	Turkey	66.5	33.0	0.5

Symptomatic = positive hip impingement test

However, the type I variant was the most common in some other studies[9,13]. Different types of AIIS variants in the same individual were found in 27.0% of cases in the present study, compared with 21.6% reported by Balazs et al[8].

The population in the present study was considered asymptomatic. Previous studies[8,9] showed no differences in the proportions of AIIS variants in asymptomatic and symptomatic populations, although the most common type was different among various studies. Subspine impingement is commonly found in patients with FAI syndrome. Therefore, it is difficult to distinguish the causes of the symptoms and the pathology of these two conditions, in which abnormal contacts are produced with hip flexion.

Subspine impingement is considered one of the dynamic factors that produces hip pain[14]. The magnitude of hip movements and activity levels might play important roles in influencing whether individuals with underlying abnormal bony morphology become symptomatic. In contrast, individuals with "at risk" morphology could continue to be asymptomatic if there are relatively few abnormal contacts in their daily activities. This explains why there are some asymptomatic individuals with type III AIIS morphology. A previous study demonstrated that a high prevalence of Hetsroni's types II and III provided a high sensitivity of 80% for symptomatic hip impingement but a specificity of only 23%[8]. The positive predictive value of this classification was 10%, whereas the negative predictive value was 91%. Some patients with type I morphology may also require AIIS decompression due to the morphological features found during arthroscopic surgery[8].

Regarding the reliability of the classifications, there was perfect agreement, with a kappa of 1.00 in the original article by Hetsroni et al[7]. In the present study, the interobserver reliability was moderate at a kappa of 0.52; this was comparable to another study that also showed moderate interobserver reliability, with a kappa of 0.50[8]. There was no type III morphology in the current study. Disagreement between the raters occurred when one rater classified a hip as type I but the other classified it as type II. This could be due to an unclear definition of how much the ilium wall should be separated the acetabular rim from the caudal extent of the AIIS.

There were some limitations of this study. Firstly, this was a retrospective review of 3D CT reconstruction images without complete information regarding the patients' hip symptoms or the results of their physical examinations. Moreover, the 3D CT reconstruction images used in this study had a slightly different rotation angle from those used in the original research by Hetsroni et al[7] due to the image rotation settings of the software that was utilized in our study.

Conclusion

The most common AIIS morphology in the Thai population is type II, followed by type I.

What is already known on this topic?

AIIS deformity can be a cause of subspine impingement, which produces anterior groin pain upon deep flexion of the hip. AIIS morphology can be evaluated using Hetsroni's classification.

What this study adds?

The most common AIIS morphology in the Thai population is type II, followed by type I.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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