

RESEARCH ARTICLE

Diagnostic Value of Ischial Spine Sign in Patients with Acetabular Retroversion

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Abstract

Background: Acetabular Retroversion (AR) is a hip disorder and one of the causes of pain in this area. Evaluation of positive Cross Over Sign (COS) on AP X-Rays of the hip is currently the best method of diagnosis of AR. Several studies have measured co-existence of Ischial Spine Sign (ISS) in patients with AR. In this study we evaluated the diagnostic value of ISS in confirmation of AR and compared it with the diagnostic value of COS.

Methods: In this study, 4120 AP hip X-Rays from Akhtar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, were studied. Based on radiologic criteria, 1180 X-Rays were considered as standards and evaluated for ISS, COS and PWS (Posterior Wall Sign). Data analysis was done for correlation between ISS and COS.

Results: A total of 1180 out of 4120 X-Rays were considered as standard; among which, 86 were diagnosed with AR based on positive COS in presence of PWS. Both ISS and COS were positive concurrently in 69 X-Rays. ISS was positive in absence of COS in 11 X-rays. No significant difference in diagnostic value for diagnosis of acetabular retroversion was found between ISS and COS ($P < 0.05$).

Conclusion: According to our results, both ISS and COS signs can be employed for diagnosis of AR (acetabular retroversion). Considering the absence of a significant difference between these two signs in confirmation of AR, it can be perceived that the diagnostic value of ISS in confirmation of AR is equal to COS. Validation of the mentioned results requires further studies.

Level of evidence: IV

Keywords: Acetabular retroversion, Crossover sign, Diagnostic value, Ischial spine sign

Introduction

Anterior femoroacetabular impingement and its association with acetabular retroversion (AR); malunion of femoral neck fractures; and acetabular dysplasia has been cited and noticed by various literatures (1-3). Acetabular Retroversion (AR) is a form of hip dysplasia and is considered as a structural disorder. Normally the acetabulum is directed anterolaterally in

the sagittal plane, while in AR, the opening of acetabulum is in a posterolateral direction and may cause increased impingement between the femoral neck and anterior acetabular edge and fibrous labrum (4, 5). If it remains untreated, it may predispose the articular cartilage and anterior labrum to repetitive injuries and consequently prone to onset of osteoarthritic disease (1).

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Treatment approaches for AR range from non-invasive measures such as rest and pain control medications to invasive surgical intervention such as periacetabular osteotomy (PAO), arthroscopic correction of bony and soft-tissue pathology of the hip, and surgical hip dislocation, correction, and relocation (6).

AR may present independently or accompany other conditions. According to Wanger et al., among 31 participants with Acetabular labral tears (ALT), 87% had at least one structural problem, 35% had more than one structural abnormality and 10 patients suffered from AR. With respect to association of AR and osteoarthritis, Giori et al. (2003) postulated that 25% of patients with obvious idiopathic osteoarthritis had AR (8,9). Ezo and Colleagues (2006) demonstrated that the prevalence of AR in osteoarthritis, hip dysplasia and LCP disease was 20%, 18% and 42%, respectively, all of which were considerably above the rate in normal hips (10).

Few studies have assessed the prevalence of AR among various genders and ethnicities; however, some have mentioned higher incidence of AR among men, but no difference between the various ethnicities (11, 12).

AR has been recognized as a cause of hip pain and can be discussed as a secondary developmental deformity in dysplastic hips such as hypoplastic posterior wall, prominence of the anterior wall, or a rotational abnormality of the acetabulum (1, 12).

One hallmark of crossover sign on X-rays is the "figure of eight" appearance. On standard hip X-rays, the projections of the anterior and posterior walls normally meet at the cranial aspect of the acetabulum, but in patients with AR, the projections of the anterior and posterior walls intersect distal to the roof of the acetabulum, forming a crossover sign, which was first mentioned by Reynolds et al. (1999) and later confirmed by Jamali et al. (2007) (1, 13). Unfortunately, the cross over sign cannot be observed in young children due to the lack of ossification in anterior and posterior walls, instead, PRISS sign (prominence of the ischial spine) is



Figure 1. Cross Over Sign.

being used regarding diagnosis of AR (1, 13, 14).

Several radiographic markers have been introduced for diagnosis of AR, such as presence of the crossover sign (COS), the posterior wall sign (the posterior wall of the acetabulum sits medial to the center of the femoral head), and the prominence of the ischial spine (PRISS) (15). Sometimes the diagnosis of acetabular retroversion based on AP pelvic X-rays alone is difficult (13, 15).

AR can be observed on AP pelvic X-rays as the crossover sign (1). The anterior wall edge (white arrow) is medial to the edge of posterior wall (black arrow) in inferior segment of the hip, but, it forms an 8-shape on X-rays in the superior segment, which is the hallmark of COS [Figures 1; 2].

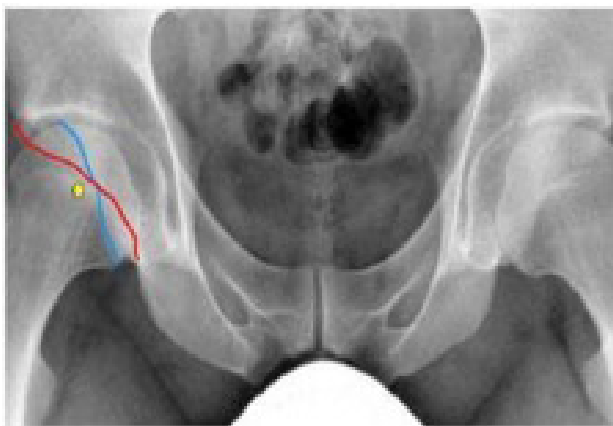
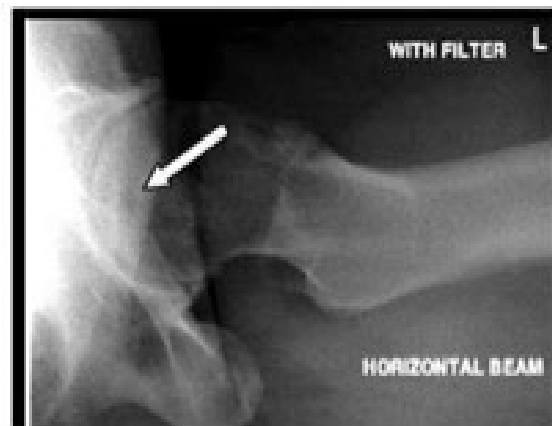


Figure 2. Cross Over Sign.



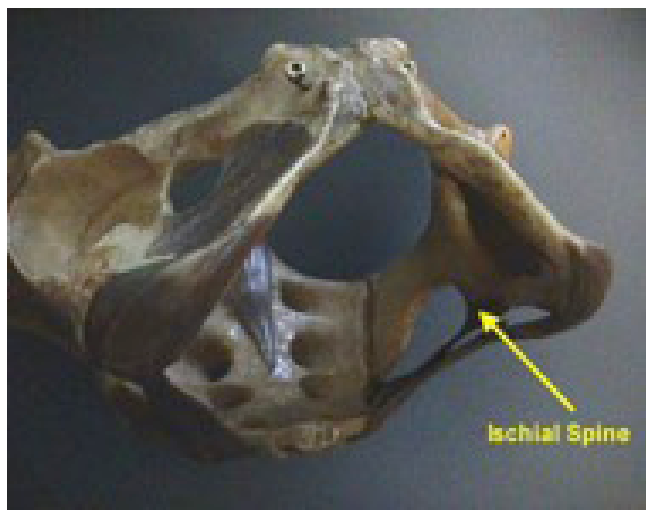


Figure 3. Ischial Spine.

It has been observed that along with the crossover sign, the ischial spine is commonly projected into the pelvic cavity. This finding is easier to observe even when the crossover sign is not visible. Hence, it seems plausible to have Ischial Spine Sign (ISS) streamline the radiologic detection of AR [Figure 3] (15). According to Kalberer et al. (2008), the accuracy and sensitivity of ISS in detecting AR is roughly around 90% (15). According to Kakaty et al. (2010), ISS is reliable for diagnosis of AR on plain X-rays taken by a standard technique regardless of pelvic tilt and rotation (16).

According to Werner et al. (2010), the PRISS was present in 61.7% of cases with positive cross-over sign. A direct correlation was observed between PRISS and the cross-over sign ratio ($P<0.001$). The PWS was positive in 31% of the hips and significantly related with the cross-over sign ratio ($P<0.001$). In cases with positive PRISS, 39.7% were also positive for PWS sign ($P<0.001$). In patients with positive PWS, 78.8% also had a positive PRISS ($P<0.001$). The presence of both PRISS and PWS signs was drastically consistent with higher COS positivity. Both the PRISS and PWS signs as well as the coexistence of COS, PRISS, and PWS are significantly associated with higher grades of AR (17).

All in all, AR is a hip disorder and a cause of pain in this area. Currently, the detection of Cross Over Sign (COS) on AP X-Rays of the hip is one of the promising approaches regarding the diagnosis of AR. As mentioned earlier, various studies have measured the co-existence of Ischial Spine Sign (ISS) in patients with AR (15-18). In this study we evaluated the diagnostic value of ISS in confirmation of AR. Since COS is often considered as the diagnostic hallmark of AR due to its high positive predictive value of %90, we compared the diagnostic value of ISS to COS regarding the confirmation of AR (9).

Materials and Methods

A total of 4120 AP hip X-Rays from the imaging center of Akhtar Hospital, Shahid Beheshti University of Medical Sciences, Tehran, were studied. Based on the radiologic criteria, 1180 X-Rays were considered as standards and were evaluated for ISS, COS and PWS. We took into account the X-rays with positive COS which were also positive for PWS as cases of acetabular retroversion in order to avoid the possibility of making a false diagnosis due to focal anterosuperior overcoverage. Data analysis was done using SPSS software version 16 (Chicago, Illinois) through Chi-Square test.

Ethical consideration and confidentiality of patients' data and history were followed accordingly throughout the study process.

Results

A total of 1180 out of 4120 obtained X-rays were included in this study as standards, among which, 86 were diagnosed with AR based on positive COS in presence of PWS. Both ISS and COS were positive concurrently in 69 X-Rays. Also, ISS was positive in the absence of COS on 11 X-rays. No significant difference was found in the diagnostic value between ISS and COS ($P=0.048$). According to Table 1, 69 patients had ISS and COS simultaneously, 11 patients were only positive for ISS, and 17 patients were only positive for COS.

Data regarding the association between ISS and COS via chi-square test can be observed in Table 2. According to Table 2, COS and ISS have a meaningful correlation ($P<0/005$). Therefore, it can be concluded that the incidence rates of COS and ISS do not have a significant difference ($df=1$, Value=791.885^a).

Discussion

According to our results, both ISS and COS signs may be employed for diagnosis of AR. Since no significant difference was observed between these two signs in confirmation of AR, it can be perceived that the diagnostic value of ISS in confirmation of AR is equal to COS; however, the validation of the mentioned results requires further studies.

Acetabular retroversion is a form of hip dysplasia in which the acetabulum opens in a posterolateral direction. This can cause impingement between the femoral neck and anterior acetabular edge. If left untreated, it can lead

Table 1. ISS * COS Crosstabulation

		COS		Total
		Pos	Neg	
ISS	Pos	69	11	80
	Neg	17	1083	1100
Total		86	1094	1180

Table 2. Association between COS and ISS					
	Value	df	Asymp. Sig.		Exact Sig.
			(2-sided)	Exact Sig. (2-sided)	(1-sided)
Pearson Chi-Square	791.885 ^a	1	.000		
Continuity Correction^b	779.399	1	.000		
Likelihood Ratio	376.454	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	791.214	1	.000		
N of Valid Cases	1180				

to injury of the articular cartilage and anterior labrum and consequently makes the patient prone to onset of osteoarthritis. Therefore it is important to employ proper diagnostic measures for precise diagnosis to prevent these consequences.

The results of current study are consistent with the report by Kalberer and Colleagues (2008), in which they observed the projection of Ischial spine into the pelvis. They postulated a strong correlation between the prominence of the ISS and COS. They studied 1010 patients and concluded that prominent ISS projecting into the pelvis maintains 91% sensitivity, 98% specificity and 98% positive predictive value and 92% negative predictive value for diagnosis of AR (15). In another study conducted by Werner and Colleagues (2010), they assessed radiographic markers of AR; however, in their study they didn't exclusively assess ISS and had a smaller sample size, which may lead to lower statistical validity (17). In another study conducted by Kappe (2011), they studied the reliability of radiologic signs among AR patients. They concluded that the COS, posterior wall sign, and ISS maintain considerable intra-observer but only moderate to substantial inter-observer reliability and it is consistent with individual experience in interpreting X-ray studies (19).

Furthermore, it is vital to assess these radiologic signs in other hip disorders. The diagnostic accuracy and sensitivity of them should be noted in other disorders as well. According to recent literatures, there is no similarity in radiologic signs among various hip disorders. For instance, Tannast et al. (2012), compared the morphologies of AR and Developmental dysplasia of the hip (DDH) and they confirmed our earlier comments, that different hip disorders present different morphologic natures and consequently different radiologic signs (20).

One of the limitations of current study is that it could not differentiate the incidences of ISS and COS among

the two genders. Another point worth mentioning is the question of chronologic sequence of ISS and COS incidence. What is their influence on each other? Do they have a synergistic effect? Another limitation is the fact that only one of the researchers was responsible for studying the X-rays and making the diagnoses; however, he is an experienced hip surgeon. It is essential to focus on the aforementioned points in future studies.

Acetabular retroversion is a form of hip dysplasia that can predispose the patients to femoroacetabular impingement and osteoarthritis if left untreated. Several radiologic markers have been defined for diagnosis of this condition. In this study we evaluated the diagnostic value of PRISS (prominence of the Ischial Spine) and compared it to the diagnostic value of COS (Cross Over Sign). Our results showed no significant difference between the diagnostic values of PRISS and COS. Therefore, the detection of PRISS can be as valuable in confirmation of acetabular retroversion as COS.

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References

1. Reynolds D, Lucas J, Klaue K. Retroversion of the acetabulum. A cause of hip pain. *J Bone Joint Surg Br.* 1999; 81(2):281-8.
2. Siebenrock KA, Schoeniger R, Ganz R. Anterior femoro-acetabular impingement due to acetabular retroversion: treatment with periacetabular osteotomy. *J Bone Joint Surg Am.* 2003; 85(2):278-86.
3. Eijer H, Myers SR, Ganz R. Anterior femoroacetabular impingement after femoral neck fractures. *J Orthop Trauma.* 2001; 15(7):475-81.
4. Klaue K, Durnin CW, Ganz R. The acetabular rim syndrome. A clinical presentation of dysplasia of the hip. *J Bone Joint Surg Br.* 1991; 73(3):423-9.
5. Sierra RJ. The management of acetabular retroversion with reverse periacetabular osteotomy. *Instr Course Lect.* 2013; 62(1):305-13.
6. Banks KP, Grayson DE. Acetabular retroversion as a rare cause of chronic hip pain: recognition of the "figure-eight" sign. *Skeletal Radiol.* 2007; 36(Suppl 1):S108-11.
7. Domb BG, Watson JN, Gupta A. Acetabular retroversion. *New York: Hip Arthroscopy and Hip Joint Preservation Surgery;* 2014. P. 1-21.
8. Wenger DE, Kendall KR, Miner MR, Trousdale RT. Acetabular labral tears rarely occur in the absence of bony abnormalities. *Clin Orthop Relat Res.* 2004; 426(1):145-50.
9. Giori NJ, Trousdale RT. Acetabular retroversion is associated with osteoarthritis of the hip. *Clin Orthop Relat Res.* 2003; 417(1):263-9.
10. Ezoë M, Naito M, Inoue T. The prevalence of acetabular retroversion among various disorders of the hip. *J Bone Joint Surg Am.* 2006; 88(2):372-9.
11. Werner CM, Copeland CE, Ruckstuhl T, Stromberg J, Seifert B, Turen CH. Prevalence of acetabular dome retroversion in a mixed race adult trauma patient population. *Acta Orthop Belg.* 2008; 74(6):766-72.
12. Tannenbaum E, Kopydlowski N, Smith M, Bedi A, Sekiya JK. Gender and racial differences in focal and global acetabular version. *J Arthroplasty.* 2014; 29(2):373-6.
13. Fujii M, Nakashima Y, Yamamoto T, Mawatari T, Motomura G, Matsushita A, et al. Acetabular retroversion in developmental dysplasia of the hip. *J Bone Joint Surg Am.* 2010; 92(4):895-903.
14. Jamali AA, Mladenov K, Meyer DC, Martinez A, Beck M, Ganz R, et al. Anteroposterior pelvic radiographs to assess acetabular retroversion: High validity of the "cross-over-sign". *J Orthop Res.* 2007; 25(6):758-65.
15. Kalberer F, Sierra RJ, Madan SS, Ganz R, Leunig M. Ischial spine projection into the pelvis: a new sign for acetabular retroversion. *Clin Orthopaed Relat Res.* 2008; 466(3):677-83.
16. Werner CM, Copeland CE, Ruckstuhl T, Stromberg J, Turen CH, Kalberer F, et al. Radiographic markers of acetabular retroversion: correlation of the cross-over sign, ischial spine sign and posterior wall sign. *Acta Orthop Belg.* 2010; 76(2):166-73.
17. Clohisy JC, Carlisle JC, Trousdale R, Kim YJ, Beaulé PE, Morgan P, et al. Radiographic evaluation of the hip has limited reliability. *Clin Orthop Relat Res.* 2009; 467(3):666-75.
18. Kakaty DK, Fischer AF, Hosalkar HS, Siebenrock KA, Tannast M. The ischial spine sign: does pelvic tilt and rotation matter? *Clin Orthop Relat Res.* 2010; 468(3):769-74.
19. Kappe T, Kocak T, Neuerburg C, Lippacher S, Bieger R, Reichel H. Reliability of radiographic signs for acetabular retroversion. *Int Orthop.* 2011; 35(6):817-21.
20. Tannast M, Pfannebecker P, Schwab JM, Albers CE, Siebenrock KA, Büchler L. Pelvic morphology differs in rotation and obliquity between developmental dysplasia of the hip and retroversion. *Clin Orthop Relat Res.* 2012; 470(12):3297-305.