The Prevalence of Acetabular Retroversion among Adult Patients Presenting with Hip Pain in Orthopedic Clinic of Al-Kindy Teaching Hospital

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ABSTRACT

Background: Acetabular retroversion has been proposed to contribute to the development of pain and osteoarthritis of the hip. Conventional anteroposterir (AP) pelvic radiographs may represent a reliable, easily available diagnostic modality.

Objective: To obtained a reproducible technique allowing the anterior and posterior acetabular rims to be visible for assessment

Method: This is a cross-sectional study conducted from December 2015 to March 2017 targeting patients with hip pain in orthopedic clinic of Al-Kindy teaching hospital. The study sample consisted of 100 patients with hip pain who were investigated with Antroposterior pelvic plain x-ray, which was done for all patients, looking for cross-over sign, the patients with positive cross-over sign radiographs were sent for CT scan to ensure retroversion of acetabulum.

Results: Presence of a cross over sign was documented in 9 patients (9%). From these 9 patient only 8 were proved by CT scan to have retroverted acetabulum. Then the prevalence was 8%.

Conclusion: The cross-over sign is a reliable indicator for diagnosis of acetabular retroversion and the presence of a cross-over sign in a plain film should heighten awareness of the advisability of proceeding to full assessment .

Keywords: Retroverted acetabulum, Impingement of hip, Osteoarthritis

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INTRODUCTION

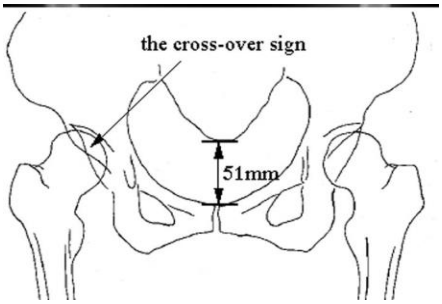
Retroverted acetabulum it is a newer described form of hip dysplasia, as the name implies, describe a condition in which the ascetabular socket faces backward. There is excessive anterior wall coverage over the femoral head and deficient wall coverage [(1)].

In the normal hip the acetabular opening is anteverted from the sagittal plane. In the retroverted condition the opening, and in particular its proximal rim (the roof edge), lies at an angle of retroversion from this plane (Figure 1). In both normal and retroverted conditions the mouth opening spirals gradually into increasing anteversion distal to the roof edge. In the retroverted acetabulum, despite this progress distally into anteversion, the anterior edge of the mouth remains in a more lateral position than is normal, and the posterior edge is more medial. [(2).]

Recent studies have revealed that acetabular retroversion, which may occur as a result of a hypoplastic posterior acetabular wall, a prominence of the anterior acetabular wall, or a rotational abnormality of the acetabulum, is also associated with hip pain and osteoarthritis of the hip [(3,4).]



Figure (1): Retroverted acetabulum and cross-over sign[(5)]



Excessive acetabular cover secondary to a retroverted acetabulum causes femuro-acetabular impingement [6,7].

Femoro -acetabular impingement has only recently been widely recognized as a cause of early osteoarthritis of the hip, although it was first described by Smith- Petersen over 70 years ago [8].

More recent interest has been attributed to Stulberg et al [9] who recognized a pistol-grip deformity of the femoral head that appeared to predispose to early osteoarthritis. It was, however, Beck et al, Ganz et al and Ito et al [10,11,12], who clarified the morphological appearance of the hip in patients with impingement and put forward a theory on how the joint becomes damaged in these patients. Two main types of impingement have been described:Cam impingement occurs where there is a reduced femoral head/neck offset.

Pincer impingement where the abnormality is primarily on the acetabular side as a result of excessive cover of the femoral head by the acetabulum, such as in acetabular retroversion and protrusion.

Femoroacetabular impingement has also been recognised recently as a cause of early osteoarthritis of the hip [10].

Excessive acetabular cover secondary to a retroverted acetabulum causes pincer impingement, which may be a mechanism by which early osteoarthritis of the hip develops. Version of the acetabulum refers to alignment in the sagittal plane. In non-dysplastic hips, a retroverted acetabulum represents an abnormality of orientation of an otherwise normal acetabulum. In dysplastic hips, a retroverted acetabulum is one in which the posterior portion of the acetabulum is deficient. Several studies have confirmed that acetabular joint reaction forces are directed posteriorly and superiorly, when viewed in the sagittal planes [6,7].

Any deficiency of the posterior wall, due to a malorientation or dysplasia, will therefore result in increased contact stresses, which possibly contribute to the development of osteoarthritis of the hip. [13].

In an anteverted acetabulum (Figure 2), a line can be drawn from the superolateral edge of the acetabulum that represents the anterior rim of the acetabulum. It runs medially and distally.

A second line representing the posterior rim of the acetabulum can be drawn, and it runs more vertically. In contrast, in a retroverted acetabulum (Fig.8), the superior part of the anterior line is actually lateral to the posterior line. As these lines progress medially and distally, the anterior line crosses the posterior line. This finding is termed the cross-over sign (Figure3). The posterior line lies at or just lateral to the center of the femoral head8. If the line of the edge of the posterior wall is located well medial to the center of the femoral head, this finding is termed the posterior wall sign (Figure-3) [14]. The posterior wall sign indicates relatively less posterior coverage [15].

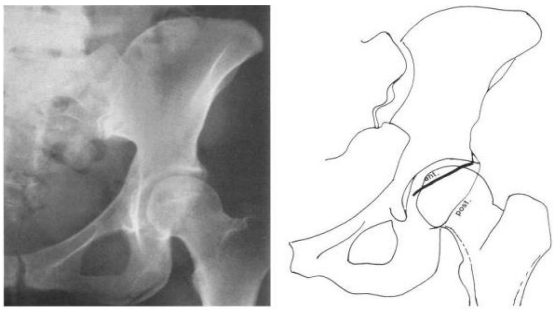


Figure 2 :Radiographs and outline diagram of the normal (anteverted) acetabulum.[5]

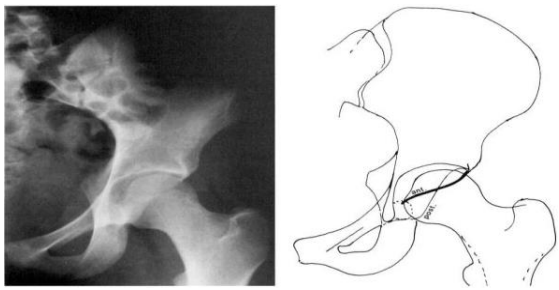


Figure 3: A. Diagram showing acetabular retroversion and the 'cross-over' sign.[2]

The diagnosis of acetabular retroversion is more difficult by plain pelvic radiograph. [14]. Therefore using a CT technique will allows standardized three-dimensional (3D) analysis of acetabular inclination and anteversion and calculation of femoral head cover in relation to a specific anatomical reference plane (the anterior pelvic plane) [16]. and to look at the relationship between radiological interpretation of retroversion and objective values obtained by CT. (Figure 4)

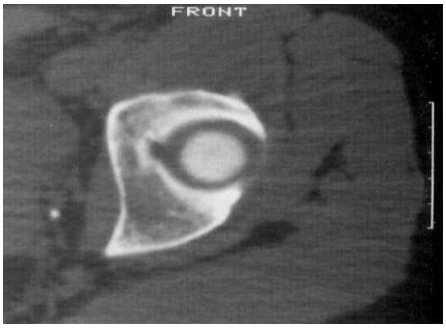


Figure4: CT of the acetabulum in retroverted alignment [(2)]

METHODS

This was a cross-sectional study conducted from December 2015 to March 2017 targeting patients with hip pain, in orthopedic clinic of Al Kindy teaching hospital. The studies were conducted on randomly selected 100 patients who were visited the out patients clinic of orthopedics, they were complaining of hip pain for different aeiteological factors and met the inclusion criteria: adult patients complained of hip pain, or osteoarthritis patient.

The exclusion criteria were: Traumatic injuries of pelvis, previous operations in pelvis.

And Congenital disease of hip.

All subjects selected were provided with a written informed consent to participate in this study.

The mean age of the study group was (35.63 ±10) years, there were (59) females (59%) with mean age (34.13 ± 9.36) years, the range was (18 – 57) years.

The remaining (41) patients (41%) were males with mean age (37.78±10.56) years; the range was (20 – 61) years.

Weight and height of all patients were measured using standardized tools and measures then body mass index (BMI) this had been calculated, as

BMI=Wight in kilogram\squared height in meter kg\m².

Normal range (19.5 – 23.5) kg/ m2

The mean BMI of total patients was (26.9 ± 4.35) kg\m² .

In addition to distribution of patient by gender also had been distributed according to age groups and BMI grades.

All patients were investigated for symptoms with a plain radiographs, then these radiographs were analyzed, and the presence of a cross-over sign was documented in 9 patients (9%).

For the hips exhibiting a positive cross-over sign the extent of cross-over was measured by noting the point at which the anterior wall crosses the line of the posterior wall.

The patient with unilateral or bilateral positive cross-over sign considered as a positive and had been given a single record in statistical analysis.

The positively cross-over sign patients were investigated, later, with a CT scanning to identify and ensure the diagnosis of retroversion of acetabulum.

The results of both radiography and CT scans were analyzed and compared to each other and, dependently, the prevalence of retroverted acetabulum.

Statistical Analysis

By using SPSS V16, 3, 1.US . software for windows, data of all patients and controls were entered and analyzed with appropriate statistical tests, Student's t-test was used to compare quantitative data of patients; age and BMI, whereas for comparison of proportions and categorical data, Chi square and Fisher exact tests,, were used, Pearson's correlation coefficient was calculated, and corresponding p-values were used to evaluate the relationships between ordinal and other variables. All values were normally distributed and showed a Gaussian distribution (P=0.05 on test of normality). In all analysis the level of significance was set at ≤0.05.

RESULT

There were 100 patients who met the inclusion criteria and they were, clinically, had hip pain and suspected to have probable retroverted acetabulum,had been selected; the demographic criteria of all patients were summarized by table (1).

There were10% of patients with age ≤30 years, 54% at 31-50 years and 36% were > 50 years of age.

Regarding BMI , 28% of patients with normal BMI <25 kg\m², 31% of patients were overweight and 41% were obese.

Statistically, no significant variation and correlation had been noted in mean age , age groups ,mean BMI and BMI grades with gender(in between groups and within groups) distribution P>0.05, while , there was a highly significant correlation between BMI and age (P=0.006) , tables (2,3,4) .

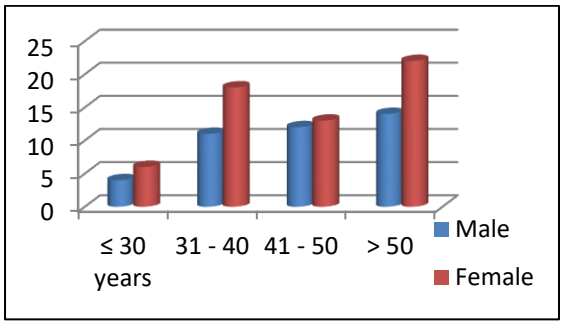


Figure (5) Distribution of patients by gender and age groups

Radiographs were revealed a positive cross-over sign in 9 % (9\100) of patients, documentation of diagnosis by CT scanning were in 8 of them. As the diagnosis was documented by CT scanning ,the Prevalence of retroverted acetabulum was (9%) , and It was more prevalent in female than males among study patients, 10.2% (6\59) among females and 7.3 % (3\41) among males, male to female ratio was (1:2), there was a highly significant difference between positive and negative results, (P = 0.00002) and it has high predictive value of negative results, on the other hand there was no significant correlation between presence of cross-over sign and gender , P>0.05, table(5).

A Cross-over sign was found to be sensitive to identify 89% of the retroverted cases , but it had low specifity only 63% i.e. about 37% of retroverted cases being wrongly labeled as retroverted ,where cases that truly anteverted were labeled as retroverted (false positive) .

Regarding the CT scans findings, 9 patients with positive cross-over sign were underwent CT scan tests and (table 6), summarized the results.

A comparison of validity of Radiograph (cross-over sign) and CT scan tests validity

Validity Test	Cross-over sign	CT scan	P-value
Sensitivity	89%	94%	0.31*
Specificity	63%	67%	0.65

* Statistically, no significant differences in validity of both tests P-value >0.05.

Finally, as shown in table (6), there was no significant differences in validity of diagnosis of reteroverted Acetabulum depending on cross-over sign or CT scanning P value >0.05.

Table 1: Distribution of patients by gender, age and body mass index (BMI) grades

Gender	No.	Percent	Age (Years)		BMI Kg m^2	
			Range	Mean (±SD)	Range	Mean (±SD)
Male	41	41	20-61	37.78 (10.56)	18.80-36.90	27.33(4.95)
Female	59	59	18-75	34.13 (9.36)	18.5-36.90	26.62 (4.26)
Total	100	100%	18-75	35.6 (10)	18.50-36.90	26.9 (4.35)
	P value		0.071		0.425	

Table 2: Distribution of patients by gender and body mass index (BMI) grades

Gender	BMI kg\m²	Count	Percent	P. value*
Male	< 25	8	19.5	0.425
	25-29.9	13	31.7	
	30-34.9	11	26.8	
	> 35	9	22.0	
	Total	41	100.0	
Female	< 25	20	38.98	0.425
	25 - 29.9	18	20.30	
	30 - 34.9	13	21.70	
	> 35	8	11.60	
	Total	59	100%	

*No significant correlation between gender and BMI

Table 3: Distribution of patients by gender and age groups

Gender	Age group (years)	Count	Percent	P. value
Male	≤ 30	4	9.80	0.373
	31-40	11	26.80	
	14-50	12	29.30	
	>50	14	34.10	
Total		41	100%	
Female	≤ 30	6	10.20	0.472
	31-40	18	30.5	
	41-50	13	2200	
	>50	22	37.30	
Total		59	100%	

* No significant variations within a group, and between groups P.value >0.05.

Table 4: Gender by cross-over sign cross tabulation on radiographs among study patients

Gender	Cross-over sign				P.value
		Negative	Positive	Total	
Male	Count	38	3	41	0.00002 Compare- ve to +ve result
	% within males	92.7%	7.3%	100.0%	
Female	Count	53	6	59	0.00002 Compare- ve to +ve result
	% within females	90.8%	10.2%	100.0%	
	% within gender	91.0%	9.0%	100%	*0.886
Total	Count	91	9	100	Both sexes compared
	% within gender	91.0%	9.0%	100.0%	

Table 5 : CT Scan result of 9 patients with positive cross over sign

Gender	**CT scan Result**		
	Negative	Positive	Total
Male	0	3	3
Female	1	5	6
Total	1	8	9

Table 6 : A comparative of validity of radiograph (cross – over sign) and CT scan tests validity

Validity	Test		P- value
	Cross - over sign	CT scan	
Sensitivity	89.%	49%	0.31*
Specificity	36%	67%	0.65

DISCUSSION

The posterior aspect of the acetabulum is subjected to high loads during the activities of daily living. With acetabular retroversion, theoretically greater unit loads are imposed on the available posterior cartilage. These increased unit loads may be responsible for the development of osteoarthritis of the hip. A proper determination of acetabular retroversion requires that the orientation of the pelvis be taken into consideration. The cross-over sign can be easily influenced by the inclination or rotation of the pelvis. Siebenrock et al [(4)], suggested that the cross-over sign is influenced by the inclination of the pelvis. They measured the distance between the pubic symphysis and the sacrococcygeal joint in healthy subjects and reported a mean value of 32.3 mm for males

and 47.3 mm for females. If pelvic inclination and rotation are overlooked, some normal images may be misdiagnosed as acetabular retroversion.

Most cases of osteoarthritis of the hip can be attributed to an underlying etiology, including mild or unrecognized hip dysplasia and previous trauma, Perthes' disease or slipped upper femoral epiphysis. Femoroacetabular impingement has also been identified as a cause of early osteoarthritis of the hip. There are two types of femoroacetabular impingement; cam and pincer. The former occurs because of an abnormal shape of the head-neck junction of the femur, as in a 'bullet-shaped' femoral head or slipped upper femoral epiphysis. Excessive acetabular cover secondary to a retroverted acetabulum causes pincer impingement. Both forms may lead to early osteoarthritis of the hip. Passive movement of the hip into simultaneous flexion, adduction and internal rotation, especially in the mid-range of flexion, is a provocative sign of impingement. There may be an associated acetabular labral tear. Degeneration of the labrum with fragmentation and ossification of the superior rim of the acetabulum follows repeated abutment of the acetabular rim and the femoral head-neck junction. This can result in a chondral injury to the posteroinferior acetabulum.

In a review of the literature, Li and Ganz [11,17] reported that acetabular retroversion was found in forty (17.2%) of 232 hips with developmental dysplasia. In contrast, Mast et al [1]. reported that acetabular retroversion was found in eighty-seven(37%) of 235 hips with developmental dysplasia. Giori [17] and Trousdale [16] compared the presence of the crossover sign in patients with osteoarthritis of the hip and in subjects with normal hips and found that the prevalence of acetabular retroversion was 20% in patients with osteoarthritis of the hip and 5% in normal subjects. W.Y.Kim [7]found the prevalence of retroverted acetabulum in OA patient 15.4%. Our finding was 8% in adult patient which may contain criteria osteoarthritis Or not. In contrast, the prevalence of acetabular retroversion in patients with so-called idiopathic osteoarthritis was 20%. Harris postulated that most instances of so-called idiopathic osteoarthritis were secondary to preexisting developmental deformities. That means that the prevalence is nearly identical to our result. Cause we searched for patient with hip pain.

We identified the presence of acetabular retroversion on the basis of a positive cross-over sign on plain radiograph because of the previously reported validity of that method. And assisted with the use of CT scan.

CT provides greater anatomical detail while allowing correction for the presence of tilt in the coronal plane. Previous CT studies of acetabular version may have underestimated true version since it is necessary to scan the superior third of the acetabulum in order to avoid missing retroversion.

In a study for W.Dandachli [16], the cross-over sign was found to be sensitive enough to identify 92% of the retroverted cases, it's specificity was low (55%), with just under half of the anteverted cases being wrongly labeled as retroverted. of the 64 hips analyzed, there were 17 false positives, where cases that were truly anteverted were labeled as retroverted because of the presence of a cross-over sign. This is in contrast to the study by Jamali *et al* [19], where it was found that the cross-over sign had a positive predictive value of 90% and a specificity of 95%. Their study was based on pelvic specimens from a collection of skeletons which had anatomical measurements made and which were then correlated with radiographs of the same specimens. All measurements were made with the position of the pelvis standardized to the anterior pelvic plane. In our study the sensitivity and specificity was 89% and 63% respectively. We had one case false positive cross over sign in which was negative in CT scan.

The exact mechanism whereby retroverted hips may be more predisposed to the development of osteoarthritis is difficult to determine.

There are several limitations to our study. Radiological evidence of osteoarthritis of the hip may not correlate with symptoms. The assessment of the severity of the condition may be subjective and prone to inter- and intra-observer variation if plain radiographs are used. Joint space has been shown to correlate most closely with the symptoms of osteoarthritis compared with the presence of osteophytes, cysts or subchondral sclerosis. The parameter is objective, being easily and reproducibly measured using CT. Our study did not assess the effect of femoral version in

patients with decreased acetabular version; this may have a compensatory effect on a retroverted acetabulum. It may in part explain why some patients with reduced acetabular version do not develop early osteoarthritis of the hip. Furthermore, we did not study the possibility of cam impingement or abnormalities of the head-neck junction of the femur, since CT virtual colonoscopy images do not extend far enough down the femur to allow this analysis. We didn't measure the version of retroverted acetabulum. We didn't separate patient with OA from normal persons cause we collect only patient with hip pain. We need to take more patient difficulty in obtaining CT scan.

CONCLUSION

The prevalence of acetabular retroversion in adult patient with hip pain was investigated and it was found that the prevalence in these group is 8%.

The cross-over sign is a reliable indicator for diagnosis of acetabular retroversion and the appearance of a cross-over sign in a plain film should heighten awareness of the advisability of proceeding to full CT assessment.

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