Acetabular dysplasia in adult hips of a Saudi population

A possible relation to coxarthrosis

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ABSTRACT

Objectives: To evaluate acetabular morphology and the prevalence of dysplasia in a Saudi population, and compare it with others in different geographical areas.

Methods: The study took place at King Fahd University Hospital, Al-Khobar, Kingdom of Saudi Arabia from May 2005 to April 2006. We recruited radiographs of 104 patients of 40-88 years of age. We digitally measured the center edge angle (CEA) of both hips.

Results: Of the 208 hips examined, 3 hips (1.44%) had mild-to-moderate acetabular dysplasia but there was no case with severe dysplasia (CEA <20 degree).

Conclusion: The study shows that acetabular dysplasia is very rare in adult Saudi hip joints, which are less dysplastic than many other populations. This could be a contributing factor for the very uncommon prevalence of hip osteoarthritis in this population.

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The acetabulum of the hip joint is considered dysplastic when it is shallow, vertically oriented, and underdeveloped. This results in a smaller weight bearing contact area with the femoral head. Consequently, the hip joint is subjected to a larger force per unit area during stress (walking) with subsequent risk of early degeneration of the articular cartilage or osteoarthritis (OA). The criteria for determining acetabular dysplasia (AD) have been well defined previously.^{1,2} In these studies, radiographic measurements of the center-edge angle of Wiberg³ (CEA) were used to express diagnostic features that differentiate a normal from a dysplastic hip. Although many other radiological measurements have been described to assess hip joint morphometry, CEA is the most reliable and widely used to determine AD.⁴ The CEA values of less than 20° were associated with AD, whereas those equal to or of more than 25° were considered normal. There is little up-to-date published data describing the geometric features of the hip joint in Saudis, which could be related to AD and hip OA. This study was conducted to evaluate the acetabular morphology and prevalence of dysplasia in a Saudi population, and compare it with others in different geographical areas.

Methods. The study was carried out at King Fahd University Hospital, Al-Khobar, Kingdom of Saudi Arabia. From the radiograph computerized register, we identified all consecutive patients above 40 years old who had attended for intravenous pyelogram (IVP) from May 2005 to April 2006. Radiographs included were those that show both hips adequately in the control or post-micturition films. Radiographs were excluded if either hip could not be visualized adequately, was replaced or diseased. One hundred and four adult pelvic antero-posterior (AP) x-rays (208 hips) for Saudis (55 male/49 female) were retrieved from the digital imaging system installed in our hospital Magic Web® for assessment. Patient mean age of the Saudi men was 52.4±11.4 years; and the mean age of Saudi women was 50.4±8.2 years; range 40-88 years, at time of IVP study. All cases were retrieved, and measurements were performed by digital analysis of the stored pelvic radiographs. A single trained observer (an orthopedic specialist) read all the radiographs, and performed the measurements. For each of the 208 hips analyzed, we measured the CEA of Wiberg³ and the acetabular angle (AcA) of Sharp.⁵ The CEA is measured between a true perpendicular line intersecting the center of the femoral head and a second line from the center of the femoral head to the center-lateral lip of the acetabulum. The centers of the femoral heads were located with the aid of a transparent plastic sheet marked with contrast circles as described by other similar studies^{6,7} (Figure 1). The smaller the angle, the more dysplastic the hip joint is. Mild to moderate AD was defined if the CEA is less than 25°. Severe AD was considered to be present if the CEA was 20° or less.⁶ The AcA of Sharp⁵ is measured between the line joining the outermost ossified portion of the acetabulum and the pelvic teardrops tangential line (Figure 1). Repeatability of the measurements was established by using a subset of 30 hips. This subset was reread blindly after one month by the same observer. There were no intra-observer variations. All values were entered and analyzed statistically using SPSS software. The proportion of AD in this study group was calculated. A t-test between the measured acetabular variables (CEA and AcA) and gender was performed, and pearson's correlation coefficient was used to test

the relationship between various variables and age. A *p*-value of less than 0.05 was considered significant.

Results. The mean CEA in this population was 33.3° (SD±4.0): with minimum 22° and maximum 44°. Three (1.4%) of the 208 hips with CEA of less than 25° were considered mildly dysplastic. However, there was no single hip with severe AD in this series ($\leq 20^{\circ}$). Figures 2 & 3 demonstrate frequency of the measured CEA and AcA and distribution of the cases. Table 1 compares the means, and the standard deviations for the CEA and AcA angles for both Saudi men and women. The Saudi men have significantly higher measures for CEA and smaller measures of AcA (p < 0.5), indicating that Saudi womens' hips were more dysplastic. Testing the relationship between CEA and AcA has shown a significantly negative correlation (R=0.323, p<0.001), but there was no significant correlation between the measured CEA and age of the cases (R=-0.019, p=0.789). In addition, there was no significant difference between right and left hips in this series (t=-0.155, p=0.877).



Figure 1 - Center edge angle of Wiberg (CEA) and acetabular angle of Sharp (AcA) in a radiograph.

 Table 1 - Comparison of hip morphology between Saudi males and females.

Hip Morphology (measured angles)	pgy Mean ± SD		T test	<i>P</i> -value
	Males	Females		
CEA of Wiberg	34.0 <u>+</u> 4.0	32.6 <u>+</u> 4.0	2.55	0.012
AcA of Sharp	34.3 <u>+</u> 4.6	36.6 <u>+</u> 4.2	-3.73	< 0.001

CEA - Center edge angle, AcA - Acetabular angle



Figure 3 - Distribution of acetabular angles of Sharp (AcA).



Figure 2 - Distribution of center edge angles (CEA).

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Discussion. There are more than 20 described static geometric parameters, and more than 7 biomechanical and kinematic parameters reported for the hip joint.^{8,9} These measures give an indirect measure of 3 dimensional contact geometry of the hip joint, and joint contact stress along its articular surfaces. This is always estimated from 2-dimensional radiographs assuming that femoral head and the acetabular surface were spherical in shape. Therefore, the pelvic radiograph has an important role in the assessment of the dysplastic hip in young adults. We have used pelvic IVP x-rays, and the CEA for detecting AD as the most reliable and widely used variable in many studies,^{4,6,7} with special precautions to avoid intra and inter-observer errors.

The hip joint of Saudis has special "unique" features.¹⁰ Although knee osteoarthritis is highly prevalent, hip OA in contrast is very rare in Saudi Arabia, reaching 0.04% among the Saudi population with 80:1 ratio of knee to hip OA.¹¹ In addition, while developmental dysplasia of the hip (DDH) in children is fairly prevalent in Saudi Arabia^{12,13} and well documented, acetabular dysplasia of the adult Saudi population is unknown, as morphometric studies of acetabular anatomy have not been performed previously. Both conditions, namely, DDH and AD are well-known risk factors for hip OA in adults. This study has shown that AD is very rare in hips of the recruited Saudi population (mild AD in 1.4%). There was no case of severe AD in this series. This could be one of the reasons why primary hip OA is very rare in Saudi Arabia. Furthermore, the hip joints in Saudis demonstrated a significant increase of the range of motion in abduction, and external rotation compared to other western populations.¹⁴ This was presumed to be related to local habitual cross-legged sitting positions. Whether the geometric features including AD of the hip joint in this population, or the kinematic factors, or both are related to the very low incidence of hip OA among Saudis is a matter of speculation.

The prevalence of AD has been reported as 3.3% in Nigerian men,¹⁵ 3.4% in white females in Britain,¹⁶ 4.5% in Chinese men,¹⁷ 2.4% in the Turkish population,¹⁸ 7.3% in a Singaporean study,¹⁹ and only 1.4% in this series. This implies that AD is very rare in Saudi Arabia compared to other populations, despite geographical variation of the hip joint morphometry.

Sound knowledge of hip geometry and anatomical "deformities" will prove valuable for treatment planning, for surgical planning of total hip replacement, and for prosthesis wear pattern. Further studies are needed to elaborate these peculiar features of the hip joint in adult Saudis, and its relation to the pattern of hip diseases in this population. **Acknowledgment.** The authors would like to express their thanks to Dr. Ahmed Bahnasy, MSc, MSPH, PhD, Associate Professor, Department of Community & Family Medicine, for his assistance in the statistical analysis of this study.

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