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The Importance of Acetabular Morphometry in Determining Hip Dysplasia

Importancia de la Morfometría Acetabular en la determinación de la displasia de cadera

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SUMMARY: The aim of this study was to evaluate the relation between acetabulum morphological measurements and present the reference values of the acetabulum. The study had a retrospective design and was conducted with 234 healthy subjects (108 females; 126 males) aged 18-53 years over a period of 4 years from 2018 to 2022. Eleven measurements including the center-edge angle (CEA), acetabular angle (AA), acetabular depth (AD), acetabular width (AW), dept to width ratio (ADWR), Extrusion A (EA)-B (EB), Extrusion index (EI), the lateral subluxation (LS), peak to edge distance (PED), and roof obliquity (RO) were taken. The $p<0.05$ value was considered significant. A significant difference was found in CEA, AA, EB, LS, and RO values, while there was no significance in the AD, AW, ADWR, EI, and PED measurements in comparison with acetabular morphometry according to gender. Also, in the evaluation of acetabulum to age-related changes, there was a significant difference in values of the CEA, AA, AD, AW, ADWR, LS, and PED from decades 1 to 5. The knowledge of radiological acetabulum findings is paramount for the diagnosis of hip dysplasia and may be useful for prosthesis, orthopedic and forensic experts. Also, the most interesting finding was that ADWR increased based on age in a directly proportional trend. The most apparent change based on age was seen in CEA (between decades 3-4), LS (decades 1-5), PED (decades 2-4), AD, and AW (decades 2-5).

KEY WORDS: Acetabulum, hip dysplasia, age and gender-related changes.

INTRODUCTION

The hip joint is one of the major weight-bearing joints of the body. It is also referred to as the ball and socket joint. The femoral head articulates with the acetabulum. Movements at this joint include flexion, extension, adduction, abduction, circumduction, and external and internal rotation (Moore & Dalley, 2007; Devi & Philip, 2014; Arıncı & Elhan, 2020). A non-adaptable joint is more inclined to develop degenerative changes than a joint with normal anatomy. A total of 25-40 % of the reasons for hip osteoarthritis may be acetabular dysplasia and a dysplastic hip also correlates with the acetabular depth. The normal acetabular depth is known as 9 mm and less than this can be accepted as dysplasia (Umer *et al*., 2006; Devi & Philip, 2014).

The acetabulum is a hemispherical cavity on the medial part of the hip joint. Anterior acetabular ridge morphology is important in total hip arthroplasty. It is valuable to know the AW and AD for the surgical treatment of acetabular fractures (Aksu *et al*., 2006). Also, the knowledge of normal anatomical structure and morphometry of the acetabulum plays an important role in understanding the mechanics of the hip joint (Devi & Philip, 2014). The acetabular roof is underdeveloped and remains vertically oriented and shallow, which results in a smaller surface available for weight-bearing in the patient with acetabular dysplasia and there are many diagnostic criteria for differentiating a normal hip from a dysplastic hip (Umer *et al*., 2006). One of the diagnostic criteria is the CEA. The center-edge angle was first described by Wiberg in 1939 and the values above 25 degrees were accepted as normal acetabulum. Additionally, the mean value of the CEA of a normal hip was 37 degrees in males and 35 degrees in females (Harris, 1986; Umer *et al*., 2006).

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The various acetabular measurements including acetabular angle, depth-to-width ratio, extrusion index, lateral subluxation, and peak to edge distance, and the central angle are used to evaluate the hip and these measurements can help to assess the degree of acetabular dysplasia, especially the CEA, which is affected by the femoral head pathological situation, plays a critical role in determining hip dysplasia (Han *et al*., 1998; Nelitz *et al*., 1999; Aktas *et al*., 2000; Umer *et al*., 2006). The other criteria to be used in the diagnosis of hip dysplasia is the roof obliquity and the RO is less than 20 degrees and the acetabular angle is more than 43 degrees, these parameters may indicate hip dysplasia (Umer *et al*., 2006).

In the present study, the purpose was to determine and evaluate the reference/normal values of the acetabulum of the Turkish healthy population. Also, the obtained data can be important both in terms of revealing the acetabulum morphometry and decision about hip dysplasia. Therefore, whether there is any relationship between acetabulum morphological measurements was examined in the study. The study question was "Are there any relations between acetabular dimensions and age/ gender or are there any changes in the acetabular parameters as age increases?".

MATERIAL AND METHOD

This study was carried out with 234 healthy subjects (108 females; 126 males) aged 18-53 years over a period of 4 years from 2018 to January 2022. This study was approved by Çukurova University Ethics Committee and had a retrospective observational design, which was conducted in Izmir Bozyaka Education and Research Hospital, Department of Radiology. The measurements were taken under the same conditions with the Digital X-Ray system (Samsung XGO GC80) with a double detector.

The main inclusion criterion was as follows.

- Healthy adult subjects were selected according to optimal health status.

The main exclusion criteria were as follows.

- Adult subjects who had a history of trauma or fractures regarding the pelvis (i.e., acetabulum), hip joint, or lower limb.
- Those who had undergone surgery on the lower limb.
- Normal hip without congenital or acquired deformities and arthritic changes.

The comparison of the 11 acetabular morphometric measurements according to gender is shown in Table I. The data were divided into two groups as healthy adult female and male subjects, and seven groups according to age (decades). Age groups were as follows:

- 18-20 years, decade 1;
- 21-30 years, decades 2;
- 31-40 years, decades 3;
- 41-50 years, decades 4;
- 51 and over years, decades 5 (Table II).

To determine the significance between decades 1-5, Post Hoc test results are given in Table III. Additionally, Pearson correlation analysis results which measured the statistical association between gender and eleven acetabular measurements are given in Table IV.

The SPSS 22.0 program was used for statistical analysis. The means, standard deviations (SD), minimum (min.), and maximum (max.) values were estimated. Normality was evaluated by the Shapiro-Wilks test, and the data tested were found to be normally distributed ($p>0.05$). Also, the One-Way ANOVA test, which is one of the parametric tests, was chosen to determine the significance between age groups. The Independent Samples T-test was used to evaluate the changes based on gender. Also, the Pearson Correlation Analysis was used to measure the statistical association between gender and 11 acetabular morphometric measurements, and the $p<0.05$ value was considered significant.

The measurement parameters were as follows.

- Centre-edge angle, acetabular angle, acetabular depth, acetabular width, dept to width ratio, extrusion A-B, extrusion index, lateral subluxation, peak-to-edge distance, and roof obliquity.
- Center-edge angle (CEA): It is also known as the vertical-center-anterior (VCA) angle and radiographic measurement of the anterior coverage of the femoral head by the acetabulum.
- Acetabular angle (AA): It is formed by the junction of Hilgenreiner's and a line drawn along the acetabular surface (Noordin *et al*., 2010).
- Acetabular depth (AD): A tangent line is drawn from the most lateral edge of the acetabulum to the symphysis pubis on the same side. A perpendicular line is drawn to the deepest point of the acetabulum roof and the distance is stated in millimeters (Umer *et al*., 2006; Engesæter *et al*., 2012).
- Acetabular width (AW): It was measured by a line joining the lateral edge of the acetabulum to the pelvic teardrop

(Umer *et al*., 2006; Engesæter *et al*., 2012).

- Depth-to-width ratio (ADWR): It defines the ratio of the distance between the inferior teardrop point and the lateral acetabular rim, and the depth of the acetabulum (Engesæter *et al*., 2012).

- Extrusion index (EI): This index is a ratio of 2 measurements: the horizontal distance between the vertical lines drawn through the medial and lateral edge of the femoral head, and the distance between the lateral edge and outer edge of the acetabulum (A/A+B) (Umer *et al*., 2006).

- Lateral subluxation (LS): It is the distance between the teardrop and the medial-most edge of the femoral head (Umer *et al*., 2006).

- Roof obliquity (RO): It is the angle subtended by the line connecting the inferior-most edge of the roof of the acetabulum to the lateral-most edge of the acetabulum with a parallel horizontal line (Umer *et al*., 2006).

- Peak-to-edge distance (PED): It is the horizontal distance between the lateral edge of the acetabulum and the most vertical point of the sourcil (Umer *et al*., 2006).

Ethical consent: The study was approved by the Institutional Review Ethics Committee at Cukurova University (No:2022/122-49).

RESULTS

The study was carried out with 234 healthy subjects (108 females; 126 males) aged 18-53 years from 2018 to January 2022. The parameters were as follows. Center-edge angle (CEA), acetabular angle (AA), acetabular depth (AD), acetabular width (AW), dept to width ratio (ADWR), extrusion A (EA)-B (EB), extrusion index (EI), lateral subluxation (LS), peak to edge distance (PED) and roof obliquity (RO).

In Table I, it is seen that a significant difference was found in values of the center-edge angle, acetabular angle, extrusion B, lateral subluxation, and roof obliquity, while there was no significance in the acetabular depth, acetabular width, depth to width ratio, extrusion index, and peak to edge distance measurements in comparison with the acetabular morphometric measurements according to gender. However, the values of CEA, AD, AW, EB, LS, and RO were found higher in females, and ADWR and PED were closer to each other. AA, EA, and EI measurements were higher in males than in females. Also, the comparison of the acetabular morphometry according to age groups and Post Hoc test results are shown in Tables II and III. According to these results, a significant difference was found in values of the CEA, AA, AD, AW, ADWR, LS, and PED between decades. The CEA measurement was the highest in decade 4. The lowest value was obtained in decade 3. Also, the significance was clear between decades 1-4; decades 2-3; decades 2-4; decades 3-4; and decades 4-5 ($p<0.05$). AA value was found to be the highest in decade 2 and the lowest in decade 3. This corresponding value showed the significance between decades 1-2; decades 2-3; decades 3-4; and decades 3-5. Additionally, the mean of AD was found to be significant between decades 1-4; decades 1-5; decades 2-3; decades 2-4; decades 2-5; and decades 3-5. In AW measurement, a significant difference was found in decades 1-5; decades 2-5; decades 3-5; and decades 4-5. Moreover, ADWR measurement showed an increase from decade 1 to decade 5. This increase was clear between decades 1-4; decades 2-3; and decades 2-4. A significant difference was found in the lateral subluxation value between decades 1-2; decades 1-4; decades 1-5; decades 2-5; and decades 3-5. The present value was lowest in decade 1, whereas the highest value was found in decade 5. Furthermore, PED measurement was lowest in decade 2, while the highest value was found in decade 5. This corresponding value showed a significant difference in decades 1-2; decades 1-4; decades 2-4; decades 2-5; decades 3-4; and decades 3-5 (Tables II and III).

In Table IV, the association of the acetabular morphometric measurements with gender is evaluated. According to this table, $p<0.05$ value showed the significance of the correlation, while the "r" value gave the association ratio. A negative (-) mark showed the inverse proportion, while a positive (+) value showed the direct proportion. Also, this table was interpreted according to the following formula.

$r<0.2$ =very weak or no correlation
$r=0.2-0.4$; weak correlation
$r=0.4-0.6$; moderate correlation
$r=0.6-0.8$; strong correlation
$0.8>r$=very strong correlation

For example, the relation between acetabular width and peak-to-edge distance was found strong, positive, and significant ($r=0.716$; $p<0.001$). A moderate correlation was found between center edge angle and gender ($r=0.524$; $p<0.001$).

Table I. The comparison of the acetabular morphometry according to sex.

Sex	Center-edge angle (CEA)	Acetabular angle (AA)	Acetabular depth (AD)	Acetabular width (AW)	Depth to width ratio (ADWR)	Extrusion A (EA)	Extrusion B (EB)	Extrusion index (EI)	Lateral subluxation (LS)	Peak to edge distance (PED)	Roof obliquity (RO)
Male	32.01±1.89	39.89±2.35	2.23±0.39	6.52±0.56	0.34±0.064	1.26±0.35	4.90±0.98	0.21±0.05	1.19±0.26	6.77±0.64	7.08±0.79
(n=126)	(28.00-39.00)	(35.63-45.65)	(1.08-3.01)	(4.61-7.69)	(0.15-0.52)	(0.84-3.08)	(3.12-7.10)	(0.14-0.46)	(0.84-2.22)	(5.23-8.80)	(3.00-8.22)
Female	33.68±1.86	38.45±2.66	2.25±0.42	6.56±0.57	0.34±0.063	1.22±0.34	5.22±1.20	0.19±0.08	1.28±0.33	6.76±0.61	7.34±0.95
(n=108)	(30-43)	(30.54-44.89)	(1.14-2.98)	(4.98-7.82)	(0.18-0.47)	(0.81-2.43)	(2.83-7.10)	(0.06-0.045)	(0.81-2.14)	(4.58-7.81)	(3.14-9.87)
Total (236)	32.78±2.05	39.22±2.60	2.24±0.40	6.54±0.56	0.34±0.064	1.24±0.34	5.05±1.10	0.20±0.07	1.23±0.30	6.77±0.63	7.20±0.87
	(28-43)	(30.54-45.55)	(1.08-3.01)	(4.61-7.82)	(0.15-0.52)	(0.81-3.08)	(2.83-7.10)	(0.06-0.46)	(0.81-2.22)	(4.58-8.80)	(3.00-9.87)
P value	<0.001	<0.001	>0.05	>0.05	>0.05	>0.05	0.027	>0.05	0.027	>0.05	0.021
			(0.778)	(0.681)	(0.998)	(0.295)		(0.172)		(0.889)	

Table II. The comparison of the acetabular morphometry according to age groups.

Age groups	Center-edge angle (CEA)	Acetabular angle (AA)	Acetabular depth (AD)	Acetabular width (AW)	Depth to width ratio (ADWR)	Extrusion A (EA)	Extrusion B (EB)	Extrusion index (EI)	Lateral subluxation (LS)	Peak to edge distance (PED)	Roof obliquity (RO)
Decade 1	32.53±2.06	38.70±2.57	2.18±0.44	6.60±0.41	0.331±0.063	1.22±0.23	5.21±1.23	0.197±0.054	1.13±0.22	6.83±0.45	7.16±1.04
(n=52)	(29.0-39.0)	(34.89-45.55)	(1.08-2.98)	(5.81-7.20)	(0.17-0.41)	(0.90-1.98)	(3.12-7.10)	(0.13-0.35)	(0.88-1.89)	(5.80-7.61)	(3.00-8.41)
Decade 2	32.91±1.92	39.79±2.32	2.13±0.43	6.45±0.53	0.332±0.070	1.239±0.32	5.07±0.98	0.199±0.049	1.24±0.29	6.59±0.69	7.19±0.88
(n=78)	(28-39)	(35.41-44.68)	(1.08-2.98)	(5.04-7.66)	(0.15-0.47)	(0.84-2.40)	(3.14-7.10)	(0.11-0.38)	(0.88-2.14)	(4.58-7.81)	(3.14-8.88)
Decade 3	31.97±1.42	38.09±2.70	2.28±0.30	6.44±0.66	0.357±0.531	1.20±0.36	5.12±1.05	0.196±0.081	1.22±0.30	6.68±0.55	7.250±0.8
(n=42)	(30-35)	(30.54-44.89)	(1.58-2.81)	(4.61-7.41)	(0.26-0.50)	(0.90-2.43)	(2.83-6.73)	(0.14-0.45)	(0.82-1.98)	(5.38-7.63)	0 (5.83-9.87)
Decade 4	33.68±2.50	39.70±2.41	2.36±0.34	6.56±0.62	0.361±0.058	1.277±0.47	4.80±1.16	0.215±0.079	1.28±0.33	6.95±0.70	7.254±0.7
(n=46)	(30-43)	(35.14-44.39)	(1.55-3.01)	(4.98-7.69)	(0.25-0.52)	(0.81-3.08)	(3.14-6.44)	(0.13-0.46)	(0.81-2.08)	(5.23-8.80)	7 (5.65-8.30)
Decade 5	32.50±1.71	39.77±3.16	2.53±0.35	6.97±0.51	0.365±0.059	1.306±0.33	4.93±1.13	0.213±0.057	1.41±0.34	7.11±0.51	7.09±0.75
(n=16)	(31-36)	(35.63-44.13)	(1.95-2.95)	(6.11-7.82)	(0.28-0.46)	(0.95-1.93)	(3.22-6.50)	(0.15-0.33)	(1.13-2.22)	(6.33-7.91)	(5.85-8.13)
P value	0.002	0.002	0.001	0.010	0.017	0.765	0.425	0.504	0.011	0.002	0.954

Table III. Post-Hoc test results of the acetabular morphometry according to age groups.

Sex	Centre-edge angle	Acetabular angle	Acetabular depth	Acetabular width	Dept to width ratio	Extrusion A	Extrusion B	Extrusion index	Lateral subluxation	Peak to edge distance	Roof obliquity
Decades 1- 2	0.286	0.016	0.420	0.137	0.955	0.773	0.470	0.820	0.046	0.028	0.823
Decades 1-3	0.178	0.249	0.232	0.180	0.050	0.760	0.701	0.981	0.160	0.258	0.616
Decades 1-4	0.005	0.050	0.030	0.738	0.017	0.428	0.066	0.150	0.015	0.308	0.592
Decades 1-5	0.962	0.137	0.002	0.019	0.062	0.393	0.383	0.360	0.001	0.102	0.789
Decade 2- Decade 3	0.014	0.001	0.041	0.952	0.038	0.548	0.795	0.811	0.724	0.399	0.737
Decade 2-Decade 4	0.039	0.852	0.002	0.284	0.011	0.558	0.190	0.178	0.464	0.001	0.712
Decade 2- Decade 5	0.456	0.982	<0.001	0.001	0.057	0.483	0.661	0.421	0.031	0.002	0.671
Decade 3- Decade 4	<0.001	0.03	0.363	0.324	0.724	0.294	0.169	0.165	0.340	0.039	0.983
Decade 3- Decade 5	0.365	0.024	0.034	0.001	0.668	0.295	0.563	0.364	0.025	0.017	0.539
Decade 4- Decade 5	0.043	0.921	0.138	0.011	0.862	0.773	0.670	0.918	0.115	0.367	0.524

Table IV. Correlation analysis of the acetabular morphometry.

Sex	Centre-edge angle	Acetabular angle	Acetabular depth	Acetabular width	Dept to width ratio	Extrusion A	Extrusion B	Extrusion index	Lateral subluxation	Peak to edge distance	Roof obliquity
Centre-edge angle	-	r=-0.139	0.164	0.025	0.091	-0.152	0.053	-0.171	0.159	-0.100	0.246
		p=0.034	0.012	>0.05	>0.05	0.020	>0.05	0.009	0.015	>0.05	<0.001
Acetabular angle	-0.139	-	0.198	-0.151	-0.089	0.173	-0.301	0.340	0.090	-0.139	-0.102
	0.034		0.002	0.021	>0.05	0.008	<0.001	<0.001	>0.05	0.034	>0.05
Acetabular dept	0.164	-0.198	-	0.307	0.797	0.040	-0.023	0.032	0.139	0.126	0.202
	0.012	0.002		<0.001	<0.001	>0.005	>0.005	>0.005	0.034	0.055	0.002
Acetabular width	0.025	-0.151	0.307	-	-0.256	0.054	0.101	-0.021	-0.073	0.716	0.161
	>0.05	0.021	<0.001		<0.001	>0.05	>0.05	>0.05	>0.05	<0.001	0.014
Dept to width ratio	0.091	-0.186	0.792	-0.236	-	0.085	-0.087	0.096	0.222	-0.167	0.023
	>0.05	>0.05	<0.005	<0.001		>0.05	>0.05	>0.05	0.001	0.010	>0.05
Extrusion A	-0.152	0.173	0.040	0.054	0.085	-	-0.135	0.632	0.258	0.115	-0.024
	0.020	0.008	>0.005	>0.05	>0.05		0.039	<0.001	<0.001	>0.05	>0.05
Extrusion B	0.053	-0.301	-0.023	0.101	-0.087	-0.135	-	-0.812	-0.035	0.096	0.096
	>0.05	<0.001	>0.005	>0.05	>0.05	0.039		<0.001	>0.05	>0.05	>0.05
Extrusion index	-0.171	-0.301	0.032	-0.021	0.096	0.632	-0.812	-	0.156	0.084	-0.105
	0.009	<0.001	>0.005	>0.05	>0.05	<0.001	<0.001		0.017	>0.05	>0.05
Lateral	0.159	0.090	0.139	-0.073	0.222	0.258	-0.035	0.156	-	0.038	0.099
subluxation	0.015	>0.05	0.034	>0.05	0.001	<0.001	>0.05	0.017		>0.05	>0.05
Peak to edge	-0.100	-0.100	0.126	0.716	-0.167	0.115	0.115	0.084	0.038	-	0.185
distance	>0.05	>0.05	0.055	<0.001	0.010	>0.05	>0.05	>0.05	>0.05		0.005
Roof obliquity	0.246	-0.102	0.202	0.161	0.023	-0.024	0.096	-0.105	0.099	0.185	-
	<0.001	>0.05	0.002	0.014	>0.05	>0.05	>0.05	>0.05	>0.05	0.005	
Sex	0.524	-0.301	0.076	0.032	0.060	-0.103	0.140	-0.234	0.117	0.033	0.152
	<0.001	<0.001	>0.005	>0.005	>0.05	>0.05	0.033	<0.001	>0.05	>0.05	0.020

DISCUSSION

The acetabulum, which is a big hollow, is present at the external surface of the hip bone and articulates with the femur head. It comprises three bones, namely os ilium (less than 2/5), os ischii (more than 2/5), and os pubis (1/5). The "Y" cartilage indicates the joining of three separate bones and the combination of those begins at 14-16 years and completes almost until 23 years. The hip joint is an important anatomical structure that has been researched by various clinical branches such as general surgery, orthopedics, radiology, rheumatology, and physical therapy for many years (Gökmen, 2003; Turgut, 2015; Arıncı & Elhan, 2020; Uzun *et al*., 2020). There is a horse-shaped joint cartilage and fossa acetabulum inside the acetabulum, which is filled with fibro-adipose tissue and covered with synovial tissue in the middle (Turgut, 2015; Uzun *et al*., 2020). The acetabulum is an important structure for the interventions in these regions (Uzun *et al*., 2020). Morphology of the front protrusion of acetabulum in total hip arthroplasty carries paramount clinical importance (Aksu *et al*., 2006; Devi & Philip, 2014). Acetabulum's morphometric measurements play an important role in total hip arthroplasty (prosthesis) because of affecting the position and stability of the acetabular component (Solomon *et al*., 2014). Any deviation including dimensions or form of the femoral head, acetabulum, or both are accepted as hip dysplasia. The reason for most of this deformity is the acetabulum development disorder. The femoral head is affected secondarily as a result of non-physiological biomechanics from the anteverted acetabulum or as a result of treatment. Also, the etiology of developmental dysplasia hip is multi-causal. The main reasons for providing a basis for the developmental dysplasia hip are ligament laxity, breech presentation, postnatal positioning, and primary acetabular dysplasia (Noordin *et al*., 2010). The diameter and acetabular depth are considered during surgical acetabular fracture treatment. The acetabulum is also becoming important in terms of gender prediction and age determination (Uzun *et al*., 2020). The CEA, AA, ADWR, and EI are commonly used in hip dysplasia radiographic index and a properly conducted pelvic radiograph with these values is principal for the radiological diagnosis (Engesæter *et al*., 2012).

The center edge angle value of >25° was considered normal, whereas those of< 20° or 25° was associated with acetabular dysplasia. This angle was accepted as a normal hip at 37° for males and 35° for females.4,6,20 Our values of both females and males were between 28° and 43° and can be accepted to be normal hip values. Additionally, acetabular dysplasia is defined by an acetabular angle of >43 degrees (Sharp, 1961). The mean of the corresponding value was found as 38.89° and 38.45° in males and females, respectively. However, the values of 14 males and 8 females were higher than the normal degree (>43°).

In a study performed by Umer *et al*. (2006) with 261 asymptomatic patients aged between 60 years to evaluate 7 measurements of the acetabulum in establishing the prevalence of acetabular dysplasia in the Singaporean population, the corresponding values in males regarding CEA (30.63°), AA (39.85°), ADWR (0.32), RO (7.79°), EI (0.20), LS (10.15mm) and PED (15.58mm) were compared with the measurement results in females of CEA (33.54°), AA (38.25°), ADWR (0.31), RO (7.78°), EI (0.14), LS (9.48mm) and PED (15.95mm). Center edge angle and extrusion index values had significant differences between Singaporean males and females. In the evaluation of age-related changes, acetabular angle and extrusion index values showed a significant difference based on age. In acetabular angle measurement, the highest value was in ages between 10 and 19 years, while the lowest value was in ages between 50 and 59 years.4 In the present study, the same values were 32.01°, 39.89°, 0.34,7.08°, 0.21, 11.90 mm, and 6.77mm, respectively in males, and the same values were calculated as 33.68°, 38.45°, 0.34, 7.34°, 0.19, 12.80 mm and 6.76, respectively in females. The CEA was higher in females than males and the AA value was lower in females than males similar to the Singaporean population. There were significant differences in the center edge angle, the acetabular angle, lateral subluxation, and roof obliquity measurements when the age-dependent changes were investigated, and significant differences were not found in the values of the extrusion index (Extrusion A and B) and roof obliquity.

The distance between the acetabular ridge nearest to the body of ischium and the anterior iliac margin intersecting the acetabular ridge was defined as acetabular diameter and the distance between the deepest point of the acetabular cavity and the horizontal plane touching the acetabular edges was defined as acetabular depth. In a study that was conducted on 154 os coxae by Aksu *et al*. (2006), the means for the AD and AW were 29.49±4.2mm and 54.29±3.8mm, respectively. The maximum and minimum values of AW were 65.5mm, and 44.8mm and AD were 38.6mm, and 22.6mm, respectively. A significant correlation was found between the depth and the diameter of the acetabulum ($r = 0.498$ $p < 0.001$).5 In this study, acetabular depth and width values were found as 22.30mm and 22.50 mm in males and females, respectively, and 65.20mm and 65.60mm in males and females, respectively. Also, a significant correlation was found between the depth and the diameter of the acetabulum ($r=0.307$;$p=<0.001$). Furthermore, the maximum values of acetabular depth and acetabular width were obtained in decade 5. The lowest value of the acetabular depth was in decade 2 and the minimum value of the acetabular width was in decade 3 in the present study.

In Devi & Philip (2014) study that was conducted by using a digital sliding caliper on 50 bilateral human adult dry hip bones of unknown age and gender, the AD and AW were 28.32±1.32mm and 50.99±1.99mm, respectively. A positive and significant correlation was found between AD and AW ($r=0.416$; $p<0.001$) (Devi & Philip, 2014). An acetabular depth of less than 9 mm is considered dysplastic. Accordingly, awareness of the average values of the bones of the hip joint will also enable early gender determination from skeletal remains by forensic experts (Loder *et al*., 2003; Umer *et al*., 2006). Also, the knowledge of this parameter can allow a better understanding of the etiopathogenesis of diseases like osteoarthrosis and the prevalence of acetabular dysplasia.

The study was planned to determine and evaluate the reference/normal values of the acetabulum of the Turkish healthy population. Some valuable results obtained are as follows. A significant difference was found in values of the CEA, AA, EB, LS, and RO, while there was no significance in the AD, AW, ADWR, EI, and PED measurements in comparison with acetabular morphometry according to gender. Acetabular depth showed a correlation with acetabular diameter. Also, in the evaluation of acetabulum age-related changes, there was a significant difference in values of the CEA, AA, AD, AW, ADWR, LS, and PED from decades 1 to 5. The knowledge of radiological acetabulum findings is paramount to diagnosing hip dysplasia and may be useful for prosthetists, and orthopedic and forensic experts. Also, the most interesting finding was that ADWR increased based on age as directly proportional. The most apparent change based on age was seen in CEA (between decades 3-4), AD and AW (decades 2-5), LS (decades 1-5), and PED (decades 2-4). In the literature review, it was seen that these measurements were important for clinical hip examination. Therefore, the result can be important for hip arthroplasty or hip disposition/ surgery, treatment of hip joint fractures, and in diagnosing congenital hip dysplasia.

VURALLI, D.; POLAT, S.; ÖKSÜZLER, M. & GÖKER, P. Importancia de la morfometría acetabular en la determinación de la displasia de cadera. *Int. J. Morphol., 40(6)*:1641-1647, 2022.

RESUMEN: El objetivo de este estudio fue evaluar la relación entre las medidas morfológicas del acetábulo y presentar sus valores de referencia. El estudio tuvo un diseño retrospectivo y se realizó con 234 sujetos sanos (108 mujeres; 126 hombres) de 18 a 53 años de edad durante un período de 4 años, desde 2018 hasta 2022. Once mediciones que incluyeron el ángulo centro-margen (ACM), ángulo acetabular (AA), profundidad acetabular (PA), ancho acetabular (AC), relación de profundidad y ancho (RPAC), extrusión A (EA)-B (EB), índice de extrusión (IE), subluxación lateral (SL). Se midió la distancia al margen (DAM) y la oblicuidad del techo (OT). Se consideró significativo el valor de p<0,05. Se encontró una diferencia significativa en los valores de ACM, AA, EB, SL y OT, mientras que no hubo significación en las medidas de AA, AC, RPAC, IE y DAM en comparación con la morfometría acetabular según el sexo. Además, en la evaluación del acetábulo respecto a los cambios relacionados con la edad, hubo una diferencia significativa en los valores de ACM, AA, PA, AC, RPAC, SL y DAM de las décadas 1 a 5. El conocimiento de los hallazgos radiológicos del acetábulo es primordial para el diagnóstico de displasia de cadera y puede ser útil para expertos en prótesis, ortopedia y medicina forense. Además, el hallazgo más interesante fue que RPAC aumentó según la edad en una tendencia directamente proporcional. El cambio más aparente según la edad se observó en ACM (entre las décadas 3 y 4), LS (décadas 1 a 5), DAM (décadas 2 a 4), PA y AC (décadas 2 a 5).

PALABRAS CLAVE: Acetábulo; Displasia de cadera;, Edad ; Sexo.

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