

# Morphology and Morphometry of the Acetabulum

ACETABULUM'UN MORFOLOJİSİ VE MORFOMETRİSİ

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### SUMMARY

Acetabulum is a hemispherical cavity on the medial part of the hip joint. Anterior acetabular ridge's morphology is clinically important during total hip arthroplasty. Additionally the depth and diameter of the acetabulum are important during surgical treatment of acetabular fractures.

**Objective** of this study is to determine the relationship between the acetabular depth and diameter. Additionally to describe the anterior acetabular ridge's morphology that can be useful for diagnosing congenital acetabular dysplasia and during acetabular surgery.

**Material and method:** This study was conducted on 154 os coxae. Two morphometrical and one morphological parameters were evaluated. The distance between the acetabular ridge nearest to body of ischium and anterior iliac margin intersecting the acetabular ridge was named as acetabular diameter. The distance between the deepest point of acetabular cavity and the horizontal plane touching the acetabular edges was named as acetabular depth. We evaluated the anterior acetabular ridge's shape morphologically and classified them as follows (irregular, curved, straight and angular). Correlation between morphometrical parameters were investigated using Pearson's test.  $p < 0.05$  was the significant level.

**Results:** Regarding to anterior acetabular ridge shape morphology; the majority was curved 71 (46,1 %), 36 (23,3 %) were straight, 26 (16,8 %) were angular and 21 (13,6 %) were irregular. The mean values for the acetabular depth and diameter were  $29.49 \pm 4.2$  mm and  $54.29 \pm 3.8$  mm respectively. Positive and significant correlation was found between the depth and the diameter of the acetabulum ( $r = 0.498$   $p < 0.001$ ).

**Conclusion:** Depth of acetabulum correlates with acetabular diameter. Most common acetabular shape is curved (46.1 %). These information may be helpful during hip arthroplasty, treatment of hip joint fractures and in diagnosing congenital hip dysplasia.

**Key words:** Acetabulum, morphometry, morphology, anterior acetabular ridge

### ÖZET

Acetabulum kalça ekleminin medial bölümünde yer alan hemisferik şekilli bir çukurdur. Acetabulum ön kenarının morfolojisi total kalça artroplastisi için önemlidir. Acetabulum çapının ve derinliğinin bilinmesi acetabulum kırıklarının cerrahi tedavisi için değerlidir.

**Amaç:** Bu çalışmanın amacı acetabulum cerrahisinde ve doğumsal acetabulum displazisi tanısında değer taşıyan acetabulum derinliğini, çapını, aralarındaki ilişkiyi ve acetabulum ön kenarının morfolojisini tanımlamaktır.

**Gereç ve yöntem:** Bu çalışma 154 kalça kemiğinde yapıldı. İki morfometrik ve bir morfolojik parametre değerlendirildi. Corpus ischii'ye en yakın acetabulum kenarı ve iliak kemik ön kenarının acetabulum kenarını kestiği nokta arasındaki uzaklık acetabulum çapı olarak adlandırıldı. Acetabulum'daki en derin nokta ile acetabulum kenarlarına teğet geçen yatay plan arasındaki dikey uzaklık acetabulum derinliği olarak adlandırıldı. Acetabulum

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ön kenarı morfolojik olarak değerlendirildi ve dört farklı grup halinde (kavisli, açılı, düz ve irregü-

ler) sınıflandırıldı.

**Bulgular:** Acetabulum ön kenarı 154 kemiğin 71'inde kavisli (%46,1), 36'sında düz (%23,3), 26'sında köşeli (%16,8), 21'inde irregüler (%13,6) olarak bulundu. Morfometrik ölçümler olan acetabulum derinliği ve çapı ortalama  $29,49 \pm 4,2$  mm ve  $54,29 \pm 3,8$  mm olarak bulundu ve iki parametre arasındaki korelasyon Pearson testi ile sınıandı. Acetabulum derinliği ve çapı arasında pozitif ve anlamlı korelasyon saptandı ( $r = 0,498$ ,  $p < 0,001$ ).

**Sonuç:** Acetabulum derinliği, acetabulum çapı ile ilişkilidir. En fazla görülen acetabulum kenarı şekli kavisli'dir (%46,1). Bu bilgi kalça artroplastisi sırasında, kalça eklemi kırıklarının tedavisinde ve konjenital kalça eklemi displazisi tanısında yararlı olabilir.

**Key words:** Acetabulum, morfometri, morfoloji, acetabulum ön kenarı

Acetabulum is a hemispherical cavity on the medial part of the hip joint (1). Anterior acetabular ridge morphology is important in total hip arthroplasty. It is valuable to know the diameter (AD1) and depth (AD2) of the acetabulum for surgical treatment of acetabular fractures. Previous studies evaluated the anterior acetabular ridge's morphology regarding whether there is proportion between the diameter and thickness of the acetabulum (2,3). Murphy studied on prehistorical New Zealand Polynesian hip bones and evaluated the usefulness of acetabulum diameter in determining the gender (4). Patriquin et al. studied correlations between AD2 and os coxae measures to determine the gender (5). Han et. al tried to determine the utility of several acetabular parameters in acetabular dysplasia diagnosis (6). Aktaş et al. described the acetabular dysplasia frequency and normal hip joint morphometry in adult Turks (7). Govsa et al. described the anterior acetabular ridge's shape morphologically (8). Başaloğlu et al. measured the vertical and transvers diameters of acetabulum in both sexes comparatively (9). In this study we aimed to determine the relationship between acetabular depth and diameter. Additionally to describe the anterior acetabular ridge's morphology that can be useful for diagnosing congenital acetabular dysplasia diagnosis and during acetabular surgery.

## MATERIAL AND METHODS

This study was held on 154 os coxae. Two morphometrical and one morphological parameters were evaluated. 0.1 mm. sensitive compass was used for morphometric measurements. Correlation between parameters were analysed using Pearson's correlation test.  $p < 0.05$  was the significant level. The distance

between the acetabular ridge nearest to corpus ischii and anterior iliac margin intersecting the acetabular ridge was named as acetabular diameter (Figure 1). The vertical distance between the deepest point of acetabular cavity and the horizontal plane touching the acetabular edges was named as acetabular depth (Figure 2). We evaluated the anterior acetabular ridge's shape morphologically and classified them as follows (irregular, curved, straight and angular).



Figure 1. The distance between the acetabular ridge nearest to corpus ischii and anterior iliac margin intersecting the acetabular ridge (acetabular diameter) (AD1)

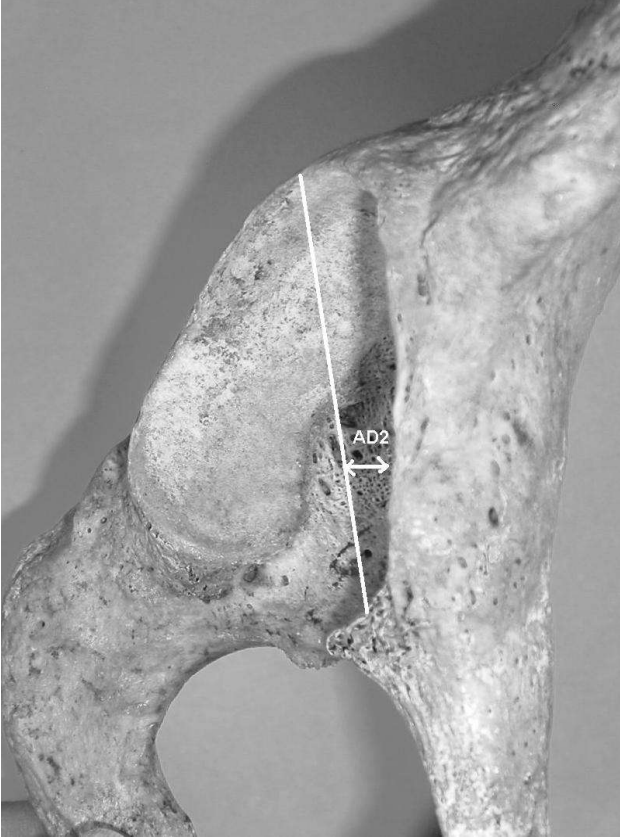


Figure 2. The vertical distance between the deepest point of acetabular cavity and the horizontal plane touching the acetabular edges (acetabular depth)(AD2)

significant correlation was found between the depth and the diameter of the acetabulum ( $r = 0.498$   $p < 0.001$ ).



Figure 3. Straight type of anterior acetabular ridge

## RESULTS

Regarding anterior acetabular ridge shape morphology; the majority was curved 71 (46,1 %) (Figure 3), 36 (23,3 %) were straight (Figure 4), 26 (16,8 %) were angular (Figure 5), 21 (13,6 %) were irregular (Figure 6). The mean values for the acetabular depth and diameter were  $29.49 \pm 4.2$  mm and  $54.29 \pm 3.8$  mm respectively. The maximum and minimum measurements of acetabular diameter were 65.5 mm, 44.8 mm and acetabular depth were 38.6 mm, 22.6 mm respectively. Positive and

## DISCUSSION

Clinically it is very important to know the morphology of anterior acetabular ridge during total hip arthroplasty. Maruyama et al. evaluated the morphology of anterior acetabular ridge to perform the hip joint implants correctly (2).

Our results differ from Maruyama et al.'s (Table I). Particularly, the high incidence of straight ridge in our study may be due to ethnical origins.

Straight type of anterior acetabular ridge was seen more than Govsa et al.'s (8) (Table II).



Figure 4. Curved type of anterior acetabular ridge

Aktaş et al. performed a radiological study to determine the normal hip joint morphometry and acetabular dysplasia rate in Turkish adults. They measured the acetabular depth in various age groups and found depths between 10.00 and 11.1 mm. In addition they reported that the morphometry of the hip joint displayed ethnical differences (7).

Han et al. conducted a radiological study and presented the radiological parameters for acetabular dysplasia diagnosis. They measured the acetabular depth radiologically and found that depth differ which decreases by aging (average AD2  $10.9 \pm 2.7$  mm in women and  $11.5 \pm 2.6$  mm in men) (6). AD1 measurements were different

in the present because it was assessed in dry bone ( $29.49 \pm 4.2$  mm).



Figure 5. Angular type of anterior acetabular ridge

The measurements of AD1 in our study are similar with the measurements of transvers diameter of the acetabulum in Başaloğlu et al.'s study (9). Varodompun et al. investigated if there is a statistically significant correlation between acetabular diameter and thickness and could not find a statistically significant correlation (3). Our study showed a significant correlation between AD1 and AD2. This information can be beneficial for the early diagnosis of acetabular dysplasia.

## CONCLUSION

Depth of acetabulum correlates with acetabular diameter. Most common acetabular shape is curved (46.1

%). These information may be helpful during hip arthroplasty, treatment of hip joint fractures and in diagnosing congenital hip dysplasia.



Figure 6. Irregular type of anterior acetabular ridge

**Table I.** The results of morphologic parameters reported in the present study and in the study of Maruyama et al.'s.

Shape of the outer ridge of anterior column	Maruyama et al.		Present study	
	n	%	n	%
Curved	121	60,50	71	46,10
Angular	51	25,50	26	16,88
Irregular	19	9,50	21	13,63
Straight	9	4,50	36	23,37
Total	200	100,00	154	100,00

**Table II.** The results of morphologic parameters reported in the present study and in the study of Govsa et al.'s.

Shape of the outer ridge of anterior column	Govsa et al.		Present study	
	n	%	n	%
Curved	98	43,36	71	46,10
Angular	64	28,33	26	16,88

Irregular	37	16,37	21	13,63
Straight	27	11,94	36	23,37
Total	226	100,00	154	100,00

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