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Research Article

MORPHOMETRIC STUDY OF OCCIPITAL CONDYLES IN ADULT DRY SKULLS OF SOUTH INDIA

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ABSTRACT
The study was done to understand the Anatomy of occipital condyle. The study was done on 55 adult dry skulls. The different shapes of occipital condyles were noted. The length & width of occipital condyles were measured using digital Vernier calipers. The results were tabulated & analyzed statistically. The parameters were compared between right & left side for significance. The results showed that oval shaped occipital condyle was the most common type. The mean length of OC was 22.85mm and mean width was 12.5mm. The mean anterior & posterior inter condylar distances were 19.2mm & 39.3mm respectively. The above data base should be taken into consideration during posterior and lateral approaches to craniovertebral junction.

Keywords*: Occipital Condyles, Craniovertebral Joint, Foramen Magnum, Atlas Vertebra*

INTRODUCTION
The occipital condyles (OC) are situated over the superior articular facets of the atlas vertebra on the sides of foramen Magnum. It forms an important junction between the cranium & the vertebral column (Bozbuga *et al*., 1999). The stability of the craniovertebral joint (CVJ) depends largely on the morphometric parameters of the OC (Vishteh *et al*., 1999),
Each OC is obliquely oriented & is the only articulation between the cranium & the atlas. The anterior ends of OC are closer to the midline than their posterior ends. The OC is directed forwards & medially. The articular surfaces of the OC are convex from before backwards & from side to side.
Tumors at the level of foramen Magnum (FM) can be reached surgically either by using ventral & dorsal approaches. The dorsal approach is preferred at CVJ since the ventral approach is dangerous & has high morbidity (AlMefty *et al.,* 1996; Wen *et al*., 1997).
In the recent times, the lesions close to FM are surgically accessed through transcondylar approach by piercing the OC. The extent of bone removal for optimal exposure may range from suboccipital craniotomy to total OC removal (Muthukumar *et al*., 2005; Naderi *et al*., 2005).
This approach decreases the depth of the surgical area & provides better visibility without brain retraction. The present study aims at determining the shape & dimensions of OC in adult human dry skull, which is of utmost importance to the neurosurgeons while performing the transcondylar approach surgeries.

MATERIALS AND METHODS
The present study was done on 110 OCs in 55 adult dry skulls. The skulls with bony abnormalities were excluded from the study. The shape of OC were noted & they were classified into following eight types namely Oval, Triangular, Bifurcated, Kidney shaped, Tongue shaped, '8' shaped, 'S' shaped or distorted types.
The following parameters were measured on OC by using a digital Vernier calipers
1. Length of OC on right (LR) & left side (LL) - measured as the maximum distance between anterior & posterior end of OC.
2. Width of OC on right (WR) & left side (WL) - measured as the maximum distance between midpoint of medial & lateral margin of OC.
3. Anterior intercondylar distance (AID) - measured as the distance between the anterior tips of right & left OCs.

5. Posterior intercondylar distance (PID) - measured as the distance between the posterior tips of right & left OCs.

The results were tabulated & analyzed statistically. The mean & standard deviation was calculated. The parameters were compared between right & left side for significance. The level of significance was set at $p < 0.05$. The data was analyzed using SPSS version 16.0 (SPSS Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

Results

The Oval shaped OC (Figure 1a) (48%) Table 1 was the most common type of OC observed in the present study followed by '8' shaped (15.03%) (Figure 1b) & triangular shaped OC (9.8%) (Figure 1d). The least common type was 'S' shaped (Figure 1b) & distorted OC (0.9%) (Figure 1h) as observed in table 1. The mean length of OC on right side (LR) was 2.29±0.07 cms & 2.28±0.05 cms on left side (LL). On comparing of mean length of OC on right & left side there were no statistically significant results (Table 2). The mean width of OC on right side (WR) was 1.27±0.16 cms & on left side was 1.23±0.14 cms. On comparing mean width of OC on right & left side there were no statistically significant results (Table 2). The mean Anterior intercondylar distance (AID) was 1.92±0.17cms & the mean posterior intercondylar distance (PID) was 3.93±0.28 cms (Table 2).

Table 1: Showing the Various Shapes of Occipital Condyles

	Shape of Occipital Condyles	Frequency (%)
1	Oval shaped	48
2	Kidney shaped	8.9
3	'8' shaped	15.03
4	Triangular shaped	9.8
5	Bifurcated	1.7
6	'S' shaped	0.9
7	Distorted	0.9
8	Tongue shaped	3.04

Table 2: Parameters of OC on Left & Right Side

Sl No	Parameters	Mean (In mm)	Standard Deviation	P Value
1.	Mean length of OC on right side (LR).	22.9	0.07	
2.	Mean length of OC on left side (LL).	22.8	0.05	0.3
3.	Mean width of OC on right side (WR).	12.7	0.16	
4.	Mean width of OC on left side (WL).	12.3	0.14	0.12
5.	Anterior intercondylar distance (AID).	19.2	0.17	
6.	Posterior intercondylar distance (PID).	39.3	0.28	

Discussion

Many methods of lateral approaches to CVJs have been reported in cases of lesions involving this area. Most of the approaches necessitate resection of the OC partially or completely. The lateral limits of the CVJ are formed by OCs. So, the configuration & orientation of the OC, may affect the lateral approaches to the CVJ. The OC is an oval mass articulating with lateral mass of C1 vertebra (Muthukumar *et al*., 2005; Naderi *et al*., 2005; Spektor *et al.,* 2009). In the present study, the mean length of OC on right & left side was 22.9 & 22.8 mm respectively. These values are similar to study done by Bozbuga *et al.,* (1999) (Table 3) & less when compared to length of OC in the study done by Naderi *et al*., (2005) and Avic *et al.,* (2011).

Figure 1a: Oval Shaped OC

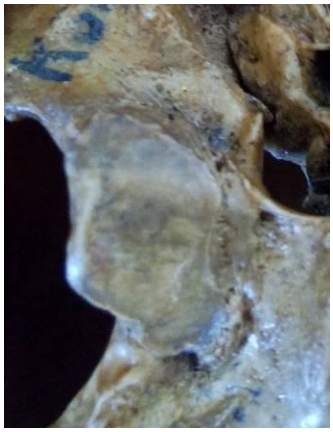

Figure 1b: 'S' Shaped OC

Figure 1c: '8' Shaped OC

Figure 1d: Triangular Shaped

Figure 1e: Tongue Shaped OOCOCOC

Figure 1f: Bifurcated Type OC

Figure 1g: Kidney Shaped OC

Figure 1h: Distorted OC

Figure 1: Picture Showing Various Shapes of Occipital Condyles

The mean width of OC on right side (WR) was 12.7mm & on left side (WL) was 12.3mm which was similar to study done by Avic *et al*., (2011). The width of OC in present study was less when compared with study done by Kavitha *et al*., (2013) & Mahajan *et al.,* (2011) (Table 3). The anterior intercondylar distance (AID) was 19.2mm which was less when compared with study done by Tale *et al.*, (2016)

(21.28mm), Naderi *et al.,* (2005) (21mm), Bozbuga *et al.*,(1999) (22.8mm). In the study done by Anil *et al*., (2014). The AID was 17.63 mm which was less when compared to the present study.

The posterior intercondylar distance (PID) was 39.3 mm which was lower when compared with studies done by Kumar and Nagar (2014) (42.02mm), Naderi *et al.,* (2015) (41.6mm), Tale *et al.,* (2016) (40.61mm). The PID of present study was higher when compared with study done by Bozbuga *et al.,* (1999) (30.2mm).

There are various shapes of OC. The shape of OC will determine the amount of condylectomy to be done to reach ventral lesions. Among the different types of OC, the triangle type, the deformed type & kidney-like type OC may require a more extensive condylectomy to reach the ventral lesions Naderi *et al.,* (2005).

Bozbuga *et al.,* (1999) classified OCs as two semicircles type, oval type, rhombus type, bean-shaped, prismatic types, flattened types, convex types, flattened convex types, flat types, short & broad types, flat & long types, small & convex types. The classification offered by Bozbuga *et al.,* (1999), is not clinically relevant as it is so complex. Naderi *et al.,* (2005) classified OC into oval, kidney-like, S-like, eight-like, triangle-like, ring-like, two-portioned & deformed. The first study, which made a systematic & detailed classification of OC was done by Naderi *et al.,* (2005), based on its shape & revealed the percentage of each particular type. They observed that the most common shape of OC observed was oval shaped (more than 50 %). In the present study also the most common shape OC was oval shaped (48%) which was similar to study done by Naderi *et al*., (2005).

Table 3: Comparison of Different Parameters of OC between Present & Previous Studies

Sl No	Parameters (In mm)	Present Study (2016)	Kavitha S *et al.,* (2013)	Mahajan D *et al.,* (2011)	Mustafa B *et al.,* (1999)	Avic E *et al.,* (2011)	Naderi *et al.,* (2005)	Tale AK (2016)
1.	Length of OC right side (LR).	22.9	21.97	22.61	23.1	23.7	23.6	21.83
2.	Length of OC left side (LL).	22.8	22.34	22.36	22.9	24	23.2	22.19
3.	Width of OC right side (WR).	12.7	13.05	13.72	11.3	12.2	10.6	11.07
4.	Width of OC left side (WL).	12.3	13.05	13.96	11.4	12.4	10.6	11.42
5.	Anterior intercondylar distance (AID).	19.2	_	_	22.8	_	21	21.28
6.	Posterior intercondylar distance (PID).	39.3	_	_	30.2	_	41.6	40.61

Conclusion

The OC is an important part of CVJ, connecting the cranium to the vertebral column. Several anatomical parameters should be taken into consideration during various surgical approaches to this region. The mean length of OC was 22.85mm and mean width was 12.5mm.

The mean anterior & posterior inter condylar distances were 19.2 mm & 39.3 mm respectively. The various parameters measured provides database on the shapes & dimension of OC which will be useful for the neurosurgeons performing transcondylar surgical approaches for reaching lesions in the posterior part of base of cranium.

Conflict of Interest: None

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