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Original Research Article

MORPHOMETRY AND MORPHOLOGY OF OCCIPITAL CONDYLE RELATED TO THE TRANSCONDYLAR APPROACH IN DRY SKULLS

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ABSTRACT

Introduction: The occipital condyles are small, bilateral inferior extensions of the occipital bones. They are intimately related to the foramen magnum and skull base by a number of ligamentous attachments. A variety of disease processes may affect the craniovertebral junction. Various lateral approaches have been used to access these lesions. Understanding the bony anatomy and variations of occipital condyle is important for these approaches. The aim of the present study is to study occipital condyle in detail.

Materials and methods: 120 dry human skulls (83 males, 37 females) were studied. The length, width and different shapes of occipital condyle were noted. Various other parameters were measured like anterior intercondylar distance, posterior intercondylar distance, distance between anterior and posterior end of occipital condyle and opisthion.

Results: The mean value of occipital condyle length (2.32cm(M) vs 2.22cm(F)) and width (1.29cm(M) vs 1.26cm(F)) were present in male and female skulls. The anterior intercondylar distance and posterior intercondylar distances were 2.06cm and 4.14cm respectively. Shape of occipital condyle was classified into different types as following- oval, kidney, s shaped, figure of eight, two portioned and deformed. The most common shape of occipital condyle was oval on both sides in males and females.

Conclusions: Thorough knowledge of occipital condyle will enable the neurosurgeons to have safe surgery and reduce the morbidity to minimum.

KEY WORDS: Occipital Condyle, Skull, Transcondylar Approach.

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INTRODUCTION

Occipital condyle (OC) is an integral part of the occiput [1] and connects the cranium and base of skull [2]. Integrity of occipital condyle has a major role in stability of craniovertebral junction [2]. The most common lesions found in this region are intradural and extradural tumours, vascular lesions of the vertebral artery, congenital lesions, anerusyms and meningiomas [3]. To access these lesions various lateral approaches have been used in surgeries [4]. The lateral approaches to the craniovertebral region include the far lateral, posterolateral and transcondylar approaches. The differences among the lateral approaches are based on the extent of bony removal and opening. The

transcondylar approach provides a better view of the anterior part of foramen magnum below the level of hypoglossal canal [5]. It is performed directly through the occipital condyle or through the atlantooccipital joint [3]. The most important part of the transcodylar approach is resection of the OC [2] for direct visualization of the brain stem and spinal cord [3]. Removal of OC can result into craniovertebral instability [1]. A sound knowledge of morphometry of OC and its anatomical variations is helpful for the neurosurgeons to perform safe surgery. The aim of the present study is to measure the various morphometric parameters of OC and variation in its shape and size.

MATERIALS AND METHODS

120 dry human skulls (83 males, 37 females) from department of anatomy and students of Vydehi Medical College were collected. All skulls were in the age group of 20 to 80 years. Skulls which were incomplete or damaged were not included in the study. All the skull bases were visually assessed for shape of occipital condyle and further classified into one of the shapes like oval, kidney, triangle, square, s shaped, figure of eight, two portioned and deformed(figure1). The measured parameters included length and width of occipital condyle, anterior and posterior intercondylar distances and the distance between anterior & posterior tip of occipital condyle and opisthion on both sides as shown in figure 2. The distances were measured using digital vernier caliper with error of 0.02mm.

Fig. 1: Illustration showing various shapes of occipital condyle.

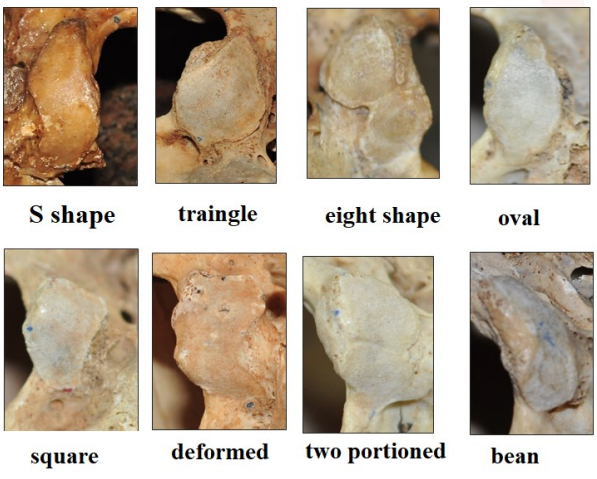
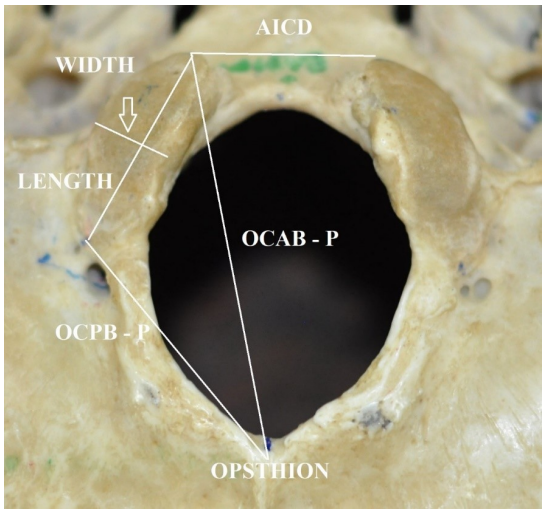


Figure 2: Illustration showing different measurments of occipital condyle



L – Length, W- Width, AICD – Anterior Intercondylar Distance, PICD – Posterior Intercondylar Distance
OCAB - Occipital Condyle Anterior border
OCPB – Occipital Condyle Posterior Border, O – Opisthion.

Statistical analysis – Data was analyzed using the SPSS – program. Student's t - test was used to evaluate the mean differences of the measured parameters of males and females. Mean value, standard deviation and range were also taken into consideration in the statistical analysis.

RESULTS

Table 1: The measurements of occipital condyle.

parameter	sex	min – max	mean	sd	p value
ROCL	male	1.88- 2.77	2.33	0.21	< 0.05
	Female	1.2 – 3.12	2.23	0.29	< 0.05
LOCL	male	1.83 – 2.81	2.31	0.19	< 0.05
	female	1.74 – 3.02	2.21	0.26	< 0.05
ROCW	male	0.96 – 2.25	1.29	0.17	> 0.05
	female	0.94 – 1.62	1.25	0.16	> 0.05
LOCW	male	0.92 – 1.96	1.29	0.15	> 0.05
	female	0.92 – 1.52	1.27	0.12	> 0.05
AICD	male	1.06 – 2.92	2.14	0.34	< 0.05
	female	0.48 – 2.7	1.99	0.39	< 0.05
PICD	male	3.48 – 4.8	4.19	0.28	>0.05
	female	3.4 – 4.97	4.09	0.33	> 0.05
RAOC -OP	male	3.33 – 4.64	3.97	0.25	< 0.05
	female	3.02 – 4.8	3.64	o.69	< 0.05
LAOC - OP	male	3.4 – 4.72	3.95	0.25	< 0.05
	female	3.27 – 4.67	3.66	0.68	< 0.05
RPOC - OP	male	2.12 – 3.52	2.81	0.23	> 0.05
	female	2.06 – 3.1	2.67	0.26	> 0.05
LPOC - OP	male	2.08 – 3.56	2.76	0.27	> 0.05
	female	2.19 – 3.48	2.71	0.33	> 0.05

Table 2: Shape of OC.

		S LIKE	BEAN	TRIANGULAR	SQUARE	FIGURE OF EIGHT	OVAL	TWO PORTIONED	FOOT	IRREGULAR
MALE	R	14 (16.80%)	16 (19.2%)	13 (15.60%)	2 (2.40%)	4 (4.80%)	29 (34.80%)	1 (1.20%)	1 (1.20%)	3 (3.60%)
	L	15 (18%)	10 (12%)	7 (8.40%)	4 (4.80%)	5 (6%)	32 (38.40%)	6 (7.20%)	1 (1.20%)	2 (2.40%)
FEMALE	R	7 (19.39%)	9 (24.93%)	8 (22.16%)	-	-	12 (33.24%)	-	-	-
	L	6 (16.62%)	4 (11.08%)	9 (24.93%)	1 (2.77%)	-	13 (36.01%)	2 (5.54%)	-	1 (2.77%)

Table 3: Type of OC.

		TYPE 1	TYPE 2	TYPE 3
MALE	RIGHT	4(4.8%)	71(85.2%)	8(9.6%)
	LEFT	6(7.2%)	67(80.4%)	10(12%)
FEMALE	RIGHT	5(6%)	29(34.8%)	3(3.6%)
	LEFT	8(9.6%)	27(32.4%)	2(2.4%)

Table 4: Comparison of length & width of occipital condyle with other studies.

	LENGTH		WIDTH	
	RIGHT	LEFT	RIGHT	LEFT
PERRIRIA et al.	2.4	2.33	1.34	1.64
OZER et al.	2.39	2.4	1.19	1.07
FETOUCH et al	2.35	2.37	1.35	1.36
BAYAT et al	1.94	1.92	0.92	0.94
AVCI et al	2.37	2.42	1.22	1.24
Present study	2.28	2.26	1.27	1.28

Average length of left OC was found to be 2.31cm in males and 2.21cm in females and length of right OC was 2.33cm in males and 2.23cm in females as shown in table 1. The average width of right and left OC was found to be 1.29cm in males on both sides whereas in females it was 1.25cm and 1.27cm on right and left side respectively. The AICD (anterior intercondylar distance) and PICD (posterior intercondylar distance) were found to be (2.14 vs 1.99) and (4.19 vs 4.09) respectively. The distance between anterior tip of OC and opisthion was measured as 3.96cm in males and 3.65cm in females. The distance between posterior tip of occipital condyle and opisthion was measured as 2.79cm in males and 2.69cm in females. A stastistically significant difference was found in some of the measurements taken in relation to gender in this study. There was no significant difference in laterality in any of the measurements.

We classified OC into different shapes. Various shapes of the OC and their percentage is shown in table 2. The most common shape of OC was oval on both sides in males and females. The most unusual type of OC was figure of 8 in females and foot condyle in males. When right and left occipital condyles of the same skull compared a symmetrical shape was found in 49(41%) skulls and an asymmetrical shape was found in 71(59%) skulls. We classified the OC according to its length into three types as shown in table 3. Type 1 – length of OC is < 20cm, Type 2 – length is between 20 – 26 cm, Type 3 – length is > 26cm. Type 2 OC was found in maximum number of cases in males and females on both sides. The most unusual type of OC was type 1 in males and type3 in females on both sides.

DISCUSSION

The anterolateral aspect of the foramen magnum is one of the deepest and most complex areas of the skull base. Occipital condyles, the thick bony prominences surround the anterior part of foramen magnum. It limits the surgical view of the lesions located anterior to foramen magnum and to approach this partial resection of OC is required [1]. Morphometry of OC can be helpful in planning and calculating the bone extent to be resected in transcondylar approach [3].

The mean value of occipital condyle length (2.32cm(M) vs 2.22cm(F)) was significantly higher in males than in females($p<0.005$). The data obtained from the present study is compared with other studies by different authors as represented in table 4. Length of both occipital condyle is lower than the studies done by Perrria et al [3], Ozer et al [6], and Avci et al [1] but greater than studies done by Bayat et al [7]. Width of occipital condyle was almost similar to study done by Avci et al [1] but greater than studies done by Bayat et al [7] & Ozer et al [6]. Extensive removal of bone is required in a wider occcipial condyle during surgery [2].

The differences between present study and other studies seem to be related to group size, ethnicity and geographical differences.

We classified OC into three types according to its length. In the present study Type 2 condyle was most commonly seen on both sides. Naderi et al [2] and Avci et al [1] also found the type 2 condyle in maximum number of specimens. The length of OC is considered as an important factor during partial condylectomy. The same amount of partial condylectomy may cause greater occipitocervical instability in short OC whereas a large condyle may require a more extensive resection [2].

Posteriorly the occipital condyles are diverged and ventrally they are converged [2]. The anterior intercondylar and posterior intercondylar distances were 2.06cm and 4.14cm. The measured distances are comparable to the results obtained by Fetouch et al [8] but away from the results obtained by Kizikanat et al [9]. The AICD was significantly higher in males than females($p<0.005$). The occipital condyles have anterior and posterior angles due to the huge differences between anterior and posterior intercondylar distances. The distances between anterior and posterior tip of occipital condyle and opisthion were measured as 3.80 cm and 2.73cm respectively. The distance between anterior tip of occipital condyle and opisthion was significantly higher in males than females($p<0.005$). The distance between the posterior tip of OC and opisthion is important because a larger distance provides a wider area for posterolateral approaches [2].

The visual classification showed that the most frequent morphological types of OC were oval, bean, triangular, square, figure of 8, two portioned, foot and irregular. In the literature, there is great discordance regarding the predominant morphological type of OC. Among some authors like Naderi et al [2], Kalthur et al [10] and Ozer et al [6] the oval shape is considered to be the main type, while it is kidney shape according to Bayat et al [7] and Fetouh et al [8] and the s shaped according to Natsis et al [11]. In the present study most frequently found morphological type of OC was oval shaped in male and female skulls. In nail insertion the highest surgical success is seen in oval like condyles since they have larger area. In other types of condyles like triangular, ring or deformed type have narrow area and might cause problems in nail fixation [6].

The chances of surgical success in craniovertebral intersections will increase owing to the larger distances between posterior tip of OC and opisthion, posterior intercondylar distance as well as in oval type of occipital condyles [6].

CONCLUSION

The present study has determined the sex differences in the dimensions of the occipital condyle and variations in its shape. The data obtained from the present study will be useful not only to neurosurgeons but also to the anthropologists, morphologists and clinical anatomists.

ABBEREVAIONS

OC -Occipital Condyle

SPSS – Stastistical Package For The Social Sciences

AICD – Anterior Intercondylar Distance

PICD – Posterior Intercondylar Distance

Conflicts of Interests: None

REFERENCES

[1]. Avci E, Dagtekin A, Ozturk AH, kara E, ozturk NC, Akture E et. al. Anatomical variations of the foramen magnum, occipital condyle and jugular tubercle. Turkish Neurosurgery 2011; 21(2):181-190.

[2]. Naderi S, Korman E, Citak G, Guvencen M, Arman C, Senoglu M. Morphometric analysis of human occipital condyle. Clinical Neurology and Neurosurgery 2005; 107:191-199.

[3]. Pereira GAM, Lopes PTS, Santos AMPV, Durate RD, Piva L, Pozzobon A. Morphometric analysis related to the transcondylar approach in dry skulls and computed tomography. International journal of Morphology 2012; 30(2):399-404.

[4]. N Muthukumar, R Swaminathan, G Venkatesh, SP Bhanumathy. A morphometric analysis of the foramen magnum region as it relates to the transcondylar approach. Acta Neurochir2005; 147: 889–895.

[5]. Matsushima T, Natori Y, Katsuta T, Ikezaki K, Fukui M, Rhoton T. Microsurgical Anatomy for Lateral Approaches to the Foramen Magnum with Special References to Transcondylar Fossa (Supracodylar Trasjugular Tubercle) Approach. Skull Base Surgery 1998; 8(3) :119-125.

[6]. Ozer MA, Celik S, Govsa F, Ulusoy MO. Anatomical determination of a safe entry point for occipital condyle screw using three dimensional landmarks. Eur Spine Journal 2011; 20:1510-1517.

[7]. Bayat P, Bagheri M, Ghanbari A, Raoofi A. Characterization of occipital condyle and comparison of its dimensions with head and foramena magnum circumferences in dry skulls of Iran. International journal of Morphology 2014; 32(2): 444-448.

[8]. Fetouch FA, Awadalla AM. Morphometric analysis of the occipital condyle and its surgical implications in transcondylar approach. The Pan Arab Neurosurgery society

[9]. Kizilkanat E. Morphometry of the hypoglossal canal, occipital condyle and foramen magnum. Neurosurgery Quarterly 2006; 16(3): 121-125.

[10]. Kalthur SG, Padmashali S, Gupta C, Dsouza AS. Anatomical study of the occipital condyle and its surgical implications in transcondylar approach. Journal of craniovertebral junction spine 2014; 5(2) :71-7.

[11].Natsis K, Piagkou M, Skotsiomara G, Piagkos G, Skandalaksis PA. Morphometric anatomical and comparative study of the foramen magnum region in a Greek population. Surg Radio Anat 2013; 35(10) :925 -934

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