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Morphological and Morphometrical Analysis of Condylar Process of the Mandible and its Surgical Relevance

Kiran Srinivas.B[1] and Yuvaraj Babu.K[2]*

[1]*Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai -600077, India*

[2]*Assistant professor, Department of Anatomy, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai -600077, India*

ABSTRACT

Mandible, known to be the lower jaw bone is the strongest and the largest bone in the human face, forming the lower jaw consists of ramus which has a horseshoe shaped body and two processes – the coronoid and condylar processes. The condyloid process consists of a neck surmounted by an oval head with an articular facet in the process. The aim of the study is to morphologically and morphometrically analyze the condylar process of the human mandible. 55 unsexed mandibles were taken from the Department of Anatomy, Saveetha Dental College. The length and width of the condylar processes of the taken mandibles were measured with the help of vernier caliper. After measuring the dimensions [length and width] the shapes of the condylar processes were observed along with it. The data were statistically analyzed by unpaired t test derived from the SPSS software. The left mandibular condyle was greater in mesio-distal diameter when compared to the right mandibular condyle. On considering the antero-posterior diameter, the right mandibular condyle was greater in the diameter. And most of the condyles observed were plane shaped rather than round and pointed ones. These analyses can help the surgeons to plan treatments for fractures in TMJ regions and other parts of the mandible too.

KEY WORDS: CONDYLAR PROCESS, CORONOID PROCESS, MANDIBULAR MORPHOMETRY, SHAPES OF CONDYLAR PROCESS, VERNIER CALIPER.

INTRODUCTION

The mandible is the only movable bone found in the face region. The mandible being the lower jaw articulates with the upper jaw (or) maxilla in the viscero-cranium via the teeth when the mouth is closed(d'Aquino et al., 2009). It also articulates with the neuro-cranium via the temporal bone forming the TMJ [Temporo-mandibular joint] . The mandible is one of the largest and strongest bones in the face region. TMJ is a freely movable joint, found between the condyle of the mandible and squamous portion of the temporal bone at the base of the skull(Misch, Qu and Bidez, 1999). The condyle is very important as the expression of the mandibular growth is provided by the mandibular condyle. The ramus of the mandible consists of the condylar process and the coronoid process. The condylar process is highly calcified when compared to the coronoid process. The condyle is represented by a hammer shaped head region and a narrow neck(Choudhari and Thenmozhi, 2016).

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*Corresponding Author: yuvarajbabu@saveetha.com
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Mandibular condyle bears all types of mechanical forces exerted on it by the temporo mandibular joint. The elongation of the ramus is mainly concerned by the condylar cartilage(Priya and Parthasarathy, 2019). Clinically, dimensions of condylar processes are essential to plan out surgeries in TMJ regions and other mandibular regions too. Some rare conditions called osteochondroma occur in the mandibular condyle, where enlargement of the condylar process occurs progressively leading to temporo- mandibular dysfunction. Osteochondroma appears to be a lesion originating from the cortex of the bone(Sharen and Sangeetha, 2019).

Many research works are based on the whole of the mandible which includes works like age changes in the mandible(Vignesh, Babu and Mohanraj, 2018) . Radio graphical studies were done on mandibular fractures and sexed mandibles were also studied (Manson and Lucas, 1962). As the mandible is the strongest and hardest bone in the face, fractures associated studies are not that prevalent. Various foramen and ramus of the mandible were researched fields(Trost, Trouilloud and Malka, 2009). Diameter, shape, and other anatomy applied to coronoid was detailed in many research works than for the condylar process(Ellis and Throckmorton, 2005). Very few works were on condylar processes, most of these works were done radio graphically and not on dry mandibles, they were done tomo-graphically(Markic et al., 2015).

The Condylar process did not grasp the attention of many research workers(Mohan Choontharu et al., 2018). In the condyles, the ossifications were studied including the timeline and they were tabulated. Sex wise condyle separation was also done in this basis(Malik, 2016). With a rich case bank established over 3 decades we have been able to publish extensively in our domain (Abdul Wahab et al., 2017; Eapen, Baig and Avinash, 2017; Patil et al., 2017; Jain and Nazar, 2018; J et al., 2018; Marimuthu et al., 2018; Wahab et al., 2018; Abhinav et al., 2019; Ramadorai, Ravi and Narayanan, 2019; Senthil Kumar et al., 2019; Sweta, Abhinav and Ramesh, 2019). Based on this inspiration we aim to analyse the condylar process of the mandible morphometrically.

Very few works are done on condylar processes, these works were mostly on sex differentiation(Kadhim and Fatah, 2016) and determination. Most of these works were on living individuals accomplished on radio graphically(Katagiri, Nakazawa and Kishino, 2008). In this study, dry human mandibles are used to assess dimensions and shapes morphologically as well as morphometrically. This study determines the length and width of the condylar processes and different shapes of the condylar processes were also determined in it.

MATERIAL AND METHODS

Unsexed dry human mandibles of fifty five in number were taken from the Department of Anatomy, Saveetha Dental College, Chennai. The dimensions [width and breadth] of the condylar processes of the mandibles were measured with the help of a digital vernier caliper along with the shape of the condylar heads. The longer side was marked as the length which is the mesio-distal diameter of the condyle and the shorter one is width which is the antero-posterior diameter.

LENGTH: Mesio-distal diameter of the mandibular condyle is the diameter which joins the mesial side with the distal side and is considered to be the length of the condylar process of the mandible.

BREADTH: Antero-posterior diameter of the mandibular condyle is the diameter which joins the anterior side with the posterior side and is considered to be the breadth of the condylar process of the mandible.

VERNIER CALIPER: Gives accurate measurements for dual graduation markings. Accurate up to 0.01cm.

SHAPE: The shapes of the condylar processes were also observed along with the dimensions of the condyle.

Statistical Analysis Used: After collection of data – length and breadth of the mandibular condyle, they were analyzed statistically using unpaired t test through software named as SPSS.

UNPAIRED T TEST: It is a statistical procedure which is used to compare the averages [or] means of two independent groups.

SPSS: Used to analyze various databases descriptively as well as statistically.

RESULTS AND DISCUSSION

Dimensions:

1. Length [Mesio-distal diameter]:

Table 1. This table represents the Mesio-distal diameters [range] of the right and left condyles along with its average P-value - 0.023; statistically significant at P < 0.05.

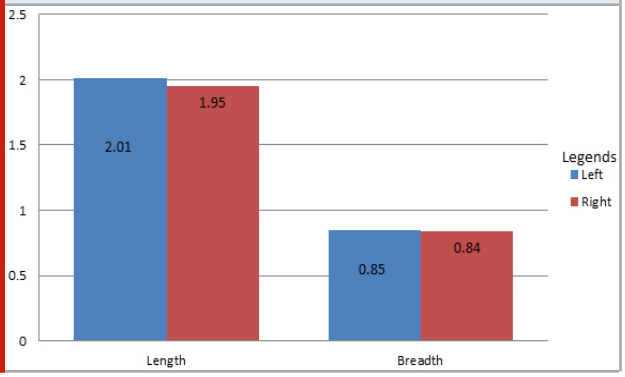
SIDES	LENGTH RANGE	LENGTH AVERAGE
LEFT	1.79 - 2.29 cm	2.01±0.13
RIGHT	1.74 -2.30 cm	1.95±0.10

2. Breadth [Antero-posterior diameter]:

Table 2. This table represents the antero-posterior diameter [range]of the right and left condyles along with its average P-value – 1; not statistically significant at P < 0.05.

SIDES	BREADTH RANGE	BREADTH AVERAGE
LEFT	0.72 - 0.99 cm	0.85±0.08 cm
RIGHT	0.74 - 1.01 cm	0.84±0.08 cm

Figure 1: This bar graph represents the length and the breadth in right and left mandibular condyles.

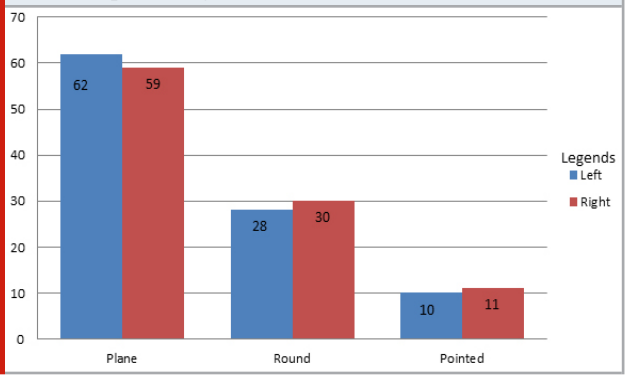


Shapes:

Table 3. This table represents the prevalence of shapes that occur in the mandibular condyles

SHAPES	RIGHT	LEFT
PLANE	59%	62%
ROUND	30%	28%
POINTED	11%	10%

Figure 2: This bar graph represents the prevalent shapes that occur in the right and left mandibular condyles in terms of percentage



From the obtained results it is clear that most of the left mandibular condyles mesio-distally [length] lie in the range between 1.79 and 2.29 cm, Average is found to be 2.01 cm. While in the right mandibular condyle the range lies between 1.74 and 2.30 cm, Average is found to be 1.95 cm. P value was found to be 0.023 (>0.05), so it is statistically significant . The average length of the mandibular condyle on the left side seems to be longer than on the right side [Table 1]. When the antero-posterior diameter [breadth] is assessed [Table 2], the range for the left condyle lies between 0.72 and 0.99 cm, where its average is found to be 0.85 cm. The range lies between 0.74 – 1.01 cm for the right condyle and its average is found to be 0.84 cm. P value was found to be 1(>0.05), so it is not statistically significant.

In the observed mandibles the left condyle appeared to be greater in diameter [antero-posteriorly] than the right condylar process of the mandible. [fig 1] bar graphs compare both length and AP diameter of mandibular condyles on both the left and right side.

On considering the shapes [Table 3] of the condylar processes; plane, rounded and pointed were the shapes that were prevalently found in them. Of these, on the right condyle almost 59% were of plane shaped followed by round, which is around 30% and pointed which is 11% of the observed mandibular condyles. On the left condylar processes of the mandibles, the prevalence were 62%, 28%, 10% for the plane, rounded and pointed respectively. From these results it is clear that plane shaped mandibular condyles are commonly occurring ones in most cases and pointed type is the least observed shape [fig 2].

Many researchers have done research on the whole of the mandible, their morphology and age changes. Most of the research works by Sharen and Mohan et al, were done on the coronoid process of the mandible. Landmarks for gender variation along with morphometry of the coronoid process was done in a study, this study was done on 15 dry mandibles but were sexed ones (Kausar et al., 2020). Of the few studies done on the condylar process, study done by Ganugapanta et al., was a notable one, it was accomplished using CBCT [Cone Beam Computed Tomography], but the analyses were not accurate because of hindrances caused by various types of ligaments that adjoin the mandibular condyle(Ganugapanta et al., 2017). Another relevant study was done on 15 dry mandibles, but only shapes of condyles were assessed, they did not include the dimensions of the condylar processes of the mandible, plane shaped heads were found in more than 75% of the observed mandibles(Sahithi et al., 2016).

Cephalometric study of the condyles were done which includes, the articulating positions of the condylar process, they were done using cephalograms. Forensic based studies were also done on condyles, with the help of sex determination the condyles are used in resolving unidentified crimes. In a study done by Matsumato et al., the dimensions were analyzed in a CBCT manner, that study declared that the right condyle is greater in antero-posterior diameter than the left condyle of the mandible which is relevant to our current study, but the dimensions were not accurate(Matsumato, 2012). In another study the shapes of the condyle were studied, in which 25 mandibles were assessed and all 25 were found to be plane shaped mandibles(Goymen and Gulec, 2017).

Previous study results were declared the same as the current study because 59% of the left condyles were found to be plane and 62% of the right condyles were found to be plane. In a study done in India for the shape of the condyles for the patients with TMJ dysfunctions found that plane shaped condyles are found among most of the Indians(Tutamayi and Al-Kamali, 2014). In a study done on Condylar process of the mandible,

morphometrically with the help of vernier caliper on dry mandibles, south Indian population based mandibles were analyzed, reported that the mesio-distal diameters of the mandibles are greater than their antero-posterior diameter whose results are relevant to this study(Sharen and Sangeetha, 2019).

Almost every researcher has done their research on either dimensions or the shapes of the condyles, but this study successfully combines both dimensions as well as the shapes of the mandibular condyles. As it is done on dry mandibles with digital vernier caliper, the values are mostly accurate when compared to other studies. The sample size is limited due to the availability of the mandibles. All mandibles were Indian based ones, so variation in the dimensions and shapes are very rare. Different shapes remain undiscovered. The dimensions vary based on geographic locations which includes varied food habits. The study should be done for more number of mandibles. The mandibles from other continents should also be studied for the betterment of the results and its variations. Importance should be given for the condylar process as well.

CONCLUSION

The morphometrical analysis of the condylar process of the mandible is helpful in many TMJ dysfunctional cases. It also helps the surgeons to plan out surgeries in those areas. This knowledge will also help in other clinical procedures associated with the mandibles. It is a growing field, if importance is given to this field; it may be helpful in the identification of the unknown remains as well.

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Conflict of Interest: The author declares that there is no conflict of interest in the present study.

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