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MORPHOLOGICAL AND MORPHOMETRICAL STUDY OF CORONOID PROCESS IN HUMAN MANDIBLES

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ABSTRACT: Background: The coronoid process of mandible is thin flat triangular process from the ramus of the mandible. This varies in the shapes and size. It gives attachment to two main muscles that is temporalis and masseter muscle. The coronoid process is the favourable donor site. A Coronoid process graft can be used for alveolar defects repair, orbital floor repair, maxillary augmentation, repair of non-union fracture of mandible. These grafts can be widely used in the reconstruction of osseous defects in oral and maxilla-facial region. **Aim of the Study:** This study is done to find out the variation in shape of coronoid process of mandible, Intercoronoid distance, coronoid- condylar distance and the length and breadth and thickness of the coronoid process of mandible. **Methods:** The study was done on the 100 dry human mandibles from the osteology bank of Saveetha medical college and hospital. The distance was measured using the digital vernier callipers and the values were analysed. **Results:** This study is useful for the maxillofacial surgeon and this useful for determining the buccal vestibule during denture fabrication and helps us to understand the angle and extent opening of the mouth.

INTRODUCTION: The mandible is the largest, strongest bone of the facial skeleton and it is the second bone in the body to ossify. It has a horizontally curved body and two vertically placed rami that ascend in the posterior aspect. The rami bear the coronoid and the condylar process. The coronoid process projects upwards and slightly forwards as a triangular plate of bone. Its posterior border bounds the mandibular incisures and its anterior border continues into that of the ramus.

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The apex, anterior margin, medial surface and a part of lateral surface close to the apex of the coronoid process provides attachment to the temporalis muscle. The lateral surface is covered by anterior fibres of masseter muscle. Meckel's cartilage forms embryonic lower jaw skeleton, but the coronoid and the condylar processes do not develop from the primary cartilage but from secondary cartilages that appear along the anterior border which disappear before birth. Elongation of the coronoid process may be found bilaterally or unilaterally, resulting in progressive, painless restriction in mandibular opening, due to impingement of the coronoid on the medial aspect of the zygomatic arches. This rare condition is more common in males, aetiology of which is unknown [1].

The common treatment involves the sectioning of the coronoid process [1]. So far, four shapes of the coronoid process of mandible, have been documented [1], being, triangular, hooked and rounded and miscellaneous. The most common shape being triangular followed by hooked [2]. Presence of double or second coronoid process has also been cited [3]. The coronoid process is ossified from membrane, it also shows less resorption. Autogenous bone grafts can be obtained from ilium, rib and calvarias; but each site has its own associated morbidity [4]. A local bone graft from Coronoid process of mandible can be used as it can be harvested easily, with minimal morbidity and no cutaneous scarring as bone is harvested intra - orally. A Coronoid process graft can be used for alveolar defects repair, orbital floor repair, maxillary augmentation, repair of non-union fracture of mandible [5]. These grafts can be widely used in the reconstruction of osseous defects in oral and maxilla-facial region. The Coronoid process makes a perfect donor graft site for reconstruction of orbital floor deformities [5, 6]. The use of a temporalis myofascial flap both as a single and as composite flap with cranial bone, as the arteries supplying the coronoid process, arise from vessels that supply the muscles attaching to these processes, and generally not from the inferior alveolar artery which primarily supplies the mandibular body and teeth [7]. Coronoid process is skin island can be used in all aspects of reconstructive cranio - maxillofacial surgery including trauma, deformities, tumors, temporomandibular joint ankylosis and Facial nerve paralysis. No functional limitations were apparent after removing the coronoid process [7].

MATERIALS AND METHODS: The study was done on 100 dry human mandibles (56 males and 44 female) from the osteology bank of department of Anatomy, Saveetha medical college, Chennai, Tamil Nadu India. The bones were classified into male and female by the available parameters [3]. In the present study, the shape, length, breadth, thickness of the coronoid process were measured, inter-coronoid distance, distance between coronoid process and mandibular foramen and coronoid-condylar distance was measured using the digital vernier calliper and the angle of the coronoid process was measured using goniometer. The length of the coronoid process was taken from the line tangential to the deepest part of the mandibular notch to the apex. The base of the coronoid process was taken as the reference point for measurement of the breadth.

The mid part of the coronoid process was taken as the reference for the measurement of thickness. The data was collected, and the mean, standard deviation of the values were determined and analysed. Exclusion criteria: The broken mandible, asymmetrical and deformed mandible were excluded from the study.

RESULTS: Out of 100 dry mandibles, 56 were classified as male and 44 as female. The Shapes of the coronoid process was classified into four types: triangular, rounded and hook.

Triangular: Pointed apex, straight anterior and posterior border (**Fig. 1**).

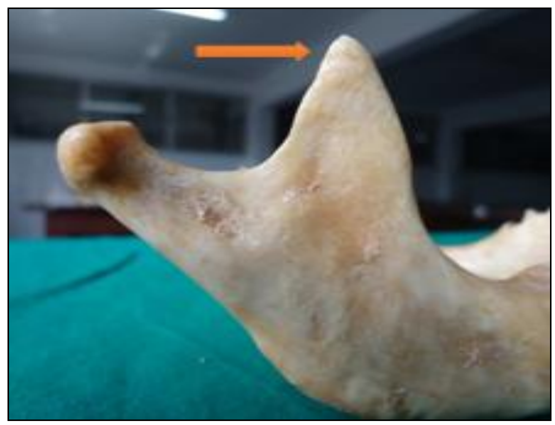

FIG. 1: SHOWING TRIANGULAR CORONOID PROCESS

Hook: Pointed apex, anterior border being convex, posterior border being concave. (**Fig. 2**).

FIG. 2: SHOWING HOOKED CORONOID PROCESS

Rounded: Blunt apex, straight anterior and posterior border (**Fig. 3**).

FIG. 3: SHOWING ROUNDED CORONOID PROCESS

TABLE: 1 VARIATION OF THE SHAPE OF CORONOID PROCESS

Shape	Total Number and %
Triangular	38
Hook	36
Rounded	26
Miscellanous	0

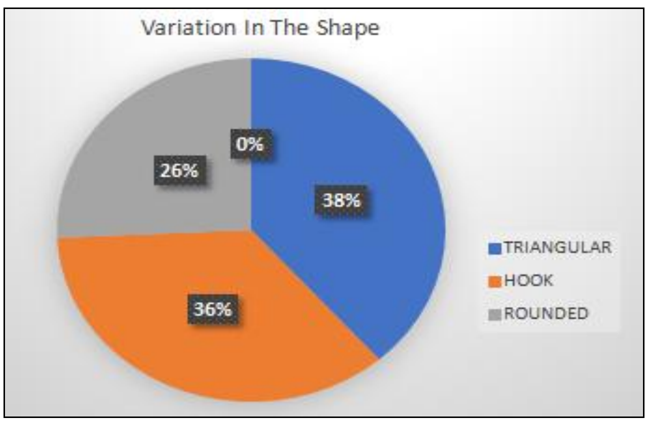

FIG. 4: VARIATION IN THE SHAPE

TABLE: 2 LENGTH OF THE CORONOID PROCESS

Shape	Left (in cm)	Left (in cm)	Right (in cm)	Right (in cm)
	mean	Standard deviation	Mean	Standard deviation
Triangular	2.03 cm	0.50	1.56 cm	0.40
Rounded	3.00 cm	0.36	1.07cm	0.36
Hook	1.06 cm	0.17	1.02 cm	0.46

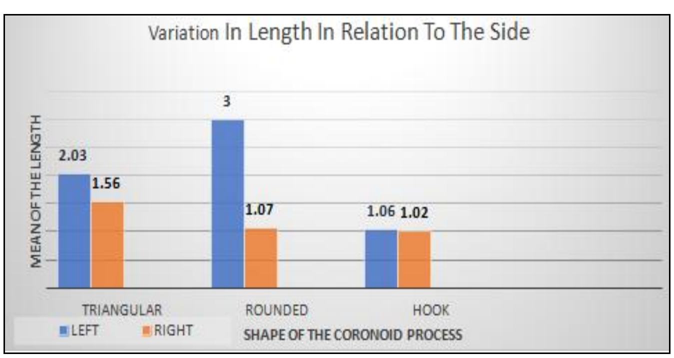

FIG: 5: VARIATION IN LENGTH IN RELATION TO THE SIDE

TABLE: 3 BREADTH OF THE CORONOID PROCESS

Shape	Left (in cm)	Left	Right (in cm)	Right
	Mean	Standard deviation	mean	Standard deviation
Triangular	1.09 cm	0.1	1.09 cm	0.2
Rounded	1.86 cm	0.15	1.09 cm	0.1
Hook	2.03 cm	0.05	1.93 cm	0.05

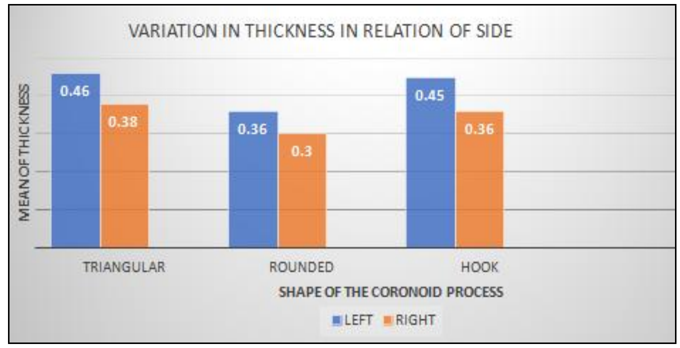

FIG. 7: VARIATION IN THICKNESS IN RELATION OF SIDE

TABLE 4: CORONOID-CONDYLAR DISTANCE

Shape	Left (in cm)	Left	Right (in cm)	Right
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Triangular	3.6cm	0.36	3.1cm	0.01
Rounded	3.53cm	0.05	3.36cm	0.05
Hook	3.5cm	0.01	3.36cm	0.01

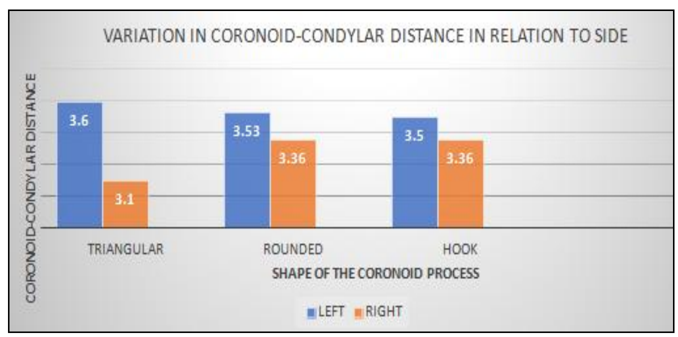

FIG. 8: VARIATION IN CORONOID-CONDYLAR DISTANCE IN RELATION TO SIDE

TABLE 5: INTER- CORONOID DISTANCE

Shape	Inter Coronoid Distance	
	Mean	**Standard Deviation**
Triangular	9.01cm	0.26
Rounded	8.96 cm	0.45
Hook	9.08 cm	0.85

TABLE 6: CORONOID – MANDIBULAR FORAMEN DISTANCE

Shape	Coronoid Mandibular Foramen Distance	
	Left mean (in cm)	**Right mean (in cm)**
Triangular	4.03cm	4.14
Rounded	3.83 cm	4
Hook	4.1 cm	3.96

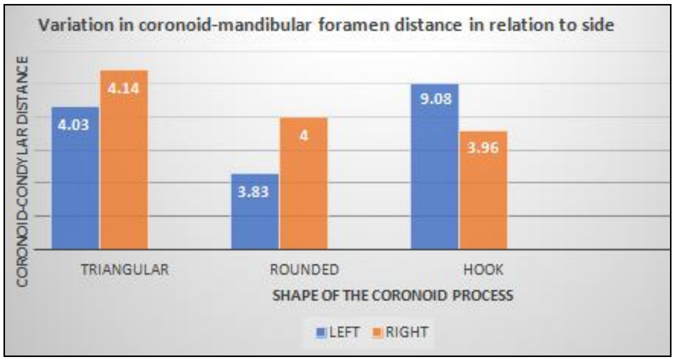

FIG. 9: VARIATION IN CORONOID-MANDIBULAR FORAMEN DISTANCE IN RELATION TO SIDE

DISCUSSION: The coronoid process, 'Coronoid meaning Crow', has been described as one of the bony processes of the ramus of the mandible [6]. The coronoid process as beak shaped [8], triangular coronoid process [9, 10, 11, 12]. In our present study, the triangular and hook shaped type were more common and rounded process were least common which coincides with a study done by which showed most common shape was triangular(67%) and least common was rounded (3%). In contrary, beak shaped as common [12] showed most common as triangular and least common were hook shaped. In the present study, three shapes of coronoid process have been noted, out of which the triangular coronoid was most common (38%) **Fig. 1** followed by hook (36%) **Fig. 2** and rounded (26%) **Fig. 3** as shown in **Table 1**.

Our results regarding the shapes of the coronoid process are similar to most of the study. Further, the age of the mandible was also assessed by the appearance of alveolar process and the present study showed, the incidence of round coronoid process was found predominantly in young age mandibles with no incidence of hook shape. In adult age groups, the incidence of triangular coronoid process was predominant, whereas the hook shaped was only found in old age mandibles. Therefore in the present study, we also postulate that this difference in shape of the coronoid process in relation to the age may be due to traction by the temporalis muscle, which changes the shape of the coronoid process, as age progresses have mentioned that these differences in the shape of the coronoid process may be due to genetic factors [14, 15].

The length of the coronoid process was taken from a tangent line drawn to the deepest part of the mandibular notch to the apex. In the present study, the length of the coronoid process was highest in rounded coronoid process with a mean of 3 cm, triangular 2.03 cm and hooked 1.06 cm as showed in the **Table 2**. The coronoid process projects above the condylar process at the time of birth, with growth of the neck of the mandible it comes to lie at the lower level in adults. Abnormal elongation of the coronoid process, without any synovial tissue around it, is suggestive of coronoid hyperplasia has been reported for the first.[16]. The length of the coronoid process was found to be longer on the left side than the right side, this may be due to genetic factors, functional factors, and hormonal impact on muscle growth, bone remodelling and probably lead to enhanced functional stress on mandible due to mastication [17].

In the present study, the mean breadth of the left and right showed no significant differences, the average of the breadth of the triangular shaped coronoid was found to be 1.09cm in left and right side. The average of the breadth of rounded coronoid was found to be 1.86cm in left and 1.09cm in right. The average of the breadth of hook shaped coronoid was found to be 2.03cm in left and 1.93cm in right side as shown in **Table 3**. In the present study, the mean thickness of the left side was found to be more than the right in all the three types of coronoid processes. The average of the thickness of the triangular shaped coronoid was found to be 0.46cm in left and 0.38 cm on the right side. The average of the thickness of rounded coronoid was found to be 0.36cm in left and 0.3cm in right. The average of the thickness of hook shaped coronoid was found to be 0.45cm in left and 0.36cm in right side as shown in **Table 4**. In the present study, the mean coronoid condylar distance of the left side was found to be more than the right in all the three types of coronoid processes as shown in **Table 5**.

The average of the coronoid condylar distance of the triangular shaped coronoid was found to be 3.6cm in left and 3.1 cm on the right side. The average of the coronoid condylar distance of rounded coronoid was found to be 3.53cm in left and 3.36cm in right. The average of the coronoid condylar distance of hook shaped coronoid was found to be 3.5cm in left and 3.36cm in right side.

In the present study, the mean distance between coronoid process and mandibular foramen of the triangular coronoid was found to be 4.03 cm, the same distance in the rounded coronoid was 3.83 cm and in the hook variety it was 4.1 cm in the right side of all the specimens as shown in **Table 7**. In the left side, the mean distance between coronoid process and mandibular foramen was found to be 4.14 cm in the triangular variety, and in hooked coronoid, the distance was 4 cm and in the hook variety, it was found to be 3.96 cm respectively. The measurement of this distance is particularly useful in procedures wherein the inferior alveolar nerve is used for local nerve block. In the present study, the mean of the inter coronoid distance was 9.01cm, 8.96cm and 9.08 in mandibles showing triangular, rounded and hooked coronoid processes respectively. Our findings coincides with previous studies [18, 19].

CONCLUSION: Our study suggests that triangular shape is the most common presentation in both male and female mandibles. Hook shaped is more predominant in edentulous mandible suggesting that with increase in age the shape of coronoid process gradually changes from triangular to hooked .The prevalence of hooked coronoid process is more in males and older age but absent in younger age. The data collected under various parameters, from the present study can be informative for the dental and maxillo-facial surgeons in planning graft implants and also in reconstructive surgeries. A Coronoid process donor graft can be used for alveolar defects repair, orbital floor repair, maxillary augmentation, repair of non-union fracture of mandible. Along with other features of the skull known as nonmetric variants these could be used as anthropological markers to assess different populations and races. More studies involving larger sample size and other group of population is desirable for better correlation of age and sex change in shape of coronoid process.

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CONFLICTS OF INTEREST: The authors hereby declare that there is no conflict of interest regarding the publication of the paper.

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