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A study of variations in the shape of coronoid process in dry adult human mandibles

Meril Ann Soman*, Rani Nallathamby

Department of Anatomy, Believers Church Medical College, Thiruvalla, Kerala, India

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Abstract:

Introduction: The coronoid process is one of the bony processes of the ramus of the mandible. It is a thin, triangular eminence, which is flattened from side to side. It varies in shape and size. The shape of coronoid process acts as an evolutionary marker. It is useful in anthropological and forensic studies. This study was undertaken to note the form of presentations of coronoid process and their incidence in the dry adult human mandibles.

Method: The present study was conducted in the Department of Anatomy, Yenepoya Medical College, Mangalore. A total of hundred adult human mandibles were included in the study which consisted of 62 male and 38 female mandibles. The shapes of the coronoid processes were studied bilaterally in all the mandibles and the incidence of the shapes were analyzed statistically in both male and female mandibles.

Results: Three types of variations in the shape were evident. Triangular, hook shaped and rounded. Hook shaped coronoid process was found in 90 (45%) sides, round shape in 64(32%) sides and triangular in 46 (23%) sides.

Conclusion: Knowledge regarding the morphological shapes of the Coronoid process is useful for the maxillofacial surgeons during reconstructive surgeries and can be used as a donor site for sinus augmentation. It is also useful in anthropological studies and in forensic dentistry.

Keywords: Mandible, Coronoid process, Hook, Round, Triangular, Anthropology

Introduction

The mandible, also known as inferior maxillary bone is the lowest and strongest bone in the face. It consists of a body and two rami which are attached to the body at nearly right angles [1]. Two processes named 'condyloid' and 'coronoid' process arises from the ramus of the mandible. Condyloid process is seen posteriorly and coronoid process forms the anterior projection. Coronoid process is a triangular eminence projecting upwards and slightly forwards.

Temporalis muscle is attached to the medial surface of coronoid process including its tip and anterior border. The deep layer of masseter is inserted into the lateral surface of ramus of mandible including a part of coronoid process [2].

There exist variations in the shape of the coronoid process. The shape of the coronoid process is considered to be very useful in the field of anthropology and forensic science as it acts as an evolutionary marker [3]. It is widely used by maxillo facial surgeons for reconstructive purposes. The uses of coronoid process grafts include maxillary augmentation, alveolar defects repair, TMJ ankylosis, orbital floor repair and in repair of non-union fracture of mandible [4]. The aim of this study is to note the incidence of the shapes of coronoid process bilaterally in male and female mandibles.

Materials and Methods

The present study was carried out in the Department of Anatomy, Yenepoya Medical College, Mangalore. A total of hundred dry adult human mandibles were included in the study which consisted of 62 male and 38 female mandibles. The mandibles with damaged coronoid process were excluded from the study. The coronoid process of both the sides were included, a total of 200 sides. Variations in the shapes of the coronoid process were noted down. Three different variants of the shapes were observed and were classified into hook shaped, rounded and triangular. The shapes were studied bilaterally and in both the genders. The gender of the mandible was determined using non- metric analysis. The heaviness, muscular markings, chin shape and gonial eversion were considered in the determination of gender.

***Corresponding Author:**
Meril Ann Soman,
Assistant Professor,
Department of Anatomy, Believers Church Medical College, Thiruvalla, Kerala, India.
E-mail: meril_ann@yahoo.co.in
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Results

The shapes of coronoid process were classified into three: 1) Hook shaped 2) Rounded 3) Triangular. According to Figure 1, Hook shape was seen to have the highest incidence of 45% (90 sides) followed by rounded - 32% (64 sides) and triangular shape - 23% (46 sides).

According to Table 1, Hook shape was seen bilaterally in 36 mandibles (72 sides) and unilaterally in 18 sides. (10 on right side and 8 on left side) The 10 mandibles which had hook shaped coronoid process on the right side, the corresponding left side showed 6 rounded and 4 triangular shaped coronoid processes. The 8 mandibles with hook shaped coronoid process on the left side were associated with 5 triangular and 3 rounded coronoid processes on the right side.

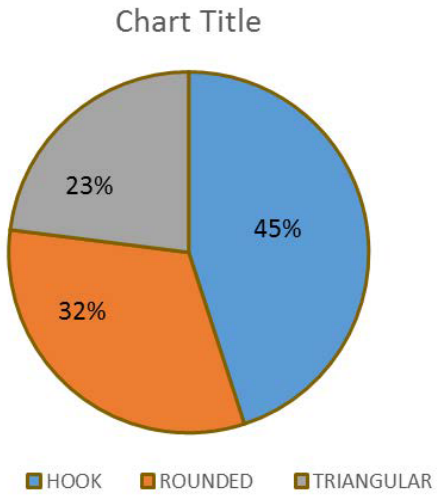

Figure 1: Pie chart showing the incidence of shapes of coronoid process.

Table 1: Incidence of shapes of coronoid process-unilaterally and bilaterally:

Shapes	Number	Bilateral	Unilateral	
			Right	Left
Hook	90	72	10	8
Rounded	64	44	11	9
Triangular	46	30	6	10

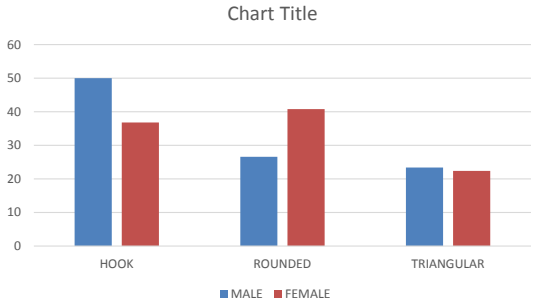

Figure 2: Bar diagram showing gender wise distribution of shapes of coronoid process.

Rounded coronoid process was present bilaterally in 22 mandibles (44sides) and unilaterally in 20 sides. (11 on right and 9 on left). The 11 mandibles which had rounded coronoid process on the right side, the corresponding left side had 6 triangular and 5 hook shaped coronoid processes. The 9 mandibles with rounded coronoid process on the left side were associated with 8 hook shaped and 1 triangular shaped coronoid process on the right side.

Triangular coronoid process was present bilaterally in 15 mandibles (30 sides) and unilaterally in 16 sides. (6 on right and 10 on left). The 6 mandibles with triangular shaped coronoid process on the right side were associated with 3 hook shaped and 3

Figure 3: Hook shaped coronoid process.

Figure 4: Rounded shaped coronoid process.

Figure 5: Triangular shaped coronoid process.

rounded coronoid process on the left side. Of the 10 mandibles which had triangular shaped coronoid process on the left side, the corresponding right side had 8 rounded and 2 hook shaped coronoid processes.

Table-2 shows the gender wise distribution of various shapes of the coronoid process in male and female mandibles. Hook shape showed the highest incidence in males followed by rounded and triangular whereas female mandibles showed the highest incidence of rounded followed by hook and triangular. (Figure-2)

Rounded coronoid process was present bilaterally in 22 mandibles (44 sides) and unilaterally in 20 sides (11 on right and 9 on left).

Discussion

The term coronoid process was derived from a Greek word 'Korone'- which means 'like a crown'. Coronoid process is ossified from secondary cartilages, attached to the Meckel's cartilage. The term coronoid is also given to two other structures in the human body- Coronoid process in ulna and Coronoid fossa in humerus. Three different shapes have been observed for the coronoid process of mandible. Hook shaped, rounded and triangular. In a hook shaped coronoid process (Figure 3), the tip points backwards. In rounded coronoid process (Figure 4), the tip appears rounded and in triangular (Figure 5), the tip is pointed straight upwards [5-16].

The variations in the shape may be due to nutritional habits, hereditary factors, genetic factors and occupational factors. The Temporalis muscle attachment plays a vital role as the muscular pull can alter the shape of coronoid process markedly [6,7].

The coronoid process can be considered as a non-metric skull variant in the assessment of age, race, gender and species. A bone graft can be taken from the coronoid process of the mandible without causing any cutaneous scarring. It is widely used in the reconstruction of osseous defects in oral and maxillo-facial area of the skull. It is used for paranasal augmentation as well. Temporalis myofascial flap can be used as a composite flap for reconstructive surgeries as the arteries supplying coronoid process and the muscle are the same [8]. Additional advantages of using coronoid process as a graft are its biocompatibility, availability and reduced operation time for graft surgeries [9].

The most common area of fracture in the mandible is at the condyle (36%), body (21%), angle (20%) and symphysis (14%). The coronoid process fractures are very rare (2%) as it is an anatomically protected area complex zygomatic arch-temporo-

Table 2: Gender wise distribution of different shapes of coronoid process:

Shape	Male			Female		
	Number (124 sides)	Bilateral	Unilateral	Number (76 sides)	Bilateral	Unilateral
Hook	62 (50%)	50	12	28 (36.8%)	22	6
Rounded	33 (26.6%)	18	15	31 (40.8%)	26	5
Triangular	29 (23.4%)	20	9	17 (22.4%)	10	7

Table 3: Percentage variations in the incidence of shapes of coronoid process in various studies:

Authors	Types of coronoid process		
	Hook	Rounded	Triangular
Issac and Holla [6]	27.40%	23.60%	49%
Khan and Sharieff [3]	30%	3%	67%
Hossain et al. [12]	45%	25.35%	29.65%
Prajapati et al. [2,8]	21.25%	24.58%	54.17%
Nirmale et al. [5]	28%	7%	65%
Tapas [4]	22%	18%	60%
Present Study	45%	32%	23%

Table 4: Comparison of variations in the shapes of coronoid process in relation to gender with other studies:

Types of coronoid process	Triangular (%)		Hook (%)		Rounded (%)	
	Male	Female	Male	Female	Male	Female
Isaac and Holla [6]	46.5	53.5	30	22.8	23.5	23.6
Hossain et al. [12]	27.27	35.37	44.95	45.12	27.78	19.51
Prajapati et al. [2,8]	56	51.11	21.33	21.11	22.66	27.77
Pradhan et al. [11]	45.83	47.72	21.87	13.63	32.29	38.63
Varalakshmi et al. [14]	46.7	43.3	30.5	34.4	23.7	2.3
Lalitha and Sridevi [13]	68.18	34.48	11.36	25.86	20.45	39.65
Present Study	23.4	22.4	50	36.8	26.6	40.8

zygomatic bone and associated muscles [10,15]. The variations in the shape of coronoid process may lead to narrowing of vestibular spaces as the coronoid process lies in close relation with the distal molar tooth. It may cause impingement and result in restriction of mouth opening and mandibular hypomobility [11]

Table 3 shows percentage variations in the incidence of shapes of coronoid process in various studies. Few studies have shown highest incidence of triangular shape followed by hook shape and rounded. Present study shows highest incidence of hook shape followed by rounded and triangular. Study conducted by Hossain et al. [12] also shows higher incidence of hook shaped followed by triangular and rounded.

According to Table 4, various studies have been conducted to note the gender wise distribution in the shapes of coronoid process of dry adult human mandibles. Most of the studies have shown highest incidence of triangular shape in both males and females. In this study, the order of prevalence from highest to lowest in males is hook, rounded and triangular which is similar with the findings of Hossain et al. [12] and in females round shape has the highest incidence which is similar to the findings of Lalitha and Sridevi [13].

Conclusion

In the present study, hook shaped coronoid process had the highest incidence followed by rounded and triangular. Hook shape showed the highest incidence in males whereas in females, round shape was the most predominant.73 mandibles out of 100 showed similar shaped coronoid process bilaterally. 27 mandibles showed bilaterally different presentations. Detailed knowledge of various shapes of coronoid process would greatly help maxillo-facial surgeons especially during reconstructive surgeries. It is as well important for anatomists, anthropologists and forensic experts.

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