

# Morphological variation of coronoid process, sigmoid notch, and condylar process among patients of tertiary care centre of Nepal

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## Abstract

**Background:** Mandibular ramus undergoes remodelling with time. The remodeling is also influenced by factors such as ageing, dental status, gender, stress, trauma, force exerted during occlusion, and joint diseases. Studies have reported variations in morphology of coronoid process, condylar process, and sigmoid notch of the mandible.

**Objectives:** To assess the morphological variations of processes of mandible and the sigmoid notch in a tertiary care centre of Nepal.

**Methods:** A retrospective study was conducted at Chitwan Medical College. This study included 310 orthopantomograms (OPGs) retrieved from the archives of the hospital data from 2022 May-June. All OPGs were taken with same radiographic equipment. Data taken in predesigned proforma were entered and analysed in SPSS v.16. Descriptive statistics was used to explain the results in tabulated form.

**Results:** Among 310 OPGs assessed, 188 (60.6%) were female and rest male. Angled mandibular condyle was prevalent on both right 123 (39.7%) and left side 134 (43.2%). More than 50% of sigmoid notch was of sloping shape on both right and left side. Triangular type of coronoid process was present 185 (59.7%) on right side and 183 (59.0%) on left side. Among the coronoid process types, triangular was found more in male and females on both right and left sides.

**Conclusion:** This study concluded that the angled type of condylar process, sloping type of sigmoid notch, and triangular type of coronoid process were more prevalent on both right and left side. All three parameters were also observed to be prevalent in females suggesting gender variation.

**Key words:** Condylar process; Coronoid process; Morphology; Orthopantomogram; Sigmoid notch

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## INTRODUCTION

Mandible is the largest and strongest bone of face consisting of two ascending rami connected with horizontally lying body. Ramus has condylar and coronoid process and a sigmoid notch.<sup>1</sup> Mandibular condyle along with glenoid fossa and articular disc in between them form temporomandibular joint (TMJ).

Mandibular condyle acts as growth centre in the postnatal life. The sigmoid notch is a deep notch which separates coronoid process and condylar process while coronoid process is a flat triangular plate in which temporalis muscle attaches.<sup>1,2</sup> These structures present in the rami of mandible also have lot of variations as illustrated in several studies.<sup>1-5</sup> These variations have been observed with respect to age, dentition status, gender, facial type, occlusal force, between the right and left side.<sup>3,6,7</sup>

Although, many studies related to TMJ and dimensional analysis of condyle have been conducted, only few

studies have discussed the morphometric analysis of mandibular condyle in Nepal.<sup>2,8</sup> Sigmoid notch and coronoid process of mandible among Nepali have not been studied. A thorough understanding of these structures are necessary to recognise the variations. Hence the current study aimed to assess the morphological variations of processes of mandible and the sigmoid notch in a tertiary care centre of Nepal.

### METHODOLOGY

This study was a retrospective assessment involving 310 orthopantomograms (OPGs) of Nepali patients between the age of 18-70 years old. This study was conducted in School of Dental Sciences, Chitwan Medical College, Chitwan, Nepal on May 2022-June 2022. The study was approved by the Institutional Review Committee of Chitwan Medical College, Bharatpur, Chitwan, Nepal (Ref. CMC-IRC/078/079-214).

A convenience sampling method was used. Sample size was calculated using  $n = Z^2pq/d^2$ , where  $Z = 1.96$  at 95% confidence interval and  $p = 55.4\%$ , and  $d = 6\%$  margin of error. The total sample size was calculated to be 263.67. However, in this study 310 OPGs were assessed. The panoramic radiographs included in this study were taken from the patients who visited the School of Dental Sciences with dental problems as a part of routine investigations only. OPG of patients showing any pathology of condyles or the glenoid fossa, fractures of the TMJ region, having magnification errors and poor quality, superimposed normal anatomical structures were excluded from the study.

All projections were taken with the same radiographic equipment (GendexOrthoralix 9200 panoramic radiographic machine, with 66 kVp, 12 seconds of exposure time and 12 mA current). The outline of each mandibular ramus on right and left side was then assessed for the various morphological shapes of the coronoid process, condylar process and sigmoid notch which was interpreted as described by Sahithi et al.<sup>1</sup>

Data entry and analysis were performed using SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). To describe about the descriptive statistics, frequency and percentages were used. For continuous

variables, mean and standard deviation (SD) were calculated. The data were presented in form of table.

### RESULTS

Among 310 OPGs observed, 122 (39.4%) were of male and 188 (60.6%) were of female. The mean age was  $44.25 \pm 11.47$  years (age range 18-70 years) (Table 1). Angled mandibular condyle was prevalent in both right side 123 (39.7%) and left side 134 (43.2%). More than 50% of sigmoid notch was of sloping shape in both right and left side. Triangular type of coronoid process was present nearly 60% in both right and left side (Table 2).

Table 3 showed that angled type of condyle was prevalent in female in left side 92 (48.9%) followed by on the right side 82 (43.6%). Flat type of condylar process was more among male 12 (9.8%) in both right and 13 (10.7%) left side than in female. In femalesloping type of sigmoid notch was prevalent in both right 120 (63.8%) and left side 123 (65.4%). Among the coronoid process, triangular type was found more in male and in female in both right and left side.

**Table 1: Genderwise distribution of the participants**

Characteristics	Frequency (%)
Gender	Male 122 (39.4)
	Female 188 (60.6)

**Table 2: Morphological characteristics of mandibular ramus**

Morphology of Ramus	Right Frequency (%)	Left Frequency (%)
Condylar process	Round 66 (21.3)	61 (19.7)
	Angled 123 (39.7)	134 (43.2)
	Convex 106 (34.2)	96 (31.0)
	Flat 15 (4.8)	19 (6.1)
Sigmoid notch	Beak 93 (30.0)	92 (29.7)
	Sloping 167 (53.9)	172 (55.2)
	Wide 50 (16.1)	46 (14.8)
Coronoid process	Rounded 125 (40.3)	127 (41.0)
	Triangular 185 (59.7)	183 (59.0)

**Table 3: Comparison of mandibular ramus between male and female**

Morphology of Ramus	Male		Female		
	Right Frequency (%)	Left Frequency (%)	Right Frequency (%)	Left Frequency (%)	
Condylar process	Round	27 (22.1)	26 (21.3)	39 (20.7)	35 (18.6)
	Angled	41 (33.6)	42 (34.4)	82 (43.6)	92 (48.9)
	Convex	42 (34.4)	41 (33.6)	64 (34.0)	55 (29.3)
	Flat	12 (9.8)	13 (10.7)	3 (1.6)	6 (3.2)
Sigmoid notch	Beak	49 (40.2)	51 (41.8)	44 (23.4)	41 (21.8)
	Sloping	47 (38.5)	49 (40.2)	120 (63.8)	123 (65.4)
	Wide	26 (21.3)	22 (18.0)	24 (12.8)	24 (12.8)
Coronoid process	Rounded	60 (49.2)	57 (46.7)	65 (34.6)	70 (37.2)
	Triangular	62 (50.8)	65 (53.3)	123 (65.4)	118 (62.8)

## DISCUSSION

The vertebrate bodies are subjected to morphological variations. This is due to the growth and developmental phases they come across developmental disorders or functional variations.<sup>1</sup> Throughout an individual's lifetime, their skeleton alters as a result of many factors. It is possible to infer a person's age, sex, stature, ancestry, and comparative human identity from the density of the bone and the outlines. An individual's bones can thus be used to identify using biologic anthropology methods.<sup>10</sup>

The mandible is the skull bone known to be the most resilient, sexually dimorphic, and resistant to alterations after death. The only movable skull bones are the mandible and the tympanic ossicles.<sup>11</sup> The location and function of muscles can have a dynamic impact on the mandibular contours' size and alignment. The masseter and temporalis muscles' attachment and activation change the condyle and coronoid's form. The sigmoid notch can have a variety of "shapes" depending on genetic factors, hormonal changes in the condyle, and the coronoid itself.<sup>12</sup> In this study, we examined the morphological characteristics of the condylar process, coronoid process, and intervening sigmoid notch in tertiary care centre using patients OPG. The comparison of morphology of all the three parameters was done on basis of right and left side and among males and females.

Many authors have given various classification of all the studied parameters. In this study, the various morphological shapes of the coronoid process, condyle, and sigmoid notch was described as according to Sahithi et al.<sup>1</sup> In the present study, the angulated shape was the most prevalent type of condylar process, followed by convex, round and flat. This was in harmony with the

study reported by Nagaraj et al.<sup>9</sup> In another study by Manoj et al. reported predominance of triangular type followed by round, beak and flat type.<sup>10</sup> Few studies have reported prevalence of oval type of condyle using different classification system in Nepal.<sup>2,8,13</sup> This variation of the results may be due to the difference of age, sample size and geographical settings. Gender wise comparison of mandibular condyle in the present study, has revealed that the angled type was more prevalent in females, while in males there was equal predominance of angled and convex type. This was not in accordance with the earlier results reported from Nepal<sup>2,8,13</sup> and India.<sup>3,10</sup> In the South Indian population, Sahithi D et al. reported that males tended to have angular condyles whereas females tended to have rounder condyles.<sup>1</sup> The results from the present study and other studies done in Nepal and India demonstrate the variation in condylar shapes. The shape of the condyle has been classified in different ways in many literatures.<sup>1,2</sup> Slight variations also exist on basis of classification used. The condylar cartilage affects both the vertical and horizontal growth of the mandible. Pathologies such as ankyloses, condylar hyperplasia, infections, malignancies, and fractures can cause changes in the condylar shapes.<sup>12</sup> The mandibular and temporal components of the TMJ are preserve their capacity for remodeling even after growth has stopped. As the age of person advances, the condyle gets remodeled and rounded.<sup>14</sup>

The most prevalent coronoid process was triangular, followed by a round shape. The beak and flat type of coronoid processes were lacking. Upon gender wise comparison, the triangular coronoid process was prevalent in females while there was nearly equal presence of rounded and triangular type of coronoid

in males. The present results were similar to that reported by Nagaraj et al.<sup>9</sup> and but Manoj et al. in their study observed the predominance of round coronoid process.<sup>10</sup> However, studies performed on dry skull also showed predominance of angled type of coronoid process.<sup>11,15</sup> Tapas<sup>6</sup> reported 60% of coronoid processes with triangular shape while 22% had a hook shape, and 18% had round shape. The elongated coronoid process is explained by a number of theories. They include temporalis hyperactivity, TMJ dysfunction brought on by chronic disc displacement, dental causes such as occlusion guidance and variations in condylar inclination, as well as additional factors like hormone stimulation, diet, and hereditary predisposition.<sup>16</sup>

The sigmoid notch had a sloping shape, followed by beak and broad shapes in the present study. The present findings are similar to Nagaraj et al.<sup>9</sup> However, the result was contradictory to that reported by other studies.<sup>1,10</sup> In the study conducted by Sahithi et al., the wide type

was predominant followed by round and sloping.<sup>1</sup> The findings related to all the parameters indicate that there are variations on basis of side and gender.

This is single centre study so the results obtained cannot be generalised. Comparison of the mandibular condyle and coronoid process and sigmoid notch on basis of age groups could have been conducted, however, it was limited by the objective of the study.

## CONCLUSION

The morphology of the coronoid, condyle, and intervening sigmoid notch showed variations in the observed OPG. Morphological variations were observed on both right and left sides. All the three parameters were also observed to be prevalent on females suggesting the gender variation.

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