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Amorphometric study of condyloid process of dry human mandible for sexing from its shape

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Abstract

The mandible is having the condyloid process which articulates with the temporal fossa to form the temporomandibular joint, on which all the movements occur during the eating, chewing and even on talking also. It is having the articular facet on its head. This articulating facet is having different shapes and sizes which varies according to sex also. The shapes of condyloid processes are classified into four types i.e. convex, flat, rounded and angular. The size of the articular facet varies mandible to mandible and male to female. In the present study120 condyloid processes are studied and different shapes found were convex (55%), flat (20%), rounded (12.50%) and angled (12.50%). To measure the size of articular facet of the condyloid process of the mandible antero-posterior(AP) dimension from the anterior and posterior margins of the articular facet and medio-lateral(ML) dimension from the medial and lateral margins of the facets are taken with the help of vernier calliper. The mean of(AP) dimension of right and left condyles in male found to be (7.23±1.123)mm and (6.50±0.805)mm in females. The mean of medio-lateral dimension in male is (20.13±1.260)mm and in female it is (17.23±1.74)mm. As there is a difference in the size of condyloid process of male and female so the measurements are also helpful in determining the sex of the mandible. The present study is helpful for forensic dentistry, forensic medicine, orodental surgeons, traumatologists and plastic surgeons in the determination of sex of the mandible through the condyloid process of mandible and diagnosis and treatment of the patients.

Keywords: classification, articular facet, diameters, temporomandibular joint, orodental surgeon, traumatologist, ischaemic bone disease, tooth wear, anthropologists, ankylosis

Introduction

The mandible is the skeleton of lower part of face. It consists of a horse-shaped body, flat ramus and two processes i. e. coronoid and condyloid processes. The condyloid process consists of a neck surmounted by oval head with an articular facet on its process. The neck is having depression called pterygoid fovea, which lies on the anterior surface of the neck, lateral pterygoid muscle gets insertion in the fovea. The posterior surface is smooth and is continuous with the posterior surface of the head as well as the posterior border of the ramus. The lateral ligament of the temporomandibular joint is attached to the lateral and posterior aspect of the neck. The head of the mandible is convex but considerably elongated from side to side and narrow from anterior to posterior side of the neck. Its long axis is slightly oblique and passes medially and a little backwards. It is separated from the mandibular fossa by an articular disc.[1]

The condyloid process projects more at its medial pole. Its articular surface descends only a little on its anterior surface, covers the whole of its superior aspect and descends 5mm posteriorly. Its projecting lateral part is separated from the cartilaginous external acoustic meatus by the parotid gland. Laterally on its neck the joint's lateral ligament is attached, covered by parotid gland. The pterygoid fovea, receives the lateral pterygoid muscle. The medial side of the neck is related to the auriculotemporal nerve above and maxillary artery below.[2]

The mandibular condyle is the part of the mandible that articulates with the articular fossa of the temporal bone. Its shape and morphology affect the functional properties of the temporomandibular joint. For instance, the morphology and morphometry of the condyle in relation to the articular fossa have been shown to affect occlusal properties of the mandible.[3] The condyles are made up of spongy bone covered by a layer of thick fibro cartilaginous tissue, mainly formed by collagen and a small amount of elastic fibers. This cover is thicker in areas that have to work harder, giving them physical and biological attributes that are appropriate for receiving heavier loads during mastication.[4] The cartilage of the mandibular condyle acts as an important center for the endochondrial growth of the mandible during embryological morphogenesis.[5]

Condyle morphology was categorized both in the sagital and coronal planes.[6] The increase in the size of the lateral facet may be explained by considering the conditions. Yale et al.[7] described that the mandibular condyles were well characterized by the shape of the superior condylar surface. Ueda et al. created models by computer graphics(CG) that were used to test whether curvature analysis could differentiate mandibular condyle morphology effectively. Five CG condylar models were used i.e. convex, angled, flat, rounded and concave. This categorization was similar to that proposed by Yale et al.[7] except for the concave type.

Factors influencing stress distribution in the condylar region were investigated in earlier studies and revealed that morphological changes in the condyle head could alter the stress distribution in the region of roof of glenoid fossa(RGF). It was also previously reported that mechanical stimulation might cause an increase in bone thickness in the glenoid fossa.[8]

Material and method

The present study was conducted in the Department of Anatomy of Maharishi Markandeshwar Medical College and Hospital, Kumarhatti and District Solan(Himachal Pradesh). 60 dry human mandibles were collected from the Anatomy department with known sex. Out of 60 dry human mandibles 38 were of males and 22 were of females. As such 76 condyles were of males and 44 condyles were of females. The condyles were well formed and their condylar facets were clear. The margins of the condylar facets were marked with black marker to make the margins of the condylar facets more clear for the measurements. Both the condyles of both the sexes were studied. The size and shapes of all the condylar facets were studied. The size of the condylar facets were taken inmm with the help of vernier caliper. The variations in size and shape of the condylar facet in males and females was noted and recorded. The present study was compared with the standard literature and studies done by other authors. The present study will be helpful to orodental surgeons in the condylar replacement and also useful to anthropologists, general surgeons, forensic medicine and forensic dentistry in the determination of sex and in their diagnosis and treatment.

Observations

the present study 120(right and left) condyles of 60 dry human mandibles were studied. Out of 120 condyles 76 condyles were of males and 44 of females (Table 1). The different shapes of condyles were recorded in both the sexes (Table 2–4). The size of the condylar facets were taken inmm with the help of vernier callipers (Table 5)(Table 6).

Table 1 Total number of cases of coronoid process studied=120

Sex	Number of cases
Male	76
Female	44

Distribution of condyloid process according to sex

Table 2 Classification of shape of facet of condyloid process of mandible found in males and female

S. No	Types of shape	Number of cases found	Percentage (%age)
1	Convex	66	55
2	Flat	24	20
3	Rounded	15	12.5
4	Angled	15	12.5

Out of 120 condyloid processes 66(55%) condyloid processes were of convex type (Figure 1), 24(20%) flat type (Figure 2), 15(12.50%) rounded type (Figure 3) and 15(12.50%) were of angled type (Figure 4) combined in both the sexes. Out of 76 male condyles 42(55.26%) condyles were of convex type, 14(18.42%) flat type, 10(13.16%) rounded type and 10(13.16%) angled type. In Females out of 44 condyles 24(54.26%) condyles were of convex type, 10(22.73%) flat type, 5(11.36%) rounded type and 5(11.36%) angled type. The shapes were bilaterally present. No unilateral case was noted. There are variations in the number of all the four types of condyloid processes in male and female. In males there is more numbers in every type of condyloid process. This variation is helpful in morphological study of the mandible; this result is not so much helpful in determining the sex with the condyloid process of the mandible. The present study was compared with the standard literature and studies done by other authors. The present study will be helpful in the formation of prostheses of proper dimension and shape of the condyloid process in case of replacement in orodental surgery.

Table 3 Classification of shape of facet of condyloid process of mandible found in males

S. No	Types of shape	Number of cases found	Percentage (%age)
1	Convex	42	55.26
2	Flat	14	18.42
3	Rounded	10	13.16
4	Angled	10	13.16

Table 4 Classification of shape of facet of condyloid process of mandible found in females

S. No	Types of shape	Number of cases found	Percentage (%age)
1	Convex	24	54.26
2	Flat	10	22.73
3	Rounded	5	11.36
4	Angled	5	11.36

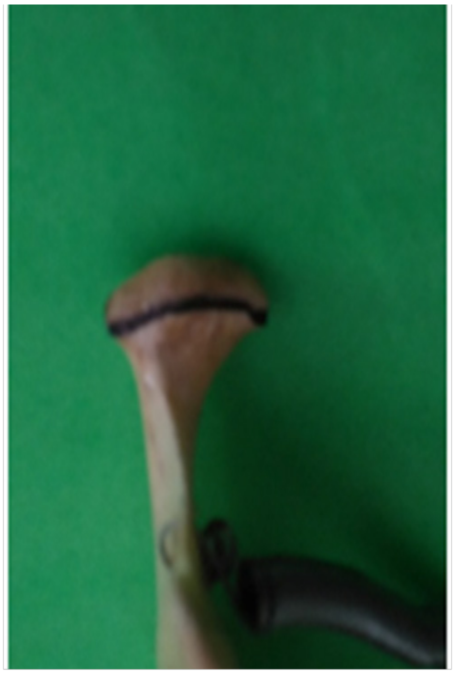

Figure 1 Convex type.

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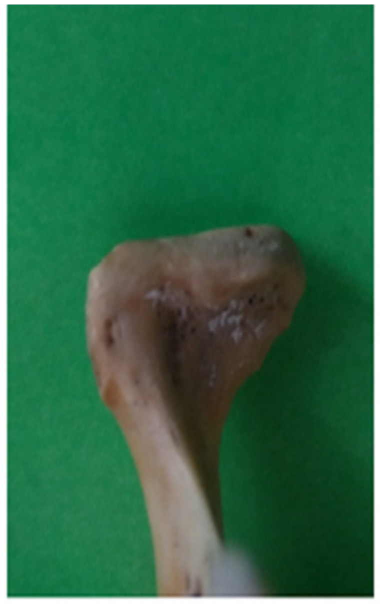

Figure 2 Flat type.

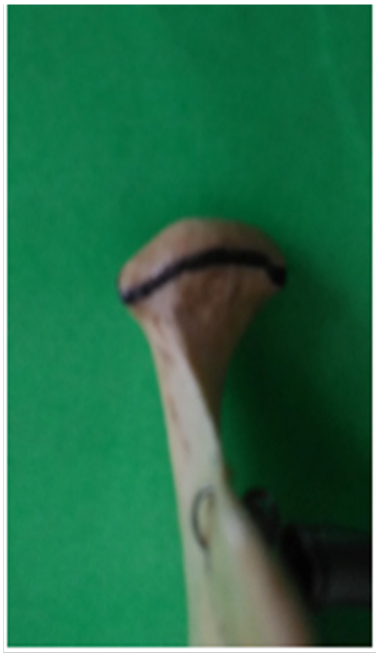

Figure 3 Rounded type.

To determine the sex of the mandible from the measurements of articular facets (Figure 5 & Figure 6) of the condyloid processes, it has been found in this study that average(Antero-Posterior) dimension in male is(7.225±1.156)mm and(Medio-Lateral) dimension is(20.125±1.223)mm. In female the average are(Antero-Posterior) dimension found is(6.495±1.325)mm and(Medio-Lateral) dimension is(17.225±1.220)mm. This shows that both the average dimensions of condyloid process of the mandible are more in male than the female. So the heads of condyloid processes are bigger in size in males than the females. These measurements will help in the determination of sex of the mandible. This study will be helpful to the orodental surgeons during the replacement of condyloid process in case of its crush injury or ischaemic bone disease. The study definitely helpful to forensic dentistry, forensic medicine, orodental surgeons, traumatologits and plastic surgeons in the diagnosis and treatment.

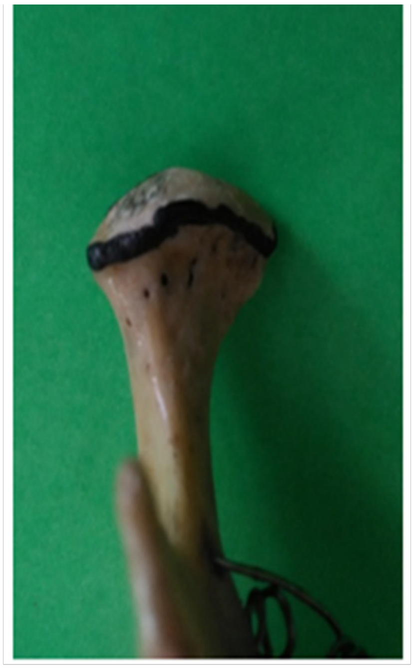

Figure 4 Angled type.

Figure 5 Marked facet.

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Table 5 Average size of male condyloid process

Right condyloid process				Left condyloid process			
Average AP distance in mm	**SD**	**Average ML distance in mm**	**SD**	**Average AP distance in mm**	**SD**	**Average ML distance in mm**	**SD**
7.36	±1.125	20.25	±1.121	7.09	±1.186	20	±1.334

Table 6 Average size of the female condyloid process

Right condyloid process				Left condyloid process			
Average AP distance in mm	**SD**	**Average ML distance in mm**	**SD**	**Average AP distance in mm**	**SD**	**Average ML distance in mm**	**SD**
6.6	±0.91	17.4	±0.70	6.39	±1.74	17.05	±1.74

Figure 6 Measuring of facet.

Discussion

The mandibular condyles vary considerably both in size and shape. When viewed from above, the condyle is roughly ovoid in shape. It is 15-20mm wide side to side and 8-10mm from front to back.[9] It is often assumed that the normal condyle head must have a convex configuration throughout and that symmetry should exist between contralateral sides in the same individual. Several studies have attempted to evaluate the morphology of the human condyles. The variation in the human mandiblular condyle shape was noted by previous researchers.[10] The condyle has an irregular cylindrical shape due to a slight tilting of the mandible neck. The articular surface of the condylar processes are upwards and anteriorly and has two variables. Grieve[11] obtained data in which the mesolateral dimension of the condylar process measured approximately 15-20mm and the antero- posterior dimension measured 8-10mm and the medial pole was generally more prominent than the lateral one.

Mandibular condyle morphology is characterized by a rounded bone projection with an upper biconvex and oval surface in axial plane.[12] Typically, the antero-posterior dimensions are shorter than the medio-lateral whose ends are called medial and lateral poles. The condyle morphology was categorized both in the sagital and coronal planes. The coronal plane was set parallel to the axis of the condyle and the sagital plane was set perpendicular to the coronal one. The condyles were classified as convex, rounded, flat, angled and other in the coronal plane described by Ejima et al.[6]

A normal variation of the condylar morphology occur with age, gender, facial type, functional load, occlusal force, malocclusal type and between right and left sides.[3,12–16] The studies of orthodontics patients have confirmed that the condyle can adapt to altered mechanical factors;[17] Pullinger et al.,[18] Mongini[19] suggested that the medial aspect of the condyle was most affected in subjects with substantial chewing forces associated with tooth wear.

Condylar prostheses therefore have to be of such form as to return the function of the temporomandibular joint to as close to normal as possible. Condylar prostheses are commonly used to correct traumatic injury or in procedures requiring resection with disarticulation, such as tumours, trauma, congenital malformation and degenerative diseases.[20]

Hegde et al.[21] described that the appearance of mandibular condyle varies greatly among different age groups and individuals. Human mandibular condyles may be categorized into five basic types i.e. flattened, convex, angled, rounded and concave. Morphologic changes of condyle occur due to developmental variations, remodeling, various diseases, trauma, endocrine disturbances(acromegaly) and radiation therapy. Genetic, acquired functional factors, age groups, individual have a role in morphologic changes of condyle. Thus variability in the shapes and sizes of condyles should be an important factor in diagnosis of the disorders of temporomandibular joint.

The increase in the size of the lateral facet may be explained by considering the conditions under which there is the great load on the condyle. It has been shown by Hylander[22] that the reaction forces are greater on the balancing side condyle. The power stroke of mastication and the slide into the position of maximum intercuspation are accompanied by the greatest force.[23,24] If the chewing cycle is a grinding and not a chopping stroke, the balancing condyle would be forced laterally against the articular eminence. According to Pritchard[25] remodeling of connective tissue occurs to provide a more favorable distribution of stress so as to avoid tissue damage. Hence the increase in the size on the joint are predominantly lateral during optimum chewing function. Mongini[26] found that the condyles had standing medial and lateral slopes in specimens that had uniform tooth wear.

Conclusion

The morphological shapes of the condyloid process is important for the production of prostheses for the replacement of the condyloid process in case of its crush injury, ischaemic disease, ankylosis of the temporomandibular joint. The measurements of the condylar facet will be helpful in the determination of sex of the mandible as there is difference between the size of the male and female condylar facets(Table 3)(Table 4). Male condylar facets are larger as compared to female condylar facets. The present study will be helpful in determination of sex of the mandible and also helpful in proper formation of the facets with proper dimensions on the head of prostheses. The present study will be definitely helpful for the orodental surgeons, forensic dentistry, forensic medicine, plastic surgeons, anthropologists and anatomists in the determination of the sex, diagnosis and treatment of the patients.

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None.

Conflict of interest

Author declares that there is no conflict of interest.

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