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MORPHOMETRIC ANALYSIS OF CORONOID PROCESS AND MANDIBULAR ANGLE IN GENDER DETERMINATION-A RETROSPECTIVE INTERDISCIPLINARY STUDY

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ABSTRACT

Aim

To analyse the various morophological variations of the coronoid process and to determine the mandibular angle using digital orthopantamograms (OPGs) radiographs in a retrospective analysis for identification of the sex of the individual.

Material and methods

The study was carried out using 50 digital OPGs comprising of both sexes and the different shapes of the coronoid process were traced and the mandibular angles were measured bilaterally.

Results

The most commonly observed outline form of the coronoid processes were triangular in males whereas round in case of females. The average mandibular angle measurement was found to be 99.8 degrees in males, whereas was found to be a little more increased in females i.e. 105.3 degrees in females.

Conclusion

Although there were variations even between both the right and left coronoid processes of the individual with varied shapes such as round, triangular, flat and beak like, the majority and most commonly occurring outline form of the coronoid process can be used tentatively for identification of the sex of the individual. Similarly there variations in the measurements of the angle of the mandible, still the average

measurements revealed a more obtuse inclination for females compared to males which suggest that with these parameters the gender can be determined to a certain extent and can also be used in forensic analysis.

Keywords: Orthopantamogram, coronoid process, morphology, mandibular angle, gender determination

INTRODUCTION

Dental identification are done either by a comparative method or by postmortem dental profiling **[1]**. Forensic odontology is a branch of forensic science that deals with the application of dental principles to legal issues **[2]**. The sex determination is a very important aspect in the personal identification of the individual.Sex determination can be done either by morphological analysis or molecular analysis **[3]**. Morphological analysis can be de done for hard tissues that is by odontometric, orthometric methods **[4]** and for soft tissues by cheiloscopy, rugoscopy etc., **[5]**. An orthopantamogram (OPG) is a two dimensional diagnostic imaging modality provides a panoramic view for visualising the teeth of both the upper and lower jaws in a single radiographic film **[6]**. An OPG can be used to visualise most of the anatomical landmarks in the orofacial region as well as for identification of pathologies **[7]**. Using the morphometric analysis the various variations in the morphology of condyle, coronoid process, sigmoid notch depth, mandibular ramus, mandibular angle measurements,gonial angle measurements ,mental foramen position etc., can be done and these measurements can be used to determine the age and sex of the individual **[8]**.

MATERIAL AND METHODS

This study was carried by randomly collecting 50 digital OPGs comprising of both sexes. The outlines of both the right and left coronoid processes were traced and the angles of the mandible were measured bilaterally.

RESULTS

The morphological outline form of the coronoid process varied from round, triangular, flat and beak like appearance **[9]**. There were variations in this morphology between right and left coronoid processes also. The most common morphology of the coronoid process was found to be triangular in case of males whereas a more rounded outline was found to be in females.

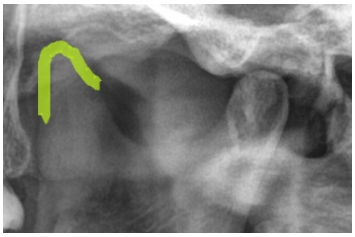


Figure 1: Rounded outline form of coronoid process

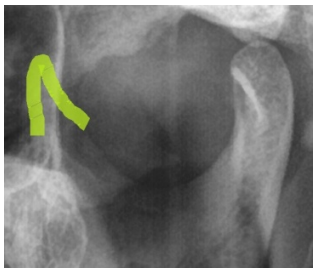


Figure 2: Triangular outline form of coronoid process

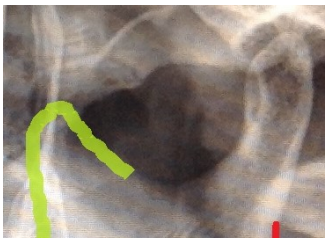


Figure 3: Flattened outline form of coronoid process

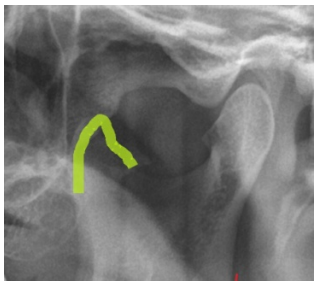
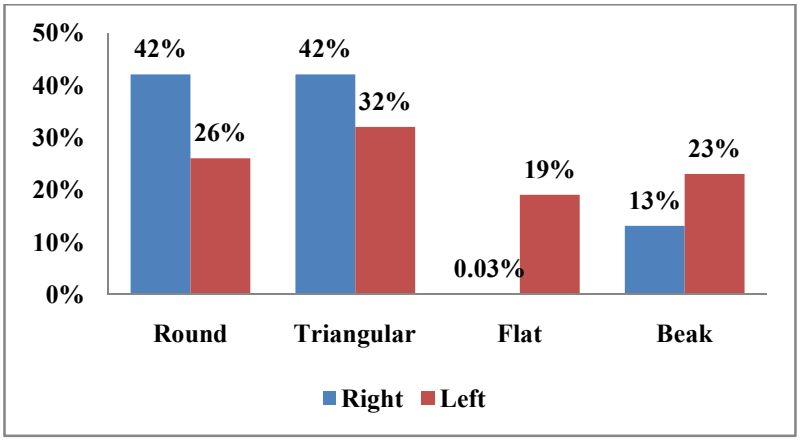
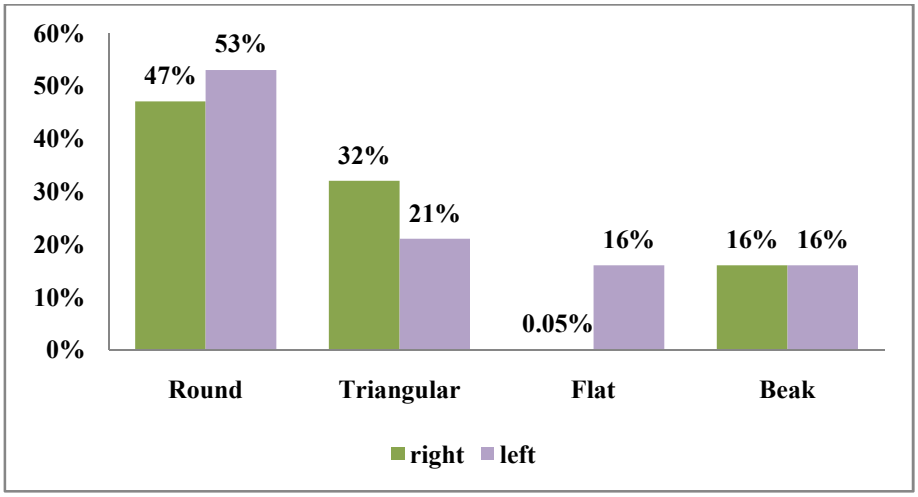


Figure 4: Beak like outline form of coronoid process



Graph 1: Summary of various outline forms of right and left coronoid processes in males



Graph 2: Summary of various outline forms of right and left coronoid processes in females

Figure 5: Measurement of the angle of the mandible in a case of male patient

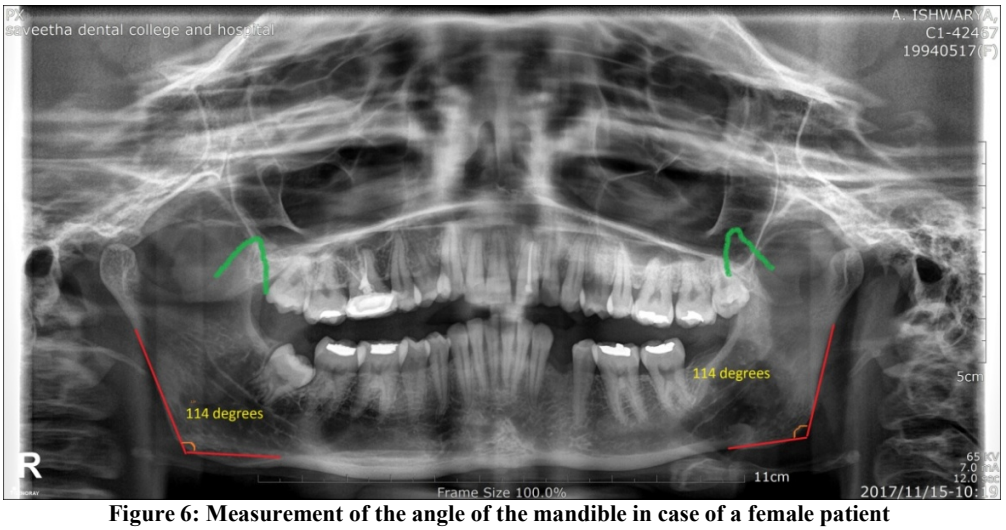


Figure 6: Measurement of the angle of the mandible in case of a female patient

DISCUSSION

The coronoid process of the mandible is a thin triangular eminence that is flattened from side to side and has variations in shape and size. The anterior border of the coronoid process is convex and is continuous with the anterior border of the ramus. The posterior border is concave and forms the anterior boundary of the mandibular notch.Lateral surface is smooth and gives rise to insertion for temporalis and masseter. Temporalis muscle again takes one more insertion from the medial surface of the coronoid process. The medial surface of the coronoid process has a ridge which begins at the apex of the process,runs downward and forward to the inner surface of the last molar tooth **[10]**. Between this ridge and the anterior border of the coronoid process, there is a grooved triangular area which gives attachment to the temporalis and some parts of buccinators **[11]**. The coronoid process can be used as a non metric skull variant in assessment of age, sex, race and species **[12]**. The socio demographic factors either directly or indirectly affect the final morphology of the coronoid process. There is also a correlation of the coronoid process with the mode and attachment of the temporalis muscle **[13]**. There are different morphological shapes of the coronoid process and they can be triangular, rounded, beak shaped or even flattened **[14]**. This variation in the morphology is seen both between the right and left coronoid processes and among gender also.Around 42% of the males either had a round or a triangular outline form of the right condyle. Ashwinrani et al. in 2017, around 57.8% of the males had a triangular shaped coronoid process on the right side which was in accordance with our study **[15]**. Around 13% of the males had a beak shaped condyle process and only 0.03% had a flat surface of the right side condyle respectively.Similarly 0.05% of the females exhibited a flattened surface on their right side of the condyle.In a similar study done by Shrijana et al. in 2013, only one OPG of a left coronoid process of a male exhibited a flattened outline form **[16]**. However a study by Narayan *et al* in 2004 stated that the beak and flattened form of coronoid process was seen only in aged individuals **[17]**. Around 32%of the males exhibited a triangular form of their left coronoid process.In a similar study done by Dathar *et al*. in 2016, the triangular form was the most common outline form with respect to the left coronoid process **[18]**. The next in order of the common forms were the round (26%), beak (23%) and flattened surface forms. Around 19% of the males exhibited a flat outline

form of their left coronoid process which was in contrast to the study done by Narayanan *et al*. in 2004 who had stated that the flattened morphological form increased as age had progressed. With respect to females around 47% of them had a rounded coronoid process of their left side,while 32% of them had a triangular form, 16% had a beak form and 0.05%of them had a flattened form of their right coronoid processes respectively.In relation to the left coronoid processes in females, 53% had a round form, 21 %had a triangular outline form while an equal proportion of 16% had either a beak or flattened configuration.To summarise the triangular shape was the most commonly observed morphological outline form of the coronoid process in males whereas round outline form was the most common morphological form of the coronoid process exhibited in females.Similarly a study done by Dathar *et al*. in 2016, the most commonly observed form of the coronoid processes in males and females were triangular followed by the round form which was in accordance with our study. The gonial angle is the angle of the mandible which is located at the posterior border at the junction of the lower border of the ramus of the mandible and it can be either inverted or everted and is marked by rough, oblique ridges on each side and provides attachment for the masseter muscle laterally, the medial pterygoid muscle medially and the stylomandibular ligament is attached to the angle between these muscles **[19]**. In our study, the arithmetic average of the gonial angle in males was found to be 99.8 degrees in males whereas was found to be little more increased in females that were around 105.3 degrees.In a similar study done by Revant *et al*. in 2013, a significant difference in gonial angle was found between males and females. Gonial angle in males was found to be 118.056° ± 6.47 and in females was 123.109° ± 7.439 ($P<0.05$) **[20]**. Despite the significant difference in the average values of the gonial angle measurements between males and females,there were lot of variations among the individual gonial angle measurements of both the sexes.A lowest of 85 degrees to a more obtuse form of 111 degrees were seen in males, likewise a lowest of 89 degrees to 115 degrees of gonial angle measurement were seen in females.This indicates that using gonial angle as an indicator for gender determination is still in doubt,but still can be tentatively used along with other parameters for gender determination **[21]**.

CONCLUSION

A thorough knowledge of the various anatomical and cephalometric landmarks in

these digital radiographs can have immense application in forensic sciences and other criminology aspects for the personal identification of the individual.An appropriate interpretation of these radiographs should be done with the help of experienced radiologists to eliminate the risk of bias and minimize errors in identification.

Future recommendations

More number of studies with increased sample size and taking into account more number of landmarks like morphometric analysis of condyle, mandibular ramus, sigmoid notch depth, submandibular fossae depth etc., can be done for more precise results. More number of studies can also be done in 3-Dimensional imaging techniques like Cone Beam Computed Tomography (CBCT), contrast enhanced CBCT, TMJ tomography, TMJ views (Transcranial, Transorbital, Transpharyngeal) for more consistent results.

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Conflict of interest

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