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Short Communication

Morphological Changes and Gender-Based Differences in Human Dry Mandible

Madhu Deva S[1], Kowsheka V[2], Vennila G[3]

[1,2]First Year BDS Student, JKKN Dental College and Hospital, Namakkal Dist, Tamil Nadu, India.
[3]Senior Lecturer, Department of Anatomy, JKKN Dental College and Hospital, Namakkal Dist, Tamil Nadu, India.
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Corresponding Author:
Vennila G, JKKN Dental College and Hospital, Namakkal Dist, Tamil Nadu, India.
E-mail Id:
vennila.g1988@gmail.com
Orcid Id:
https://orcid.org/0009-0005-5147-3427
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A B S T R A C T

Introduction: The natural ageing process can cause changes in the teeth and gums, which can further impact the structure and function of the mandible. The major parts of a mandible are the condylar process, the angle of the mandible, and the mandibular canal. These anatomical structures play a key role in various branches of dentistry like orthodontics, prosthodontics, forensic dentistry, and maxillofacial surgery.

Methods: The present study included 100 dry adult human mandibles of known genders. We measured the condylar volume with a vernier calliper, the angle of the mandible with a protractor, and the length of the mandibular canal by passing a probe through the mandibular foramen to the mental foramen.

Results: We found that the angle of the mandible was higher in females, while the condylar volumes were greater in males. The length of the mandibular canal did not show much difference in the two genders. The mean value of mandibular canal length in adult females was greater than that of males, and the p value was greater than 0.05, making this difference statistically insignificant (p = 0.1318). There was no correlation between gender and mandibular canal.

Conclusion: The study showed that two parameters (condylar volume and angle of mandible) can undoubtedly be used for assessing sexual dimorphism and can also be an aid in various branches of dentistry with respect to diagnoses, treatment plans, executing surgeries, rehabilitation, and facial reconstructions.

Keywords: Mandible, Condylar Volume, Angle of Mandible, Mandibular Canal, Forensic Dentistry, Maxillofacial Surgeons

Introduction

The mandible, or lower jaw bone, is the largest and strongest bone in the human face. It is an essential component of the human skull and plays a vital role in functions such as eating, speaking, and facial expressions.[1] Like all bones in the human body, the mandible changes throughout a person's lifespan. During childhood and adolescence, the mandible undergoes significant growth and development, as it is involved in the process of tooth eruption and jaw growth.[2] As individuals age, the mandible undergoes a process known as bone resorption, which involves the breakdown and removal of old bone tissue. This can result in changes in the shape and structure of the jaw, including a decrease in the height and thickness of the mandible, which can contribute

to age-related changes in facial appearance. Additionally, the natural ageing process can also cause changes in the teeth and gums, which can further impact the structure and function of the mandible.[3] Overall, age-related changes in the mandible are a natural part of the ageing process and can have a significant impact on a person's overall health and well-being. The major parts of a mandible are the condylar process, the angle of the mandible and the mandibular canal. These anatomical structures play a key role in various branches of dentistry like orthodontics, prosthodontics, forensic dentistry, and maxillofacial surgery.[4]

These age-related changes in the mandible can have important implications for dentistry, particularly in terms of tooth alignment and dental occlusion.[5] One of the most significant changes that occur in the mandible with age is the resorption of the alveolar bone. This is the bone that supports the teeth in their sockets, and as we age, it tends to shrink and become less dense. This can lead to tooth mobility, shifting of teeth, and even tooth loss in severe cases.[6] Another age-related change in the mandible is the reduction of the height of the ramus, which is the part of the mandible that connects to the skull. This can affect the position of the condyle, which is the joint that connects the mandible to the skull, and can lead to changes in dental occlusion.[7] Additionally, the mandible tends to become more angular and prominent with age, particularly in males. This can lead to changes in facial appearance and may require orthodontic treatment to correct any resulting malocclusions. Hence dentists and orthodontists should be aware of these changes and should take them into account when developing treatment plans for their patients. The awareness regarding the anatomy of the mandible along with its variations in age, gender, and race will aid anthropologists, medico-legal authorities, surgeons, and physicians to accurately interpret the diagnostic procedures.

Materials and Methods

The study included 100 dry adult human mandibles of known genders (male: 54, female: 46) obtained from the Department of Anatomy, JKKN Dental College & Hospital. The study was approved by the Institutional Clinical Ethics Committee (JKKN/ICEC/04/2022). Condylar volume, angle of mandible, and length of the mandibular canal were measured using a vernier calliper, a protractor, and by passing a probe through the mandibular foramen to the mental foramen, respectively (Figure 1). Dry human mandibles with intact mandibular canals were selected for the study. It was made sure that the mandibles were clean and free from any debris. Overall, the process of measuring the length of the mandibular canal, mandibular angle and volume of the condylar process in a dry human mandible requires careful selection of specimens, accurate identification of landmarks, and precise measurements using appropriate tools.

The length, width, and height of the mandibular condyle were measured using a vernier calliper. The volume of the mandibular condyle was then calculated using the formula for the volume of an ellipsoid ($V = (4/3)\ \pi abc$). The dry human mandible was positioned on a flat surface and the angle formed by the ramus and the body of the mandible was measured using a protractor. Using a probe as a material, the distance between the mandibular foramen and the mental foramen was measured. This distance represents the length of the mandibular canal. The values from different measurements were recorded in a Microsoft Excel sheet, and the corresponding means and standard deviations were calculated. We compared the mean values of the results using the Student's t test and calculated the p value using an online p value calculator.

Results

We studied the volume of the condylar process, the angle of the mandible and the length of the mandibular canal and co-related these with the gender of the adult human dry mandible. We found that the angle of the mandible was higher in females and the condylar volumes were higher in males, whereas the length of the mandibular canal did not show much difference in genders. The mean value (Table 1) of mandibular angle was higher in females (males: 118.7 ± 11.6, females: 131.54 ± 11.1). The mean value of the condylar volume of the mandible (males: 1.8 ± 0.7, females: 1.4 ± 0.5) was higher in males (Table 2), with a p value = 0.0017. which indicates that features are sexually dimorphic. Finally, the mean value of mandibular canal length in adult females was greater than that in males and the p value was greater than 0.05, making this difference statistically insignificant (p = 0.1318). There was no correlation between gender and mandibular canal.

Table 1.Measurements of Condylar Volume, Angle of Mandible and Mandibular Canal (Mean ± Standard Deviation)

Condylar Volume (cm^3)				Mandibular Canal Length (cm)				Angle of Mandible (°)			
Male		Female		Male		Female		Male		Female	
Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
1.81 ± 0.6	1.83 ± 0.7	1.43 ± 0.5	1.47 ± 0.5	6.01 ± 0.7	6.01 ± 0.7	6.2 ± 0.6	6.2 ± 0.6	118.7 ± 11.6	118.7 ± 11.6	131.54 ± 11.1	131.54 ± 11.1

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Table 2.Mean and p Values of Condylar Volume, Angle of Mandible and Mandibular Canal

Parameter	Condylar Volume (cm^3)		Mandibular Canal Length (cm)		Angle of Mandible (°)	
Gender	Male	Female	Male	Female	Male	Female
Mean value	1.8 ± 0.7	1.4 ± 0.5	6.1 ± 0.7	6.2 ± 0.6	118.7 ± 11.6	131.54 ± 11.1
p value	0.0017		0.1318		0.0001	

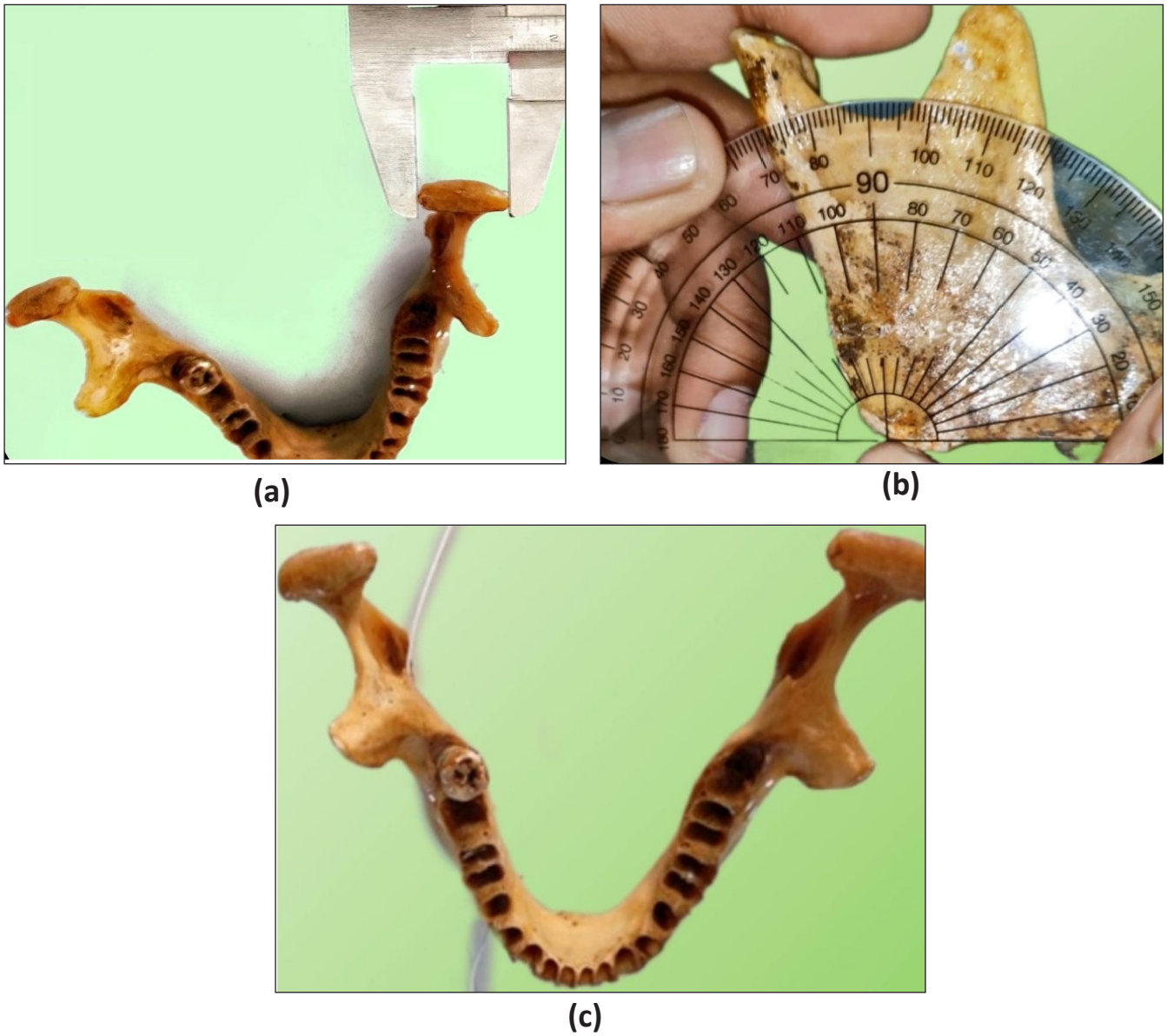

Figure 1.Tools Used to Measure Condylar Volume, Angle of Mandible and Mandibular Canal (a).Measurement of Mandibular Condyle Volume (b).Angle of Mandible Using a Protractor (c).Probe Passed Through the Mandibular Canal

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Discussion

The mandible, or lower jawbone, undergoes several age-related changes. These changes can affect the size, shape, and function of the mandible. During childhood and adolescence, the mandible grows and develops along with the rest of the facial skeleton.[8] This growth is influenced by a variety of factors, including genetics, nutrition, and hormones. As a person enters adulthood, the mandible reaches its full size and shape.[9] The mandible undergoes several changes with the age of a person. One of the most notable changes is bone loss, which can lead to a decrease in the height and width of the mandible. This can affect the appearance of the lower face and can also cause functional problems, such as difficulty chewing or speaking. Another age-related change in the mandible is the loss of teeth. Tooth loss may lead to a decrease in bone density of the condylar and alveolar process of jaw bones.[10] This can cause the mandible to shrink and can also lead to changes in the alignment of the remaining teeth.[11] In addition, the muscles and ligaments that attach to the mandible can also change with age. This can affect the movement and stability of the mandible and can lead to problems such as jaw pain or temporomandibular joint (TMJ) disorders.[12]

The information about morphological changes of condylar volume, angle of the mandible and length of the mandibular canal is useful for maxillofacial surgeons during reconstructive surgeries, forensic dentistry,[13] prosthodontics and prognathic treatments[14]. From the results of this study, it was seen that sexual dimorphism is associated mostly with condylar volume and angle of the mandible rather than the mandibular canal.[15]

There is a significant gender dimorphism in mandible size and shape. In general, male mandibles tend to be larger and more robust than female mandibles. This is due to differences in bone density, muscle attachment points, and hormonal influences during growth and development.[16] The male mandible has a larger condyle and coronoid process, which provides increased areas of attachment for powerful jaw muscles. The ramus of the male mandible tends to be broader and more angled than the female mandible, allowing for greater leverage and force during biting and chewing.[17] The female mandible, on the other hand, tends to be smaller and more delicate in shape. It is less angled and has a less pronounced chin. The female jaw is designed for more precise and controlled movements for tasks such as speaking and eating softer foods.[18] Overall, these differences in size and shape of the mandible reflect the biological and evolutionary roles that men and women historically played.

Conclusion

This study showed that the mean value of mandibular condyles is higher in males and the angle of the mandible is higher in females. There was no statistical significance between the genders regarding the length of the mandibular canal. It can be concluded that condylar volume and angle of mandible can undoubtedly be used for assessing sexual dimorphism and can also be an aid in various branches of dentistry with respect to diagnoses, treatment plans, executing surgeries, rehabilitation, and facial reconstructions. These parameters are widely used in forensic dentistry and they aid in the process of identifying individuals, estimating their age, determining ancestry or ethnicity, establishing the cause and manner of death, and providing valuable evidence in legal matters.

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Conflict of Interest: None

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