Gonial Angle as a Tool in Determination of Gender Using Orthopantomogram in South Indian Population.

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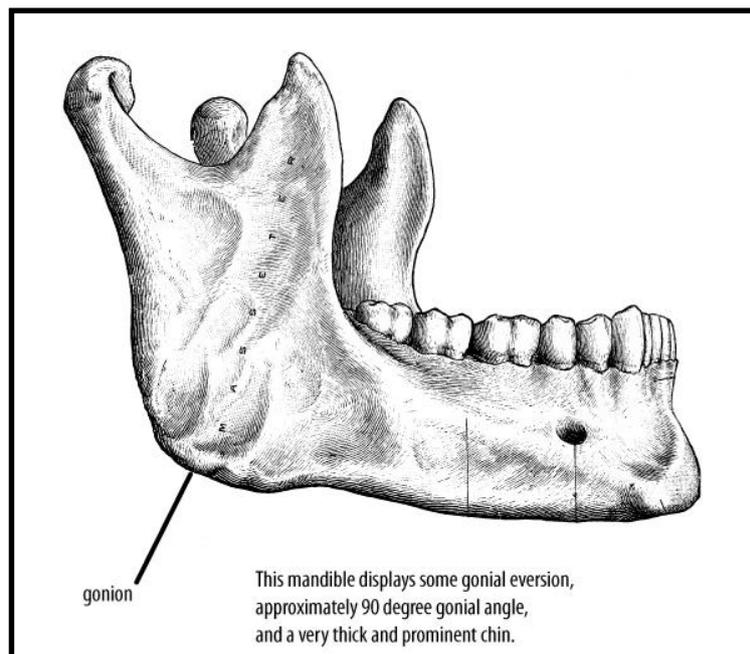
ABSTRACT

Introduction- The determination of sex from human remains has a crucial role in forensic anthropology. It has been known that the mandible has several useful traits for sex determination. The gonial angle, also referred to as the mandibular angle or angle of the mandible, is formed at the confluence of the posterior border of the ramus and the lower border of the mandible. This angle, subject to sexual dimorphism, manifests distinct variations between males and females. Typically, males exhibit a wider and more obtuse gonial angle, while females display a narrower and more acute angle. This inherent anatomical difference lays the foundation for gender determination when scrutinizing OPGs. Materials and Methods- 50 OPGs (25 males and 25 females) were analyzed, the value of the gonial angle was measured and then it was subjected to statistical analysis using SPSS software to determine gender. Results- The results were insignificant as the p value was p> 0.05. Discussion- Various parameters of the mandible have been successfully used to estimate sex of individuals. Conclusion- The gonial angle of the mandible is not a reliable marker of sex estimation..

Key Words: Gonial Angle, Gender Analysis, Radiographs, Tool Marker

INTRODUCTION

Sex estimation is one of the "big three" of human identification and is a vital aspect of the process of generating biological profiles of unknown deceased. Anthropometric and odontometric methods that utilize measurement of distances between certain landmarks are commonly employed to differentiate between the 2 sexes. (1) Sex identification from human remains has a fundamental requirement in anthropological, archeological, forensic and medico legal practice. Sex determination based on morphological criteria is significantly limited in the cases of juvenile remains and adult skeletons in a poor state of preservation. (2)The determination of gender, a fundamental aspect of human identification, plays a crucial role in various fields such as forensic anthropology, forensic medicine, and dental science.(3) Accurate gender determination is essential for solving crimes, identifying human remains, understanding population demographics, and providing personalized medical care. One method that has gained significance in recent years for gender determination is the analysis of the gonial angle, an anatomical feature found in the mandible. (4)

The utilization of the gonial angle, a crucial anatomical landmark found in the mandible, as a tool for determining gender through orthopantomogram (OPG) analysis in the South Indian population, is a subject of profound significance within the realms of forensic anthropology and dental medicine.(5)

gonion

This mandible displays some gonial eversion,
approximately 90 degree gonial angle,
and a very thick and prominent chin.

The mandible undergoes remodeling and morphological alterations throughout the life of an individual, and it is subjected to sex- and age-related structural changes. Personal identification from skeletal remains represents one of the most difficult challenges for a forensic anthropologist. (6) The study of mandibular morphology is an important aid in determining the sex and age of skeletal remains. It also has a strong structural framework and has been assessed to have several useful traits for sex determination. The forensic term for the midpoint of the mandibular angle is the gonion. This point is a cephalometric landmark located at the lowest, posterior, and lateral point on the angle, which is at the apex of the maximum curvature of the mandible, where the ascending ramus becomes the body of the mandible. The gonial angle, which is an important anthropological trait, is described as the posterior inferior angle region of the mandible as well as to the angle formed by a tangent to the lower border of the mandible and a tangent touching the posterior border of the ramus at two points, one at the condyle and one at the angle region. (7) This angle is also used for the defining of facial growth pattern with some other measures such as mandibular plane angle. Several traits of the mandible have been previously evaluated by forensic practitioners to identify sexual dimorphism with morphologic and metrical analyses. However, there are opposing approaches on the sexual dimorphism of the gonial angle in the literature, which contradict each other. One of the primary advantages of employing the gonial angle for gender determination lies in its non-invasive nature, rendering it particularly valuable in forensic contexts where the preservation of human remains is of paramount importance. (8) Moreover, OPGs are readily obtainable in dental clinics and hospitals, adding to the convenience of this resource for researchers and forensic experts. There are also some other studies asserting that it cannot be employed in sex determination. (9) Orthopantomogram, colloquially known as a panoramic X-ray, stands as a pivotal diagnostic instrument in dentistry. It offers a panoramic view of the oral and maxillofacial structures, including the mandible, which plays a pivotal role in gender determination. In South India, as in many regions globally, there exists a growing need for accurate gender identification methods, particularly in forensic investigations and anthropological research.(10) However, it is imperative to underscore that the gonial angle should not be utilized in isolation for gender determination. Gender identification is a multifaceted process that necessitates the consideration of multiple factors, encompassing cranial and dental features, along with the gonial angle. Therefore, the gonial angle should be employed in conjunction with other techniques and assessments to yield the most precise and reliable results.

Generally, the male mandible tends to be larger and more robust than the female mandible. This size difference is influenced by the effects of testosterone, which leads to increased bone density and muscle attachment areas. In contrast, the female mandible is typically smaller and more delicate in comparison to the male. This difference in size is a result of the lower levels of testosterone during development. (11)

Males often exhibit a more prominent and square-shaped mandible. The angles of the mandible, known as the gonial angles, are typically more obtuse in males. Female mandibles, on the other hand, tend to be more rounded and less prominent. The gonial angles are usually more acute in females, contributing to a softer appearance. (12)

The importance of this methodology extends beyond the realm of forensic anthropology. In the context of dental medicine,

understanding sexual dimorphism is pivotal for treatment planning. Dentists in South India often find themselves in situations where knowledge of a patient's gender can influence the choice of treatment and prosthetic interventions. The gonial angle, as a diagnostic tool, empowers dental professionals in making informed decisions that cater to the specific needs of the patient.

Materials and Methods

The current study was conducted in the Department of Forensic Odontology, Saveetha Dental College and Hospitals Chennai. The OPG samples were collected from the Department of Oral Medicine and Radiology. Total 50 samples were collected which included 25 males and 25 females in the age group of 25-30 years. The mandibular gonial angle was calculated with the help of PLANMECA software and the values were recorded. The statistical analysis and t-test of the recorded values was done with the help of SPSS software v2.0. The inclusion criteria was selected for the study and OPGs with proper mandibular ossification without any demineralisation were selected and measurements were taken. The dislocated mandible were excluded keeping in mind the osteoclastic activity of the body and ramus. The results were evaluated.

Results

The study included 50 samples out of which there were 25 Females and 25 Males aged between 25-30 years. Independent t-test was conducted with the help of SPSS software. The mean and standard deviation for the entire sample size was found to be 77.15±7.42mm. The p value was found to be 0.484 which means there was no significant difference between the Gonial angle between males and females (p<0.05). The mean and standard deviation values for ramus height for males was 76.63e±6.10mm and that for females was 67.95±4.78mm [Table 1]. The standard error mean for males was 0.133 and that for females was 0.028 [Table 2]. Anova test was also conducted and the paired differences between the males and females were 37.814±9.06mm with p value 0.539 which shows no significant difference between the right Gonial angle of males and females [Table 3].

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MaleR	76.6333	30	6.10231	1.11412
	MaleL	76.3467	30	7.05861	1.28872
Pair 2	FemaleR	67.9567	30	4.78184	.87304
	FemaleL	68.8667	30	5.08034	.92754

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	MaleR & MaleL	30	.133	.484
Pair 2	FemaleR & FemaleL	30	-.028	.883

Table 1 and Table 2: Results of Paired T test to determine correlation between Gonial angle and Sex.

ANOVA

MaleR

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1058.782	28	37.814	1.790	.539
Within Groups	21.125	1	21.125		
Total	1079.907	29			

Table 3:Showing the results of One-Way Anova for females. A p value of p> 0.05 shows statistical insignificance.

ANOVA

FemaleR

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	632.694	28	22.596	.743	.744
Within Groups	30.420	1	30.420		
Total	663.114	29			

Table 4: Showing the results of One-Way Anova for females. A p value of p> 0.05 shows statistical insignificance.

Discussion

The mandible is the largest and hardest facial bone and retains its shape better than other bones in the forensic and physical anthropological field. It is relatively resistant to decay and thus it can be used to distinguish among ethnic groups and between sexes. Previous study by Ramneet et al., 2021, (13) showed the use of using the ramus height to determine the sex of 150 individuals, and found that females had a significantly lower ramus height as compared to males. Studies by Arumugam et al., 2020 (14) used the basal bone height of the mandible to determine age and sex, they had a p value of 0.89 which suggested statistical insignificance and thus meant that basal bone height is not a reliable marker for gender determination. Studies by Tanya et al., 2017,(15) used intraclass correlation coefficient (ICC) analysis CT scans of 478 mandibles for estimating gender, their also did statistical analysis using one way ANOVA and obtained a statistically significant result (p value: 0.021) thus concluding that ICC be used to determine gender.(16) Joana et al., 2021(17) used CBCT to analyze 200 mandibles in the Portuguese population for accurate determination of gender. The results showed that bigonial width was 87% accurate in estimating the gender in the Portuguese population. In another study by Kyung et al., 2006, (18) they stated that the contour of the lower border of the mandible can conclusively differentiate between sexes in the Korean population. a p-value of 0.032 shows a significant correlation between gender and contour of the lower border of the mandible.(19) Males have a relatively blunt curvature of the lower border whereas Females have a sharper contour. Another study by Arumugam et al., 2021 (20) used mandibular ramus flexure to estimate the sex of individuals using Orthopantomogram and Lateral Cephalogram.(21)

Limitations

The sample size of the study was less. A higher sample size may yield a more significant result.Variations in genetics, diet, and lifestyle can influence the gonial angle to some extent.

Conclusion

The utilization of the gonial angle as a tool for gender determination through orthopantomogram analysis in the South Indian population holds immense potential. Its non-invasive nature, ease of measurement, and accessibility make it a valuable resource in forensic anthropology, population studies, dental medicine, and anthropological research. However, it is crucial to approach its application with a thorough understanding of its limitations and to consider it as part of a comprehensive analysis that includes other gender determination techniques. As research and validation studies continue to refine and enhance this method within the South Indian context, the gonial angle's role in gender determination is expected to become even more reliable and valuable in the future..

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