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Sexual Dimorphism in Mandibular Ramus of South Indian Population

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Abstract

Background: The determination of sex and estimation of stature are among the important aspect of forensic anthropology and vital in medico-legal investigations. Aim: The purpose of the present study is to analysis of sexual dimorphism in the mandible of South Indian origin. Materials and Methods: A total of 60 male and 60 female adult dry mandibles were evaluated .Six parameters were taken into considerations, the values were measured and data recorded. Statistical Analysis was done using SPSS software. Results: The present study showed that one of the parameter analyzed, superior-inferior height (right side) was found to be significantly different among males and females. Conclusion: We conclude that the mandible can be a very useful tool for sex determination in this population after a comprehensive study has been undertaken.

Key words: Forensic Anthropology, Population Data, forensic dentistry, Forensic anthropology, Mandible

Introduction

Determination of sex by morphological assessment has been one of the oldest approaches in forensic anthropology and medico-legal examinations. The method may vary and depend upon the available bones and their conditions. The identification of sex is of significance in cases of mass fatality incidents where bodies are damaged beyond recognition.

When entire adult skeleton is available for analysis, sex can be determined up to 100% accuracy (Pelvis). But in cases of mass disasters where usually fragmented bones are found, sex determination with 100% accuracy is not possible and it depends largely on the available parts of skeleton.

Skull is the most dimorphic and easily sexed portion of skeleton after pelvis. But in cases where intact skull is

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not found, mandible may play a vital role in sex determination, as it is the most dimorphic bone of skull. Anthropometry of the face and intraoral regions can help in the field of forensic odontology when common forensic data are unavailable [1].

'Sexual dimorphism' refers to those differences in size, stature and appearance between male and female that can be applied to dental identification because no two mouths are alike [2].

The mandible is the largest and hardest facial bone and retains its shape better than other bones in the forensic and physical anthropologic field. The mandible can be used to distinguish among ethnic groups and between sexes.

Mandibular ramus can differentiate between sexes, as the stages of mandibular development, growth rates, and duration are distinctly different in both sexes. In addition, masticatory forces exerted are different for males and females, which influences the shape of the mandibular ramus.

In study done by Saini et al, Coronoid height was the single best parameter providing an accuracy of 74.1% [3].

Study done by Steyn et al showed bigonial breadth was the most dimorphic of the measurements taken [4].

No significant difference was observed in mandibular angle in sex determination in the young Lebanese population (83 young individuals - 40 males and 43 females) aged between 17 and 26 years [5].

Various parameters have been used for sexing the mandible. Studies done by Loth et al, on their nonmetric examination on South African sub adult samples claimed that, shape differences in the symphyseal region and anterior body of the mandible can be used to predict sex with above 80% accuracy. In a blind test of that technique, however, Scheuer showed that when applied to different population samples, sex classification accuracy declined considerably to 64%. The most accurate single indicators among cranial methods were the robustness of the mandible with accuracy of 70.93% [6].

Many variables showed significant differences which includes: bicondylar breadth, gonial angle and minimum ramus breadth according to study done by Kharoshah et al [7].

In recent years, geometric morphometric methods have become increasingly common for studying human skeletal biology in both physical, and of late forensic anthropology. These methods have been used to a greater extent because they are versatile and allow detailed assessment of differences among specimens.

Loth and Henneberg described a single morphological indicator of sexual dimorphism, namely the presence or absence of flexure on the posterior border of the mandible with a predictive accuracy of 90.6 to 99.0% [8].

In the other studies, which have criticized mandibular ramus flexure as sex indicator in adult and fossils specimens by the same method, the accuracy of sexing was found between 59.0% and 80.4% which is well below the reported 90.6 to 99.0%.

Size alone is not the best indicator of sex. This study presents, a new morphologic indicator of sexual dimorphism in the human mandible.

Materials

The present study examines 120 adult mandibles (60 males and 60 females) from south Indian population selected from the Saveetha Dental and Saveetha Medical College, Saveetha University, Chennai. Proposed study was presented before Saveetha Review Board (SRB) the Ethical clearance was obtained. The entire sample comprises "known individuals"; thus, the sex, local population, and a statement of age are documented for each specimen [9 and 10].

Inclusion criteria:

- Presence of bilateral molar teeth
- Alveolar socket prominent

Exclusion criteria:

- Any Pathosis of mandible
- Fractured or deformed mandible

Methodology:

Using the divider the following parameters were measured.

- Vertical distance (internal surface of mandible) was taken from the middle of sigmoid notch to the angle of mandible.
- Anterior posterior distance from anterior border of ramus to posterior border of ramus (at level of occlusal plane).
- The distance from the mandibular foramen to the superior border, the anterior border, the posterior border and inferior border were measured.
- Also the supero-inferior and antero-posterior diameter of the foramen was measured.

The divider points were applied to the points of measurement. Then divider was held against the Digital Vernier caliper and the readings were noted. To minimize the observer error all the measurements were taken with digital vernier calipers (0.01 mm precision) three times and the average values were utilized for the analysis.

One person recorded all the measurements and all values were rounded to two decimal places. In order to assess the reliability of the measurements, intra-observer error was tested. The same measurements were obtained from the specimens at a different time by the same author to assess intra-observer error.

Another observer measured the same randomly selected teeth in order to test the inter-observer error. Their measurements were analyzed using Student's t-test. There was no statistically significant difference between the findings of the two observers. All measurements were recorded in a tabulated manner and statistically analyzed.

Statistical Analysis

Statistically significant sexual dimorphisms in male and female odontometric features were tested by the unpaired t-test.

Discussion

Thus among the parameters analyzed the supero-inferior length (right side) was found to be significantly different among males and females. The supero-inferior length from the deepest portion sigmoid notch to the angle of mandible can be used as an alternative method in differentiating the sexes in case of medico-legal investigations. This pilot study on mandibles from the Indian population clearly indicates that the ramus part of mandible has satisfactory potential for determination of sex. It can especially be used for forensic cases where damaged and partially preserved mandibles are frequently found.Most dimorphic regions of the mandible were the condyle and ramus, and to a lesser extent the lateral body. The etiology of such variation is likely attributable to differential growth trajectories and functional adaptations [11,12 and 13]. Larger samples and populations from more diverse geographic regions should be analyzed which would enhance the reliability of this parameter.

References

[1] Acharya AB, Sivapasundaram B. Forensic Odontology. In: Rajendran R, Sivapasundaram B. (Eds). Shafer's Textbook of Oral Pathology. 5th Ed. Elsevier: New Delhi; 2006. 1199-1227

[2] Kieser JA. Human adult odontometrics. In: The study of variation in adult tooth size. Cambridge University Press, 1990.

[3] Vineeta Saini M. Sc., Rashmi Srivastava, Rajesh K. Rai, Satya N. Shamal, Tej B. Singh, Sunil K. Tripathi. Mandibular Ramus: An Indicator for Sex in Fragmentary Mandible. Journal of Forensic Sciences Volume 56: pages S13–S16; January 2011

[4] Steyn M, Ican MY. Sexual dimorphism in the crania and mandibles of South African whites. Forensic Sci Int. 1998 Nov 30; 98(1-2): 9-16.

[5] Ayoub F, Rizk A, Yehya M, Cassia A, Chartouni S, Atiyeh F, Majzoub Z. Sexual dimorphism of mandibular angle in a Lebanese sample. J. Forensic Leg Med. 2009 Apr; 16(3): 121-4.

[6] Duric, M.; Rakocevic, Z. and Donic, D. (2005): "The reliability of sex determination of skeletons from forensic context in the Balkans". Forensic Sci. Int., 147: 159- 164.

[7] Kharoshah MA, Al Madani OM, Galeb SS, Zaki MK, Abdel Fattah YA. Sexual dimorphism of the mandible in a modern Egyptian population. J Forensic Leg Med May 2010; 17(4): 213e5.

[8] Loth SR, Henneberg M. Sexually dimorphic mandibular morphology in the first few years of life. Am J Phys Anthropol 2001; 115:179–86.

[9] Tobias PV. (1987). Memories of Robert James Terry (1871–1966) and the genesis of the Terry and Dart collections of human skeletons. Adler Mus. Bull. 13, 31–34.

[10] Tobias P.V. (1991). On the scientific, medical, dental and educational value of collections of human skeletons. Int. J. Anthropol. 6, 277–280.

[11] Enlow D.H. and Hans M.G. (1996). Essentials of Facial Growth. W.B. Saunders, New York.

[12] O'Higgins P., Johnson D.R., Moore W.J. and Flinn R.M. (1990) The variability of patterns of sexual dimorphism in the hominoid skull. Experientia 46, 670–672.

[13] Bulygina E., Mitteroecker P. and Aiello L. (2006). Ontogeny of facial dimorphism and patterns of individual development within one human population. Am. J. Phys. Anthropol. 131, 432–443.

Table 1: Mean Value (Anterior-Posterior Diameter)(mm)

Sex	Number of Samples	Right Side (mm) ±SD	Left Side (mm) ±SD
Male	60	4.478±1.36	4.331±0.86
Female	60	4.037±0.71	4.156±0.607
Total	120	4.243	4.198

Table 2: Mean Value (Superior-Inferior Diameter)(mm)

Sex	Number of Samples	Right Side (mm) ±SD	Left Side (mm) ±SD
Male	60	5.530±1.24	5.590±0.93
Female	60	5.141±0.83	5.230±0.75
Total	120	5.350	5.368

Table 3: Mean Value (Anterior-Posterior Distance)(mm) (mm)

Sex	Number of Samples	Anterior Distance (AO) (mm) ± SD		Posterior Distance (OB) (mm) ± SD		AO+OB (mm)	
Male	60	R	L	R	L	R	L
		17.39 ± 2.22	18.17 ± 2.37	16.70 ± 2.60	16.38 ± 2.11	34.52	34.58
Female	60	R	L	R	L	R	L
		18.48 ± 1.94	18.25 ± 1.98	16.72 ± 2.06	16.26 ± 2.03	35.37	34.43
Total	120	17.99	18.25	16.96	16.26	34.95	34.51

Table 4: Mean Value (Superior-Inferior Distance)(mm)

Sex	Number of Samples	Superior Distance (OC) (mm) ± SD		Inferior Distance (OD) (mm) ± SD		OC+OD (Mm) ± SD	
Male	60	R	L	R	L	R	L
		17.31± 2.33	18.12± 2.19	30.82± 4.73	28.74± 4.49	48.14± 5.74	46.86± 5.30
Female	60	R	L	R	L	R	L
		16.29± 2.32	17.02± 2.24	28.20± 2.97	27.74± 3.32	44.51± 3.28	44.76± 3.79
Total	120	16.87	17.62	28.98	27.88	45.75	45.50

Table 5: Statistical Analysis

	Male	**Female**
Sample size	60	60
Arithmetic mean	48.1283	43.3720
95% CI for the mean	47.6716 to 48.5851	42.6288 to 44.1152
Variance	1.4963	3.9610
Standard deviation	1.2232	1.9902
Standard error of mean	0.2233	0.3634

$p \leq 0.05$