

Morphometric significance of maxillary arch in sexual dimorphism in North Indian population

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Introduction

Sex determination plays a major role in forensic investigations in identifying the number of missing persons in unknown skeletal remains. Depending on available bones and their condition, a number of methods

with different reliability are available for the identification of unknown remains.

DNA analysis is the most accurate method for sex determination, but due to various reasons, it is difficult to be

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Abstract

Background: Tooth is the hardest and chemically (except mineral contents) the most stable structure in the body, which makes teeth as the first-rate material for genetic and forensic investigations. Sex determination of skeletal remains forms an important part of archaeological and medicolegal examinations. Hence, the aim of the present study was to analyse the morphometric and dimensional variation between male and female in north Indian population using maxillary arch parameters. **Materials and Methods:** Fifty male and fifty female patients of age group 18–35 years were randomly selected after taking detail history. All maxillary impressions were made with alginate and poured in type III dental stone. These casts were measured for maxillary inter-canine width, maxillary first inter-premolar width, anteroposterior palatal width and palatal depth using a digital vernier caliper and findings were correlated with sexual dimorphism. **Results:** The maxillary inter-canine width, maxillary first inter-premolar width, and palatal depth showed a significant difference with $P < 0.05$ between the means of two populations. Anteroposterior palatal width showed the comparatively less significant difference between two populations. **Conclusion:** Among north Indian population, maxillary inter-canine width, maxillary first inter-premolar width, and palatal depth can be used for sex assessment. The anteroposterior palatal width parameter is comparatively less significant in sex determination.

Key words: Anteroposterior palatal width, inter-canine width, inter-premolar width, palatal depth, sexual dimorphism

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used in the Indian set up. The most effective and commonly used method for the identification of living as well as dead person is the odontometric analysis of teeth because tooth is the hardest, readily accessible for examination and the most stable structure to disintegrate.^[1]

A significant variation in the harmony of tooth size ratio leads to malocclusion and difficulties in obtaining an occlusion with optimal overjet and overbite.^[2] Overall, this difference in size, stature, and appearance between males and females can be applied to dental tissues to differentiate sex.^[1,3] Mandibular canine index (MCI) is the ratio between the mesiodistal width of lower canine and inter-canine arch width. It is a quick, reliable, and easy method for sexual identification and showed sexual dimorphism by both the right and left MCI (RMCI and LMCI) with greater significance in identifying females using RMCI.^[4]

In an ethnic group, larger tooth crown size is observed in males as compared to females because of a longer period of amelogenesis for both deciduous and permanent dentitions in males.^[5]

The nonmetric dental traits, like Carabelli's trait of upper molars and shoveling of the upper central incisors, are the dental features that can be used for sex determination.^[6]

Although the studies have been conducted in the past regarding sexual dimorphism with various oral parameters, scarcity of literature still exists on documentation of role of maxillary arch parameters in sexual differentiation. Hence, the study had been planned to correlate sexual dimorphism with maxillary inter-canine width, maxillary first inter-premolar width, anteroposterior palatal width and palatal depth measurements.

Materials and Methods

Approval from Institutional Ethical Committee was obtained before conducting the study. The present study comprised 100 individuals (50 males and 50 females) selected with simple randomization technique, from the department of dental wing of Government Hospital, Haryana, India, based on following inclusion and exclusion criteria.

Inclusion criteria

1. Age: 18–35 years
2. Complete set of fully erupted, nonattrited intact teeth
3. Periodontally healthy and noncarious teeth
4. Teeth without any malocclusion
5. No history or clinical evidence of crown restoration, orthodontic treatment, trauma
6. No history of any teeth extraction.

Exclusion criteria

1. Unerupted or partially erupted teeth

2. Teeth with any prosthetic replacement
3. Attrited, abraded, and carious teeth.

After detail history and informed consent, full-arch maxillary impressions were made with alginate, (Zalgran™, Kalabhai, Mumbai, India), an irreversible hydrocolloid impression material, using perforated metal trays and poured with type III dental stone (Kalstone™, Kalabhai, Mumbai, India). These poured maxillary casts were measured for the following parameters using a digital vernier caliper (Baker, India) with 0.01 calibration:

1. Maxillary inter-canine width [Figure 1]
2. Maxillary first inter-premolar width [Figure 2]
3. Antero-posterior palatal width [Figure 3]
4. Palatal depth [Figure 4].

The obtained readings were subjected to statistical analysis using SPSS statistics version 20 (IBM, USA). A two-sample *t*-test was used to analyze the statistical difference between means. Sexual dimorphism was calculated using a formula given by Garn and Lewis^[4] as mentioned below.

$$\text{Sexual dimorphism} = \left(\frac{x_m}{x_y} - 1 \right) \times 100.$$

x_m = mean value for males; x_y = mean value for females.

Results

The poured maxillary casts were measured for maxillary inter-canine width, maxillary first inter-premolar width, anteroposterior palatal width and palatal depth using a digital vernier caliper with 0.01 calibration and the results obtained are mentioned below.

The mean maxillary inter-canine width was higher in males than females, even though the standard deviation was lower in females as compared to males. The maxillary inter-canine width of males and females showed a significant difference in the means of the two populations [Table 1].



Figure 1: Measurement of maxillary inter-canine width

The mean maxillary first inter-premolar width of males was higher than females. The standard deviation in inter-premolar width was higher for female subjects as compared to male subjects. Maxillary first inter-premolar

width of males and females showed a significant difference in the means of the two populations [Table 2].

The mean anteroposterior width of males was not significantly different than females, and the standard deviation was found to be same for both male and female subjects. The anteroposterior palatal width of males and females showed the comparatively less significant difference in the means of the two populations [Table 3].

The mean palatal width of the male subjects was higher than female subjects, even though the standard deviation was lower for female subjects as compared to male subjects. The means for the palatal depth of male and female showed high significant difference in the two populations [Table 4].

The Maxillary inter-canine width of male and female population showed sexual dimorphism of 3.18. The maxillary first inter-premolar width of male and female population showed sexual dimorphism of 3.64. The maxillary inter-canine width and maxillary first inter-premolar width showed a small amount of sexual dimorphism. The anteroposterior palatal width showed negative sexual dimorphism (-0.4), which means that it does not contribute to sexual dimorphism.

Palatal depth has a high positive value of sexual dimorphism (10.62) between males and females. Thus it can contribute to sexual dimorphism [Table 5].



Figure 2: Measurement of maxillary first inter-premolar width



Figure 3: Measurement of anteroposterior palatal width



Figure 4: Measurement of palatal depth

Table 1: Comparison of mean values of maxillary inter-canine width in males and females

Individual	Mean±SD	t statistics	P	Significance
Male	38.2546±2.38	2.659	0.011*	Significant
Female	37.0668±1.76			

*P<0.05: Significant, SD: Standard deviation

Table 2: Comparison of mean values of maxillary first inter-premolar width in males and females

Individual	Mean±SD	t statistics	P	Significance
Male	35.8434±1.98	2.74	0.009*	Significant
Female	34.5844±2.19			

*P<0.05: Significant, SD: Standard deviation

Table 3: Comparison of mean values of anteroposterior width in males and females

Individual	Mean±SD	t statistics	P	Significance
Male	37.1726±2.28	2.609	0.012*	Significant
Female	37.3174±2.28			

*P<0.05: Significant, SD: Standard deviation

Table 4: Comparison of mean values of palatal width in males and females

Individual	Mean±SD	t statistics	P	Significance
Male	22.0852±2.48	5.315	0.001*	Highly significant
Female	19.9644±1.60			

*P<0.05: Significant, SD: Standard deviation

Table 5: Different parameters showing sexual dimorphism

Parameters	Sexual dimorphism
Maxillary inter-canine width	3.18
Maxillary first inter-premolar width	3.64
Anteroposterior palatal width	-0.4

Discussion

Individual identification sex determination is an important parameter in forensic practice in case of mass disasters. The accuracy of sex determination using body parameters such as craniofacial morphology and measurements on the pubis ranges from 96% to 100%.^[7]

In individual and sex identification, DNA profile gives accurate results. Linear dimensions used in anthropometric or odontometric, can be used for sex determination because of their simplicity, reliability, and inexpensiveness. In young individuals, teeth complete development before skeletal maturation, thus dentition can be used as a useful indicator for sex determination.^[8,9]

Filipovic G *et al.* conducted a study on 200 Serbian subjects and revealed that there are significant differences between the sexes in canine dimorphism.^[10]

According to Rastogi *et al.*, mandibular canine width, MCI, mandibular premolar arch width, mandibular molar arch width, premolar index, and molar index show a significant difference ($P < 0.001$) between males and females.^[11]

Doris *et al.* concluded that the early permanent dentitions provide the best sample for tooth size measurements as it is less mutilated and attrited, hence 18–35 years age group individuals were included in the present study.^[12]

In 300 healthy adult controls, Shastry SP *et al.* observed that mandibular canine width in males was significantly higher as compared to females. The mesiodistal widths of all the canines were significantly higher in males than in females. Both maxillary right as well as left canine index was significantly higher in males than the females. Statistically significant difference between male and female subjects was not observed pertaining to maxillary canine width and MCI. Sexual dimorphism was exhibited by two teeth, i.e., maxillary right canine and maxillary left canine.^[13]

In the present study, totally 100 individuals were selected according to the inclusion and exclusion criteria set forth at the beginning of the study. After a detail history and informed consent, full-arch maxillary impressions were made with irreversible hydrocolloid material and poured in type III dental stone. These poured casts were measured for maxillary inter-canine width, maxillary first interpremolar

width, anteroposterior palatal width and palatal depth using digital vernier caliper with 0.01 calibrations.

These measurements were statistically evaluated, and significant dimorphism was observed between mean values of maxillary inter-canine width, maxillary first inter-premolar width, and palatal depth. The mean values for anteroposterior palatal width were comparatively less significant between males and females.

MCI can only be used as a supplemental tool along with other parameters because the accuracy of MCI in the identification of sex has never exceeded 87.5%.^[4] In this study, the means for the palatal depth of male and female showed highly significant difference in the two populations and had a high positive value of sexual dimorphism (10.62) between males and females. Hence, it can be used as a tool for sex determination.

Conclusion

The present study concludes that sexual dimorphism is population specific. Among north Indian population, the maxillary inter-canine width, maxillary first inter-premolar width, and palatal depth can aid in sex determination. The anteroposterior palatal width parameter between males and females was not statistically very significant.

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Conflicts of interest

There are no conflicts of interest.

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