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Sex determination using mesiodistal width of permanent maxillary molar

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Abstract

Background: Teeth are valuable material for forensic investigations since they are the strong and stable human tissue that is resistant to physical damage. Sex determination, which is usually the first stage in the human identification process, is one of the essential criteria of biological identity.

Objectives: To evaluate the potential of mesiodistal width of permanent maxillary molar in sex determination.

Methods: This analytical cross-sectional study was done in 120 dental casts prepared for different dental treatment purposes in Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu, Nepal from 5th October, 2021 to 5th November, 2021. Convenience sampling technique was used. The mesiodistal dimension of the permanent maxillary molar was measured with the help of a digital vernier caliper (Digimatic Eco, Precise, India). The data were entered in a Microsoft Excel sheet and analysed statistically using Statistical Package for Social Sciences Statistics Version 21.

Results: The mean age of the patients was 21.05 ± 5.64 years. The mesiodistal dimension of maxillary first molar in males and females were not statistically significant on both the right and the left sides of the jaw. The sexual dimorphism percentage was 0.893% and 0.606% in right and left maxillary first molar respectively. Similarly, the frequency was 0.018 and 0.267 in right and left maxillary first molar respectively.

Conclusion: Mesiodistal dimension of maxillary first molar did not significantly differ between the right and left sides of the jaw. This study could not establish sexual dimorphism among the right and left sides of the jaw.

Key words: Forensic dentistry; Mesiodistal width; Morphometry; Nepal; Sexual dimorphism.

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INTRODUCTION

The structural morphology of male and female teeth is identical. However, cultural, environmental, ethnic, and genetic factors may influence sexual dimorphism in tooth size.[1] Physical structures, shape, and size inherited in genetic material of either sexual pattern make up this category. Sexual dimorphism in skeletal bones, particularly teeth, has been documented in numerous research.[2-4]

Teeth are the most enduring structures in the human body, withstanding bacterial deterioration and fire. These characteristics make them suitable for studies of fossils and evolution, as well as human identification.[5]

The comparison of metric and non-metric characters is used to determine sex of an individual using dental traits.[6] One of the well-established ways of sex determination is the metric examination of teeth. The maxillary first molar is a suitable tooth since it is early in eruption and less impacted than the other teeth in the jaw.[7]

The aim of this study was to establish normative data for the mesiodistal dimensions of teeth and to analyse if maxillary first molar can be used in sex determination in the Nepali population. The practical application was to identify the sex of an individual if the teeth, particularly the molars, are the only structures available to identify skeletal remains.

METHODOLOGY

This was an analytical cross-sectional study conducted in the Department of Oral Pathology and Forensic Dentistry of Tribhuvan University Teaching Hospital from 5th October, 2021 to 5th November, 2021. The ethical clearance was taken prior to the study from the Institutional Review Committee of the Institute of Medicine [Ref. 138(6-11) E²078/079]. Non-probability sampling method (convenience sampling) was used for the study. The sample size was calculated in reference to the study done in Nepali students by Shrestha et al.[8] using formula $n = 2\ sd^2(Z_{1-\alpha/2} + Z_1\text{-}_\beta)^2/(m_1\text{-}m_2)$. The calculated sample size was 60 for each sex.

This study was carried out in dental casts prepared for different dental treatment purposes in Tribhuvan University Teaching Hospital. Only the dental casts with morphologically well-formed and fully erupted maxillary first molars were included in the study. The dental casts with caries, restoration, rotation, missing, and impacted maxillary first molars were excluded from the study.

Mesiodistal (MD) dimension was measured using Digital Vernier Caliper (Digimatic Eco, Precise, India). The maximum MD width was measured three times and the average was taken. Data obtained were transferred to a Microsoft Excel sheet. The data were verified and analysed statistically using IBM Statistical Package for Social Sciences (SPSS) Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y., USA) with a confidence level set at 95% (p-value <0.05) to test for significance. The descriptive and inferential statistics were done. Garn and Lens formula was used to calculate sexual dimorphism as follows:[9]

Sexual Dimorphism = $[X_m/X_f] - 1 \times 100$
Where: X_m = Mean value for males; X_f = Mean value for females.

RESULTS

The mean age of the patients was 21.05 ± 5.64 years. The mean age of males and females were 20.90 ± 5.41 years and 21.20 ± 5.91 years respectively. Statistical t-test showed that the mesiodistal dimensions of maxillary first molar in males and females were not statistically significant on both the right (p = 2.73) and the left sides (p = 4.92) of the jaw (Table 1). Levene's test for equality of variances showed significance of 0.893% and 0.606% in right and left maxillary first molar respectively. Similarly, the frequency was 0.018 and 0.267 in right and left maxillary first molar respectively. The right side was found to have more sexual dimorphism compared to the left side (Table 2).

Table 1: Mesiodistal width of the maxillary molar in both the sexes

Mesiodistal width	Sex	N	Mean ± Standard Deviation	p-value
MD right 1st molar	Male	60	9.909 ± 0.516	2.73
	Female	60	9.719 ± 0.520	
MD left 1st molar	Male	60	9.914 ± 0.507	4.92
	Female	60	9.756 ± 0.489	

Table 2: Percentages of sexual dimorphism of maxillary first molar

Mesiodistal width	Sex	N	Frequency	Percentage
MD right 1st molar	Male	60	0.018	0.893%
	Female	60		
MD left 1st molar	Male	60	0.267	0.606%
	Female	60		

DISCUSSION

Sexual dimorphism refers to differences in traits between sexes of the same species that are thought to have evolved. One of the earliest and most important tasks in identifying an individual's identity is determining sex. Variables such as craniofacial morphology and pubis measurements have been used with high accuracy for sex determination over the years.

The number of missing people is cut in half when sex determination is done during mass fatalities.[10] Among the various skeletons, teeth are the hardest structure and resist decomposition and high temperature changes.[11] Also because most teeth develop before skeletal maturation, dentition is a useful age and sex indicator, especially in young people. As a result, they are frequently used in the comparative identification of human remains.[12,13]

The comparison of metric and non-metric characters is used to determine sex using dental traits. Comparing tooth dimensions in males and females is part of the metric analysis. The non-metric comprises of comparison of frequencies of dental traits like the upper first molar's cusp of Carabelli's trait, the lower first molar's deflecting wrinkles, the upper and lower canines' distal accessory ridges, or the upper central incisors' shoveling.[6]

The mean mesiodistal dimension of both right and left sides permanent maxillary first molar in this study was greater in males compared to females. However, the difference was not statistically significant. This finding coincides with the study done by Deo et al.[14] in the Nigerian population and Babu et al.[15] in the Indian population. Both the studies reported very minimal difference in mesiodistal width which was statistically nonsignificant. This finding contradicts the study done by Lakhanpal et al. in the Indian population who reported that maxillary first molar demonstrates sexual dimorphism.[16]

The mesiodistal width of the first molar in this study coincided with the study done by Soundarya et al. with the mean value of 9.13 mm and 9.02 mm in males and females respectively.[17] This finding contradicts the study done by Acharya and Mainali in the Nepali population itself which demonstrates maxillary first molar to have larger dimensions both in males and females with mean values of 10.54 mm and 10.36 mm respectively.[18] The mesiodistal width of the present study sample coincided with the mesiodistal width of females of other population samples: Ohio America (9.81 mm) and Jordan (9.7 mm).[19,20] On the contrary, the males of Ohio America, and Jordan tend to have larger teeth with mean values of 10.17 mm and 10 mm respectively.[19] The mesiodistal diameter of other population ranged from 10-11 mm. However, the mesiodistal dimensions in western Australia were 10.97 mm (male) and 10.73 mm (female) respectively.[21] Mesiodistal dimensions in Turkish were 10.3 mm (male) and 10.1 mm (female).[22] In Korean population, the mesiodistal dimensions were 10.6 mm (male) and 10.2 mm (female).[23] The discrepancy in the mesiodistal of maxillary first molar could be attributed to the inconsistency in the methods used in the measurement. The radiographic studies are reported to be more accurate than the clinical and plaster model measurement, as it is not subjected to hindrance by tight contact. Thus, the measurements taken can show variability in measurements.[24]

The current study also demonstrated that the maxillary first molar was larger in dimension on the left side compared to the right. This finding coincides with the study done by Zarringhalam who reported all permanent teeth in the maxilla to have greater dimension on the left side compared to the right.[25] This difference in the tooth size could be attributed to the asymmetry of the jaw as the study was conducted on orthodontic patients.

The present study showed sexual dimorphism of 0.893% and 0.606% in the right and left maxillary first molar. Various studies have revealed varying percentages of sexual dimorphism in the right and left sides in different populations. The finding of this study is in accordance with the study done by Ghose and Baghdady, which reported sexual dimorphism of 0.8% in the Iraqi population.[26] The Indian population-based studies showed diverse results as Sonika et al. reported sexual dimorphism of 4.74% and 4.84% in the right and left maxillary first molar respectively.[1] Similarly, Ahmed et al.[14] and Narang et al.[27] also reported 6.9% and 4.4% sexual dimorphism on right and left sides respectively.

The Ohio American population showed 3.9% while the Egyptian sample showed 1% of sexual dimorphism.[19,28] The divergences among various populations could be related to sample size and selections, as well as racial and genetic variances, which are most likely linked to ethnicity.

This study was unable to establish borderline numeric variation for the variables studied regarding the use of the maxillary first molar for sex determination. This flaw could be explained by the small sample size, which may not have been large enough to conduct a discriminant statistical analysis that compares males and females using confidence intervals.

CONCLUSION

The mesiodistal dimension of maxillary first molar in males and females did not have statistically significant difference on both the right and the left sides of the jaw. Hence, the present study could not establish maxillary first molar as a tool for sex determination.

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