Sexual Dimorphism in Permanent Maxillary Central Incisor in Nepali sample

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ABSTRACT

Introduction: The tooth crown size is a valuable tool and provides significant information on human evolution, biological alternations, in forensic evaluation and clinical odontology. The maxillary central incisors have contributed to sexual dimorphism, and several classifications of the form of maxillary central incisors are available in the literature.

Objective: To assess the degree of sexual dimorphism in maxillary central incisor in Nepalese population using crown linear diameters, crown module and crown index.

Materials and Method: This is a cross-sectional, comparative study which included 220 dental casts of patients seeking orthodontic treatment. This study was carried out at the Department of Oral Pathology, Kantipur Dental College and Hospital as per the inclusion criteria.

Result: Statistically significant sexual dimorphism was found in mesiodistal dimension and crown module of maxillary central incisor with males' central incisor measuring larger than females'. Left maxillary central incisor was found to be the most dimorphic in terms of mesiodistal dimension among the incisors.

Conclusion: Significant sexual dimorphism was observed in crown linear diameters and dental indices in the right and left maxillary central incisors in selected Nepali sample.

Keywords: Forensic dentistry, odontometry, sexual dimorphism

INTRODUCTION

The teeth are the hardest tissue in the human body, an excellent material in living and non-living populations for anthropological, genetic, odontologic, evolutionary and forensic investigation. Tooth size is affected by environmental, genetic, racial and cultural factors.[1] Sex determination using dental features is primarily based upon the comparison of tooth dimensions in males and females, or upon the comparison of frequencies of non-metric dental traits, like Carabelli's trait of upper molars, deflecting wrinkle of lower first molars, distal accessory ridge of the upper and lower canines or shovelling of the upper central incisors.[2]

Various explanations for tooth-size dimorphism between males and females have been proposed such as differences in hormonal balance, the effect of the Y chromosome in increasing mitotic activity within the developing dental lamina, and involvement of the chromosome X in the enamel formation.[3] The differences in teeth dimensions are suggested either due to the amount of enamel or the amount of dentin.[4] Therefore, odontometrics are reasonably accurate predictors of sex and are good adjuncts for sex differentiation[5] and can be an easy-to-use additional technique to determine sex in specific cases: in individual, as well as in group (mass disasters, archaeological sites, etc.).[6]

Gender discrimination is the important aspect of the human identification procedures that help in the establishment of biological profile from the skeletal and dental remains and also help in the facial reconstruction of unidentified bodies.[7] In forensic context, sex determination is an essential part of human identification. Predicting the sex simplifies identifications because missing persons of only the estimated sex need to be considered.[8] Although DNA profiling, finger prints, anthropometric data can be used as standard methods in the human identification procedures, odontometry can be an easier and cost effective option.[2]

Calculations of dental indexes, which derived from simple mathematical combinations of linear measurement could prove useful in sex determination.[6] Dental indexes include crown index (CI), crown module (CM) and crown area (CA).[9]

Gender determination is crucial for identification, as the number of possible matches is reduced by 50%.[10] Sexual dimorphism in tooth size has been explored focusing on the use of buccolingual (BL) and mesiodistal (MD) diameter – termed linear measurements. Premolars, first and second

molars as well maxillary incisors are also known to have significant differences.[1] As per our knowledge, there are no data for crown linear diameters and dental indexes of maxillary central incisor in Nepali population. Hence, this study aims to assess the degree of sexual dimorphism in maxillary central incisor in Nepalese population using crown linear diameters, crown module and crown index.

To assess the degree of sexual dimorphism in maxillary central incisor in Nepali sample population using crown linear diameters, crown module and crown index.

MATERIALS AND METHOD

This is a cross-sectional, observational, comparative study conducted at the Department of Oral Pathology of Kantipur dental College, Basundhara, Kathmandu. Dental casts of patients between the age of 13-49 years, visiting the Department of Orthodontics and Dentofacial Orthopaedics seeking orthodontic treatment at Kantipur Dental College and Hospital were taken.

Ethical clearance was obtained from the institutional review board of Kantipur Dental College (Ref. no: 24/022). The study was conducted between July-August, 2022. Non-probability, convenience sampling method was applied for sample collection.

From the study of Pillai *et al.*,[11] the mean standard deviation (SD) was 0.53 in the MD diameter of Maxillary central incisor (MCI).

Hence, using the formula $n = \frac{(z^2SD^2)}{e^2}$

Where z = 1.96 at confidence level 95%.
e = margin of error (0.07)
The calculated sample size was 220.

A total of 220 dental casts of the patients of Nepali origin with fully erupted complete set of morphologically well-formed, non-carious, non attrited, satisfactorily aligned maxillary teeth were included in the study. Teeth without history or clinical evidence of crown restoration, orthodontic treatment and trauma were included in the study. Dental casts of patients other than Nepali origin, incompletely erupted or morphologically altered maxillary teeth, carious or attrited, severely malaligned and teeth with history of crown restoration, orthodontic treatment and trauma were excluded from the study.

Data information sheet (Proforma) was developed. MD and BL crown diameters of both, right and left permanent MCI were taken in a dental casts using electronic digital caliper with an accuracy ± 0.01 mm. The mesiodistal crown diameter was defined as the greatest mesiodistal dimension, taken parallel to the occlusal and facial surface.[12] The buccolingual crown diameter was defined as the greatest distance between the buccal (or labial) and lingual (or palatal) surfaces of the crown, perpendicular to the mesiodistal diameter.[12] Measurements were done by a single examiner to eliminate interobserver error. Each measurement was taken three times and the average of the three values was noted to minimize the intra-observer error. Dental indices were calculated from MD and BL measurements of maxillary central incisor according to the formula given by Hillson.[13]

$$CM = \frac{(MD+BL)}{2}$$

$$CI = \frac{(100 \times BL)}{MD}$$

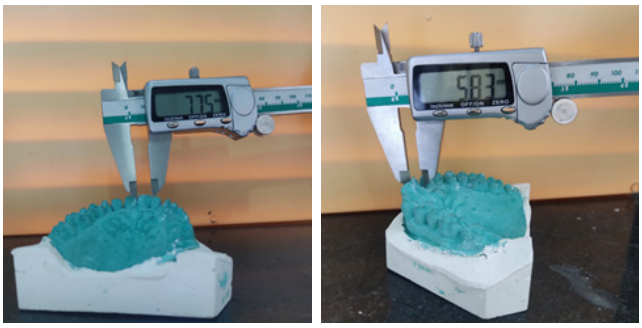
Percentage of sexual dimorphism in crown linear diameters and dental indices of maxillary central incisor was calculated according to the formula:[14]

Sexual dimorphism = [Xm/Xf] - 1 x 100
where Xm = mean value for males
Xf = mean values for females.

Data was collected and statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version[20]. Independent t test was applied.

RESULT

The buccolingual and mesiodistal diameters were measured and compared on study cast (Fig. 1) for MD (a) and LP (b) dimensions as well as for CM and CI for right and left maxillary central incisors using independent t test and statistical analysis was done by using in Statistical Package for the Social Sciences (SPSS) 20 software.



(a) (b)

Fig 1: Greatest crown diameter of maxillary central incisor using digital caliper; (a) mesiodistal (b) labiopalatal

In the study we found that males showed greater MD, LP and CM on both right and left MCI as shown in Table 1. The mean difference value of both MD diameter, left LP diameter as well as right and left CM showed statistically significant difference between male and female with $P<0.05$. The mean differences between male and female crown linear diameters and dental indices are shown in

Fig. 2. Pearson chi square correlation-coefficient showed significant correlation (<0.01) between the right and left MCI using the odontometric parameters (Table 2).

The percentage (%) of sexual dimorphism between right and left maxillary central incisors using different odontometrics parameters are presented in Table 3. It was observed that the most dimorphic odontometric parameter was left MD (3.37 %) followed by, left CM (3.11 %), left LP (2.77 %), right CM (2.12%), and right LP (1.67 %). CI showed negative value of sexual dimorph

Table 1: Assessment of sexual dimorphism using independent t test

Odontometric parameters	Gender	Mean	Standard deviation	Standard error of mean	P value
MD11	M	8.72	0.69	0.07	0.031*
	F	8.52	0.66	0.06	
LP 11	M	6.69	0.73	0.07	0.573 NS
	F	6.58	0.62	0.06	
CI 11	M	76.97	6.96	0.66	0.573 NS
	F	77.51	7.17	0.68	
CM 11	M	7.71	0.63	0.06	0.048*
	F	7.55	0.55	0.05	
MD 21	M	8.59	0.65	0.06	0.01*
	F	8.31	0.61	0.06	
LP 21	M	6.67	0.67	0.06	0.046*
	F	6.49	0.64	0.06	
CI 21	M	77.83	6.98	0.67	0.605 NS
	F	78.83	7.48	0.71	
CM 11	M	7.63	0.57	0.05	0.002*
	F	7.40	0.53	0.05	

* Statistically significant MD- mesiodistal LP- labiopalatal
NS not significant CI- crown index CM- crown module

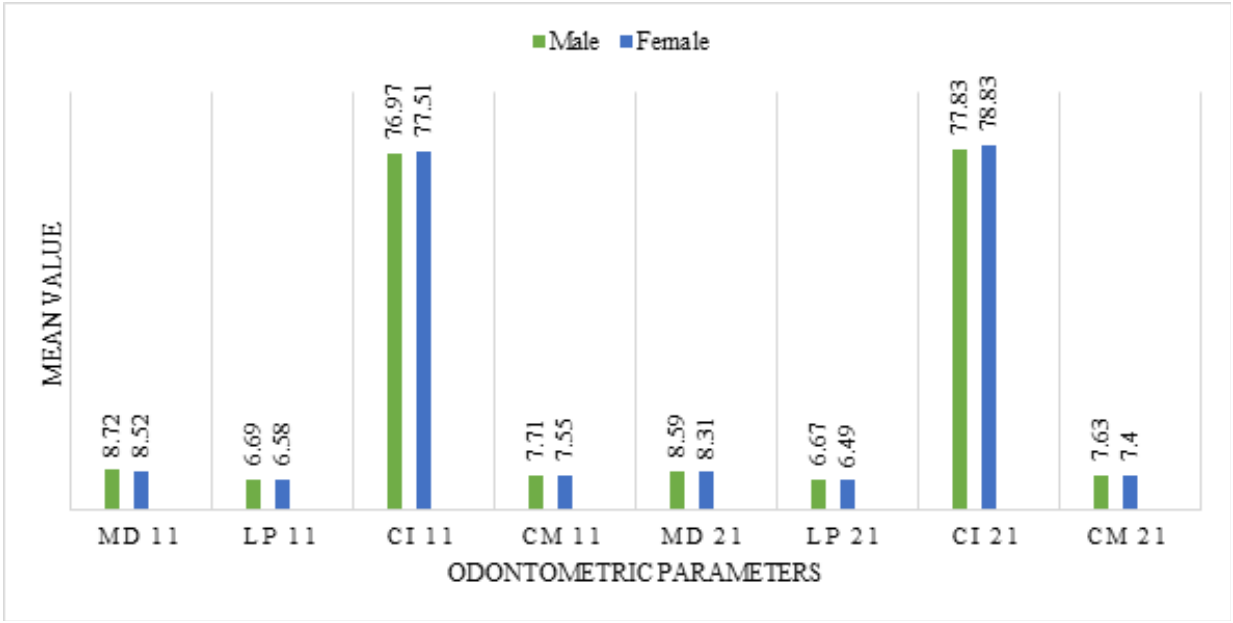


Fig 2: Bar graph showing sexual dimorphism in crown linear diameter and dental indices

Table 2: Pearson's chi square correlation-coefficient between right and left Maxillary Central Incisors using Odontometric Parameters

Odontometric parameters	Right MCI	Left MCI	Correlation coefficient
Mesiodistal	8.62	8.45	<0.01
Labiopalatal	6.64	6.58	<0.01
Crown index	77.24	78.33	<0.01
Crown module	7.63	7.52	<0.01

Correlation is significant at the 0.01 level (2 –tailed)

Table 3: Percentage of sexual dimorphism

Odontometric parameters	Right (%)	Left (%)
Mesiodistal	2.35	3.37
Labiopalatal	1.67	2.77
Crown index	-0.69	-0.64
Crown module	2.12	3.11

DISCUSSION

The general structure and morphology of the teeth are similar in both men and women, however, there are subtle differences, and such as variation in tooth dimensions can give many hints about differences between the sexes. Hence, teeth can be considered an important aspect for sex determination as they are resistant to postmortem destruction and fragmentation. The feasibility for measuring the dimensions of the teeth using morphometric devices could serve as a reliable method for solving medicolegal investigations and to identify victims of crime, natural disasters, and severe accidents. Measurements on dental cast are straight forward and reliable method for odontometrics.[15]

In our study, we analyzed the degree of the sexual dimorphism in fully erupted permanent right and left maxillary central incisors by measuring the maximum mesiodistal and buccolingual diameters, as well as calculating the CM and CI from study casts among Nepali population aged between 13-49 years seeking orthodontic treatment in the hospital.

The current study confirms the statistically significant difference in both right and left MD, CM and left LP ($p<0.05$) of maxillary central incisor where mean values of males were greater than that of females. Our findings were in agreement with the studies done by other authors, where they have observed that males had larger teeth than females in all dimensions.[1,3,16] Mesiodistal dimension of MCI showed significant sexual dimorphism in our study which was in agreement with the findings of Khangaru *et al.*, 2011.[17] Crown indices for maxillary central incisor were also greater in males than in females with significant differences for CM ($p<0.05$).

The percentage of sexual dimorphism was calculated for MD, BL, CI and CM. The difference between males and females in the percentage of dental sexual dimorphism ranged from 3-9%.[18] MD dimension showed highest sexual dimorphism (3.37%) followed by CM (3.11%) and LP (2.77%) dimension of the left MCI in our study. We found significant difference in terms of the MD, LP dimension as well as CM and CI of the right and left MCI similar to the finding of Shrestha B, 2019.[19] Our finding suggested that one side of teeth is not representative in case of odontometric parameters between male and female. In studies by Staka *et al.*[1] and da Costa *et al*.[20] showed no significant differences between the right and left MCI as well as other teeth in the human dentition. MD dimension had more sex determination potential compared to BL dimension[21] which was in accordance with the result in our study where the MD dimension of the left MCI showed the highest sexual dimorphism. Iscan *et al*.[22] have shown the LP dimension to be better predictor of sex. Hence, for sex prediction, both linear dimensions MD and LP can be considered rather than choosing a single dimension. Also, CM showed a high rate of sexual dimorphism than CI in our study which was similar in the study by Staka *et al*., 2016.[1]

The different patterns of sexual dimorphism observed between different populations reflect genetic, epigenetic and environmental influences to dental development.[10] Odontometric features vary among the specific population and even within the same population in historical and evolutionary context.[22] Hence, it is of utmost importance to determine population specific values for identification on the basis of odontometrics.[21]

The present study confirmed that a significant sexual dimorphism existed in the MD and LP dimensions as well as CM of the maxillary right and left central incisors. Left maxillary central incisor was sexually more dimorphic compared to the right among the study samples.

Thus, further investigations based on genetic, ethnic,

and metabolic/hormonal reasons for sexual dimorphism in larger sample sizes may further clarify the etiology of sexual dimorphism as well as credibility of odontometrics in different study population.

CONCLUSION

This study demonstrated statistically significant sexual dental dimorphism in crown linear diameters and dental indexes in MCI in Nepalese population. MCI can be used in forensic investigations as an adjunct along with other accepted procedures for sex determination. The left MCI in terms of mesiodistal dimension was observed as the most dimorphic tooth among the MCI. Further study including larger representative sample of Nepalese population from various provinces has to be conducted to quantify and generalize the result among Nepalese population.

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