Research Article

DOI : http://doi.org/10.64805/jnda.v25i1.202504

Comparison of Maxillary and Mandibular Canine Dimensions for Gender Estimation Among Patients Visiting a Tertiary Health Center: An Analytical Cross-sectional Study

Suraksha Yogi,[1] Harleen Bali,[2] Abhinaya Luitel,[3] Sabina Suwal,[4] Krisha Suwal,[5] Swagat Kumar Mahanta[6]

[1,2,4,5]Department of Oral Medicine and Radiology, Kathmandu University School of Medical Sciences, Dhulikhel, Kavrepalanchok, Nepal

[3]Department of Oral Medicine and Radiology, BPKIHS, Dharan, Nepal

[6]Department of Community Dentistry, Kathmandu University School of Medical Sciences, Dhulikhel, Kavrepalanchok, Nepal

Correspondence :

Suraksha Yogi. Email: surakshayogi@gmail.com

ABSTRACT

Introduction: Teeth are the hardest tissue known to resist mechanical and physical stresses, chemical destruction. Odontometric study assists in forensic and anthropological investigation to estimate gender. Among all the teeth, canine shows greatest sexual dimorphism.

Objective: To compare the dimensions of maxillary and mandibular canine for gender determination.

Methodology: This analytical cross-sectional study was conducted from October 2022 to January 2023 in the Dental Department of Dhulikhel Hospital. A total of 60 individuals were included in the study. Data collection included measurements of mesiodistal width of maxillary and mandibular canine and intercanine distance using digital vernier calipers. Participants were enrolled after their written consent only. Convenience Sampling was used to select participants and data analysis was done using SPSS 25 software. Mean and Standard Deviation were calculated, and inferential statistics chi square test was done to evaluate gender prediction.

Result: The identification of sex using the right mandibular canine index was 61.7% and using the left mandibular canine index was 65%. The mean Mesiodistal width of right and left mandibular canines and intercanine distance were comparatively more in males than females. Males showed higher mandibular canine widths (right: 6.87 ± 0.39mm, left: 6.95 ± 0.36mm) and greater intercanine distances (maxillary: 34.93 ± 2.00mm, mandibular: 26.93 ± 1.86mm) than females (right: 6.37 ± 0.45mm, left: 6.32 ± 0.46mm; maxillary: 33.82 ± 2.25mm, mandibular : 25.60 ± 1.70mm)

Conclusion: Left mandibular canine index and inter canine distance are reliable for sex prediction.

Keywords: Cross-sectional studies; cuspid; forensic dentistry; sex characteristics.

INTRODUCTION

Teeth are the chemically stable tissue found in the human body and are more resistant to postmortem obliteration than tissue of other parts of the body.[1] Postmortem obliteration of teeth starts with endogenous enzymes followed by microbes. Teeth

Citation

Yogi S et al. Comparison of Maxillary and Mandibular Canine Dimensions for Gender Estimation Among Patients Visiting a Tertiary Health Center: An Analytical Cross-sectional Study. J Nepal Dent Assoc. 2025 Jan-Jun;25(40):17-22.

being less porous limits the microbial activity and studies done by Rubio et al. showed DNA present in dental tissue remain relatively stable for 18 months.[2] Alongside, tooth also resists up to extreme temperature of 1100 degree Celsius so tooth is considered most reliable source for forensic identification in mass disasters.[3] Measurements of tooth size have been used in age and gender determination.[4] As canines have the greatest degree of sexual dimorphism and are most durable in the oral cavity they are used for gender identification.[1,4]

Forensic investigation shows that teeth are most useful in victim identification in both living and dead cases of natural calamities and mass disasters.[5] Forensic odontologists assisted with dental identification in Disaster Victim Identification (DVI) Operation of US Bangla Airlines Flight 211 Crash in 2018, Nepal.[6] Identification of tsunami victims in December 2004 (Thailand) was also done by the help of tooth.[7] Since there is no study conducted in Nepal comparing maxillary and mandibular canine for gender estimation, this study aimed to compare maxillary and mandibular canine dimensions and find which is more reliable for gender estimation.

METHODOLOGY

This analytical cross-sectional study was conducted from October 2022 to January 2023 in the Department of Oral Medicine and Radiology, Dhulikhel Hospital, Dhulikhel, Nepal. Data was collected after ethical approval from the Institutional Review Committee (IRC) of the same institute (Approval Number: IRC/165/22).

Inclusion criteria included subjects with caries free canine with healthy periodontium, subjects with absence of spacing and/or crowding in anterior teeth, subjects willing to participate, subjects of age group 19 to 29 years. (Age range of 19-29 years was chosen because canine shows minimal attrition within these age groups and only informed consent is required.)

Exclusion criteria included subjects with attrited canine (score 1 or above as per Bardsley et al.[8]), subjects with carious canine teeth, anterior teeth crowding, patient undergoing orthodontics treatment, subjects not willing to participate. Convenience Sampling was used and Sample size was calculated using the formula given by Bakkannavar et al.[5] which is stated below:

$$n1 = [(\sigma12 + \sigma22 /\kappa) (z1-\alpha/2+z1-\beta)2]/\Delta2$$

$$n2 = [(\kappa*\sigma12 + \sigma22) (z1-\alpha/2+z1-\beta)2]/\Delta2$$

The notations for the formulae are:

n1 = sample size of Group 1

n2 = sample size of Group 2

σ_1 = standard deviation of Group 1

σ_2 = standard deviation of Group 2

Δ= difference in group means

κ= ratio= n2/ n1

z1-α/2= two-sided Z value (Z=1.96 for 95% confidence interval)

z1-β = power

The sample estimated was 60 (30 males and 30 females) based on the mean difference given by Bhakkannavar et al.[5]

Subjects were made seated in an upright position then teeth were dried using a gauge piece. Mesiodistal width (MDW) of all four canines (MDW: maximum expanse between the proximal aspects of crown) and intercanine width (ICW) of maxilla and mandible was measured (ICW: linear distance between highest point on cusp of right and left canines) were measured by 2 examiners using digital Vernier Calipers (Brand: Zhart Model name: Digical 156, range: 0-6" (0-150mm), accuracy: <=±0.04mm)

The observed canine index was calculated

Observed canine index: mesiodistal crown width/ inter-canine width

•The standard canine index (CI) value is used as a cut-off point to differentiate males from females.

Standard canine index:

$$\frac{(Mean\ male\ CI - SD) + (Mean\ female\ CI + SD)}{2}$$

The observed canine index was then compared with the standard canine index value obtained in this study and correlated with previous studies like Rao et al.[11] and Bakkannavar et al.[5] If the observed canine index for the individual was higher than the standard canine index, the individual was considered to be male, and if lower or equal to standard canine index as female.

The data collected were recorded in Microsoft Excel and analyzed using SPSS 25 by one co-investigator who was blinded about the gender of subjects. Mean, standard deviation and percentage were calculated to summarize the measurements of mesiodistal width, intercanine distance and canine index for both sexes. To evaluate the association between the gender predicted and actual gender using maxillary and mandibular canine indices, a chi- square test was performed. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Study consists of 60 subjects (30 males and 30 females). Both sex were under the age group of 19 to 29 years. The mean value of the mesiodistal crown width of right and left maxillary and mandibular canine was more among males than the females as shown in Table 1. The maxillary and mandibular intercanine width are shown in Table 2. The standard canine index for right and left maxilla was 0.251 and 0.250 respectively and for Right and Left Mandible were 0.152 and 0.225 respectively as shown in Table 3.

Gender prediction was done using Standard Canine Index and Maxillary and Mandibular canine index. Using the maxillary canine index, the right canine correctly predicted sex in 50% of cases, and the left in 56.7 % (Table 4). For the mandibular canine index, the right canine showed 61.7% accuracy, while the left mandibular canine showed the highest accuracy of 65% (Table 5). Table 6 shows the sex prediction accuracy using maxillary and mandibular canine indices. Sex prediction accuracy using Chi square test showed neither mandibular (p=0.62) nor maxillary canine (p=0.34) were statistically significant

Table 1: Sex wise distribution of mesio-distal crown widths of canines, n (%).

Site	Gender	Maxillary Canine		Mandibular Canine	
		Mean	S.D.	Mean	S.D
Right	Male	7.600	0.4624	6.867	0.3925
	Female	7.067	0.661	6.367	0.4536
Left	Male	7.650	0.4577	6.950	0.3560
	Female	7.167	0.5142	6.317	0.4639

Table 2: Sex wise distribution of intercanine distance (ICD).

Arch	Gender	Mean	S.D
Maxilla	Male	34.933	2.0032
	Female	33.817	2.2495
Mandible	Male	26.933	1.8557
	Female	25.600	1.6989

Table 3: Standard canine index.

Arch	Side	Standard canine index value
Maxilla	Right	0.152
	Left	0.225
Mandible	Right	0.251
	Left	0.250

Table 4: Sex predictability using maxillary canine index.

Maxillary canine index	Male predicted	Female predicted	Correct prediction	Incorrect prediction
Right	100%	0%	50%	50%
left	33.3%	66.7%	56.7%	43.3%

Table 5: Sex predictability using mandibular canine index.

Mandibular canine index	Male predicted	Female predicted	Correct prediction	Incorrect p rediction
Right	48.3%	51.7%	61.7%	38.3%
Left	65%	35%	65%	35%

Table 6: Association between prediction and jaw.

JAW	X^2	P value*
Maxillary canine	0.90	0.34
Mandibular Canine	0.23	0.62

*Chi square test

DISCUSSION

Teeth are used for sex determination in cases where the body is decomposed or mutilated beyond recognition as teeth are resistant to decay. Thus, dimorphism in teeth is great forensic tool for identification of sex.[9] From study done by Harshim and Murshid on Saudi males and females aged 13- 20 years it was found that only canines had significant sexual dimorphism in both jaws while other teeth did not.[10] Rao. et al in 1989 introduced Mandibular canine index for dental sex estimation as mandibular canines known to be highly dimorphic and survives longest in human dentition.[11]

In our study prediction of sex using mandibular left canine index, accuracy was 65%. Using mandibular right canine index accuracy of sex prediction was 61.2% similar to study done by Reddy et al. where left mandibular canine was found to be dimorphic than right mandibular canine.[12] In the study done by Khan Farheen et al. mandibular left canine index has good sex prediction accuracy 54% than mandibular right canine index 53%.[13]In the study done by Bakkannavar et al. sex prediction accuracy was more using left mandibular canine Index 74.8% and Right mandibular canine index 74.2%.[5] In our study, the accuracy of sex prediction using the right maxillary canine index was 50% and using the left

maxillary canine index was 56.7% . In contrast to the study of Mohsenpour et al. where maxillary canine index had slightly higher sex predictability than mandibular canine index, ours showed less significance for maxillary canine index.[14] In this study, intercanine distance of male (26.933mm) was more than female (25.60mm), which aligns with Ayoub[15] (male 27.20mm and female 25.63mm) and Bakkanavar et al.[5] (male 25.25mm and female 24.75mm)

In present study, mean intercanine distance of maxilla in male (34.933mm) was more than the female (33.817mm) similar to findings of Bakkanavar et al.[5]

Our study shows greater mesiodistal width difference in mandibular left canine (0.63mm) than in right canine (0.50mm) which is similar to the study done by Gerdezi S et al., who reported mean difference of 0.497mm in left canine and 0.164mm in right canine.[16]

According to a study done by Harris et al., it was found chromosome Y controls the thickness of dentin which is variable on all teeth (dentin being larger in males than females) affecting the size of teeth and chromosome X controls the thickness of enamel which is almost similar in both sexes.[17]

The limitation of this study includes relatively small sample size (60 participants) and using convenience sampling from a single tertiary care center so may not be applicable for wider population. Finally, the left mandibular canine, while showing the highest accuracy, achieved only 65% sex prediction, indicating that canine indices alone may not be fully reliable for forensic sex determination.

CONCLUSION

This study demonstrates mandibular canine particularly left mandibular canine is more reliable for sex determination. Males showed larger mesiodistal width and intercanine distance than females highlighting odontometric measurements potential in forensic investigations. Although canine index, intercanine distance and mesiodistal width provide useful guidance for forensic identification, they should be used alongside each other for more accuracy.

Conflict of interest: None.

REFERENCES

1. Alanazi AA, Almutair AM, Alhubayshi A, et al. Morphometric analysis of permanent canines: preliminary findings on odontometric sex dimorphism. Int J Environ Res Public Health. 2022 Feb 13;19(4):2109. [DOI]
2. Rubio L, Santos I, Gaitan MJ, et al. Time dependent changes in DNA stability in decomposing teeth over 18 months. Acta Odontol Scand. 2013;71(3-4):683-43. [DOI]
3. Shivananda S, Doddawad VG, Anand A, et al. Effects on heat exposed teeth in relation to forensic identification-a pilot study. Egypt J Forensic Sci, 2025;15(1):45. [DOI]
4. Shrestha S, Shakya R, Mansoor DI, et al. Estimation of sex using mandibular canine index in a young Nepalese population. Anatomy 2019;13(3):163-7. [Full Text]
5. Bakkannavar SM, Manjunath S, Nayak VC, et al. Canine index – A tool for sex determination. Egypt J Forensic Sci.2015;5:157-61. [DOI]
6. Manica S, Pandey H, Santiago BM, et al. The role of women in forensic odontology. Rev Bras Odontol Leg RBOL. 2022;9(1):02-24. [Full text]
7. Schuller Gitzburg P, Suchanek J. Forensic odontologists successfully identify tsunami victims in Phuket, Thailand. Forensic Sci Int 2006;171;204-07 [DOI]

8. Bardsley PF, Taylor S, Milosevic A. Epidemiological studies of tooth wear and dental erosion in 14-year-old children in North West England. Part 1: The relationship with water fluoridation and social deprivation. Br Dent J. 2004 Oct 9;197(7):399-413[DOI]

9. Heng D, Manica S, Franco A. Forensic Dentistry as an analysis tool for sex estimation: A Review of current techniques. RRFMS. 2022;12:25-39. [DOI]

10. Hashim HA, Murshid ZA. Mesio- distal tooth width – a comparison between Saudi Males and Females. Egypt Dent J. 1987;39(1):343-46. [PMID]

11. Kalim Z, Tyagi R. Sex Determination Using Canine Dimorphism: Forensic Relevance. J Forensic Sci & Criminal Inves. 2018;11(1):555802. [DOI]

12. Reddy VM, Saxena S, Bansal P. Mandibular canine index as a sex determinant: A study on the population of western Uttar Pradesh. JOMFP. 2008;12(2):56-9. [DOI]

13. Khan FT, Chandak RM, Kulkarni SP, et al. Canine Index: A Tool for sex determination in forensic odontology. Int J Dent Health Sci. 2016;3(3):552-59. [Full Text]

14. Mohsenpour K, Gangadhar MR, Samehsalari S. Mandibular and maxillary canine as a tool for sex determination. J. Morphol. Sci. 2017;34(4):247-50. [DOI]

15. Ayoub F, Shamseddine L, Rifai M, et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population. Int J Dent 2014;2014:235204. [DOI]

16. Gardezi S, Hassan N, Memon S. Canine index for gender dimorphism in a subset of Karachi population. J Pak Dent Assoc. 2018;27(3):120-23. [DOI]

17. Kaushal S, Patnaik VVG, Sood V, et al. Sex Determination in north indians using mandibular canine index. JIAFM, 2004;26(2):45-9. [DOI]