

G11 Sex Estimation Using Enamel and Dentin Proportions of Human Mandibular Canines

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Learning Overview: After attending this presentation, attendees will understand sexual dimorphism in enamel and dentin proportions of mandibular canines and their possible role as a tool in sex determination in the future. Apart from age estimation from teeth, the use of ImageJ in sex determination from Radiovisuographs (RVGs) can also be appreciated. Attendees will learn that employing ratios in tissue proportions compensates for variation in tooth size across populations and overcomes difficulties encountered in radiographic standardization.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by suggesting a non-invasive method in sex determination using RVGs of teeth.

Background: Sex determination of fragmented human remains poses a challenge in archaeological excavations of mass graves, forensic anthropology, and identification of severely destroyed bodies in disaster sites.¹ Biological analysis of hard tissues provides nearly 100% sex identification of fragmented remains but, unfortunately, results in destruction of prime evidentiary material.² In such cases, teeth offer as non-invasive alternatives for sex determination. Dental sexual dimorphism between males and females is seen in overall size of teeth as well as in enamel and dentin proportions.³ Studies on tissue proportions showed more enamel in females and greater dentin in males.⁴⁻⁶ These studies explored tissue proportions by employing linear measurements on radiographs or area measurements on tooth sections.⁴⁻⁸ While linear measurements are regarded as less ideal representatives of total tissue volumes, area measurements are considered accurate sex predictors but require invasive procedures.^{5,6}

Goals: This study aimed to investigate sexual dimorphism in enamel and dentin proportions of human mandibular canines using both linear and area measurements by employing a non-invasive method using RVGs.

Materials and Methods: The study sample consisted of 85 uncalibrated RVGs (44, females and 41 males) of sound permanent mandibular canines of South Indian population in the age group of 17–35 years. All RVGs were taken earlier for diagnostic purposes and retrieved from centers with informed consent. Using ImageJ1.52a, four linear measurements (Maximum Mesiodistal Width (MMD), mesial-enamel, distal-enamel, and dentin) and three area measurements (Tooth Area (TA), Enamel Area (EA), and Pulp Area (PA)) were performed. Ratios were determined to compensate for lack of standardization of radiographs. Two ratios were determined from linear measurements (enamel/MMD and) and three ratios from area measurements (EA/TA, DA/TA, and PA/TA). Measurements were performed by a single observer. Twenty samples were randomly selected for inter- and intra-observer reliability. Data was analyzed using intra-class correlation and logistic regression analysis, and regression models were developed for sex prediction.

Results: Both linear and area enamel ratios were significantly higher in females than males, indicating more enamel in females. Similarly, both dentin ratios (linear and area) were greater in males indicating more dentin in males. No difference was seen in pulp ratios. A regression model using EA ratio correctly predicted sex in 69.4% of the cases, and a model using dentin linear ratio correctly predicted sex in 61.2% of the cases. The area method showed excellent intra- and inter-observer agreement. However, the linear method showed excellent intra- and poor inter-observer reliability.

Conclusion: Sexual dimorphism in mandibular canines is due to differences in both enamel and dentin proportions, with females showing more enamel and males more dentin. Regression models developed using enamel and dentin ratios can be utilized for sex prediction. The area method shows good reliability and sex prediction rates in comparison to the linear method.

Reference(s):

1. Vodanović M., Demo Ž., Njemirovskij V., Keros J., Brkić H. Odontometrics: A useful method for sex determination in an archaeological skeletal population? *Journal of Archaeological Science* 34(6) 2007;905-913.
2. Angadi P.V., Hemani S., Prabhu S., Acharya A.B. Analyses of odontometric sexual dimorphism and sex assessment accuracy on a large sample. *Journal of Forensic and Legal medicine* 20(6) 2013;673-677.
3. Teschler-Nicola M., Prossinger H. Sex determination using tooth dimensions. In: Alt K.W., Rosing F.W., Teschler-Nicola M. *Dental Anthropology, Fundamentals, Limits & Prospects*, Springer 1998; pg 479- 500.
4. Alvesalo L. Sex chromosomes and human growth. A dental approach. *Human Genetics* 101(1) 1997;1-5.
5. Schwartz G.T., Dean M.C. Sexual dimorphism in modern human permanent teeth. *American Journal of Physical Anthropology* 128(2)2005; 312-317.
6. Saunders S.R., Chan A.H., Kahlon B., Kluge H.F., FitzGerald C.M. Sexual dimorphism of the dental tissues in human permanent mandibular canines and third premolars. *American Journal of Physical Anthropology* 133(1)2007; 735-740.
7. Stroud J.L., Buschang P.H., Goaz P.W. Sexual dimorphism in mesiodistal dentin and enamel thickness. *Dentomaxillofacial Radiology* 23(3)1994; 169-171.
8. Harris E.F., Hicks J.D., Barcroft B.D. Tissue contributions to sex and race: Differences in tooth crown size of deciduous molars. *American Journal of Physical Anthropology* 115(3)2001; 223-237.

Sexual Dimorphism, Mandibular Canine, Enamel/Dentin Proportions