REVIEW

Determination of Sexual Dimorphism by Linear and Diagonal Odontometric Methods of the Crown in a Range of Indian Population – A Scoping Review

Bhavani Sangala Nagendra[1], Sanjeevareddygari Shylaja[2], Anish Gupta[3], Sneha Masne Deshpande[1], A. Sandhya Rani[4], Anamika Sinha[5], Sanpreet Singh Sachdev[1]

Abstract

Introduction: Sex determination using dental features is predominantly based on Odontometrics. Numerous odontometric studies were conducted on the different teeth in the Indian population but still, there is a huge lacuna of odontometric data from population-based studies.

Aim: The present scoping review aimed to determine the sexual dimorphism present in the linear and diagonal odontometric measurements of the teeth crowns in the Indian population.

Materials and Methods: The focused question was whether linear and diagonal odontometrics of crowns in permanent teeth exhibit sexual dimorphism in the Indian population. A systematic literature search was conducted on studies reported in the past 10 years by using different databases like PubMed, Cochrane, and Google Scholar.

Results: A total of N=181 articles were identified and after application of the selection criteria, n=8 articles were included for final data analysis. The percentage of accuracy of sex determination by odontometric analysis of all teeth ranged from 47% to 97.2%.

Conclusion: All the teeth exhibited varying amounts of sexual dimorphism in the Indian population. Therefore, odontometric analysis can be used as a gender identification aid in forensic and anthropological investigations.

Keywords: Odontometric, Mesiodistal measurements, Morphometric analysis, Sexual dimorphism.

Introduction

In forensic and anthropological studies identification of unknown human remains is based on building the biological profile. Determination of sex, age and ethnicity are the important steps in building a biological profile. The difference in appearance, stature and size between males and females refers to sexual dimorphism.[1, 2] Teeth being well protected in the oral cavity, exhibit maximum resistance to temperature, physical chemical, bacterial, and changes.[3, 4] Sexual dimorphism in teeth can be accessed by both metric and non-metric and biochemical methods.[5] Genetic, racial, cultural and environmental factors influence the size of the tooth. Sexual dimorphism in teeth is population-specific.[4] Numerous odontometric studies were performed in different population groups of India but still, there is a huge lacuna of odontometric data from population-based studies. Currently, there is a need for the generation of odontometric data of the Indian population that may supplement anthropological and forensic identifications.[6]

Aim

The present systematic review aimed to determine the sexual dimorphism present in the linear and diagonal odontometric measurements of the teeth crowns in the Indian population.

[1]Department of Oral Pathology and Microbiology, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Navi Mumbai, Maharashtra, India; [2]Department of Oral Pathology and Microbiology, SVS Institute of Dental Sciences, Mahabubnagar, Telangana. India; [3]Department of Oral Pathology and Microbiology, People's Dental Academy, People's University, Bhopal, Madhya Pradesh; [4]Department of Oral Pathology and Microbiology, Kamineni Institute of Dental Sciences, Narketpally, Telangana; [5]Department of Conservative Dentistry and Endodontics, Bharati Vidyapeeth (Deemed to be University), Dental College and Hospital, Navi Mumbai, Maharashtra.

Corresponding Author: Bhavani Sangala Nagendra, Department of Oral Pathology and Microbiology, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital. Navi Mumbai. Maharashtra. India. Email – drbhavani21@yahoo.com

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Materials and Methods:

Protocol - The present study followed the guidelines of PRISMA–ScR

Search strategy–

A systematic search was performed across multiple databases including PubMed, Cochrane, and Google Scholar to identify relevant articles with full text available in the English language published from 2014 to 2023. The search strategy involved the use of keywords with Boolean operators such as "Odontometric" OR "Odontometry" OR "Mesiodistal measurements" OR "Morphometric analysis" AND "Sexual dimorphism", OR "Sex determination" OR "Gender identification". Original research conducted on different population groups in India. Crown Linear and / or diagonal measurements of permanent tooth was checked and the research that analyzed sexual dimorphism in the odontometric measurements of all teeth. Research conducted on population groups other than Indians. Literature present in books, conference papers, editorials, letters to the editor and systematic reviews.

Data including author, year of publication, population group, age range of subjects, sample size, type of measurement analysed, statistical method used, presence or absence of sexual dimorphism, and accuracy rate was recorded in an Excel sheet independently by two teams of reviewers (BSN, SS, AG, and SMD, ASR, AS, SS). Any discrepancy was resolved by mutual agreement.

Results

Study selection:

A total of 188 records were identified using the mesh terms and keywords in 3 different electronic databases, i.e., Cochrane(16), Google Scholar (105) and PubMed (67). After removing 7 duplicate articles 181 articles were screened for title and abstract. After screening the abstracts, n=25 full texts were assessed for eligibility. Out of these, n=18 articles were excluded for various reasons mentioned in Table 1.[7 - 21] One additional study was identified by reference linkage. A total of n=8 studies were included in the final quality synthesis.[22-29] The details of the search strategy are illustrated in Figure 1. Out of the 8 articles, the accuracy rate was determined by discriminate functional analysis in n=5 studies, and by reference point and univariant analysis in one study each respectively.[25, 26] Only one study did not mention the accuracy rate. The percentage of

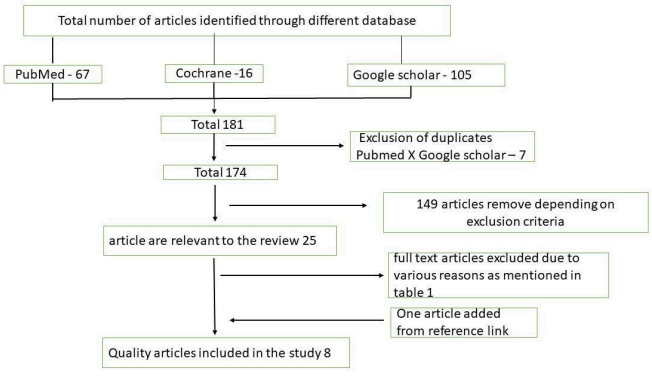

Fig. 1. Systematic literature review flow chart explaining the search strategy

Table 1: Odontometric studies in Indian samples excluded from the present review after the application of inclusion and exclusion criteria.

S. No	Author/ Year	Reason for exclusion
1.	Ahmed B.R. Mujib et al / 2014	Only Maxillary canines and first molars were accessedin the study
2.	Shalini Gupta et al / 2014	Intercanine width and mandibular canine index werealso used for sex determination.
3.	Sharma B et al /2014	Only Maxillary and Mandibular canines were accessed in the study.
4.	Paramkusam G et al / 2014	Only Maxillary and Mandibular canines were accessed in the study.
5.	Yadav AB/ 2015	The cusp index is used for sex determination.
6.	Aditi Agrawal et al/2015	Only the mandibular canine and mandibular first molarare used in the study
7.	Rashmi Metgud/ 2015	Second molars are not included in the study
8.	Ramandeep Singh Narang / 2015	Only Permanent first molars are used in the study
9.	Swati Singla/2015	Only the left and right maxillary first molars are used in the study.
10.	Abhishek Banerjee/ 2016	Only maxillary central incisor, canine, premolar and molars are used in the study. They also accessed cervical angulation for sex determination.
11.	Shireen A /2016	Only the Maxillary first molar is accessed
12.	Pandey N / 2016	Only Maxillary and Mandibular canines were accessed
13.	Tabasum Q / 2017	Only the Upper and lower molars were accessed.
14.	Rani ST / 2017	Tooth indices are used for sex determination.
15.	Mehta S / 2017	Only maxillary first molars are accessed.
16.	Agnihotri A / 2018	Intercanine width is used for sex determination
17.	Bharath Rao K / 2019	The height of an individual, inter-canine width, inter-premolar width, and arc length were also used for sex determination.
18.	Kunal Kumar / 2019	Mandibular inter canine width and Canine index were used for sex determination.

accuracy of sex determination by odontometric analysis of all teeth ranged from 47% to 97.2%. The data extracted from all the studies included in the present systematic review is collectively summarized in Table 2.

Discussion

The research question addressed in the present review is whether the studies based on linear and /or diagonal odontometrics of all permanent teeth crown exhibits sexual

Table 2: Data extracted from the articles included in the present review.

S. no	Author and year	Population Sample	Age range	Sample size	Parameters accessed	statistical method used	Sexual dimorphism	Accuracy
1	Sonali Sharma/2014	Goan children	14 – 22 yrs	22 males and 22 females	Mesiodistal and buccolingual	Pearson correlation coefficient	Present	Not Mentioned.
2	Adesh S. Manchanda/ 2015	North Indian Population	18 – 57 yrs	100 males and 100 females	Diagonal measurements	Discriminant function analysis	Present	MBDL (Mesiobuccal, Distolingual.) crown dimension ranges Male - 55% to 75% Female - 47-84% DBML crown dimension ranges Male - 55% to 80% Female - 65-80%
3	Dharman S / 2015	Chennai population	18 – 22 yrs	30 males and 30 females	Linear measurements – MD, BL & CI.)	Discriminant functional analysis	Present	The overall accuracy rate of predicting sex is78%.
4	Sharlene Sara Babu/ 2016	South Kerala	15 – 25 yrs	66 males and 66 females	Linear measurements MD & BL.	The reference point was accessed	Present	Accuracy rate 88%
5	Srinivasprasad M / 2016	Guntur, South Indian population	23 – 27 yrs	50 males and 50 females	Linear measurements MD & BL	Univariant analysis	Present	The overall accuracy rate is 92% 96% in females and 86% accuracy in male
6	Litha /2017	Indian samples	Not mentioned	250 males and 250 females	Linear measurements MD & BL	Linear stepwise discriminant function analysis	Present	99.8% accuracy
7	Shivangi Singh / 2019	Ghaziabad	16 – 23 yrs	50 males and 50 females	Diagonal measurements	Discriminant functional analysis.	Present	MBDL crown dimension formales - 68% and for females -74% The average of which was 71% for MBDL MLDB measurements – for males – 84% For females - 74% the average of which was 79%.
8.	Sathawane RS / 2020	Central Indian population	19 – 35 yrs	20 males and 20 females	Diagonal measurements	Discriminant functional analysis.	Present	maxillary MBDL is 97.2% and mandibular MBDL is 95.2%. The overall accuracy rate of maxillary DBML is 96.56% and mandibular DBML is 94.21%

dimorphism in different population groups of India. The qualitative review of 8 articles includes 1176 male and female subjects from different areas of India. Though the electronic database search identified N=25 studies which were conducted in different groups of the Indian population in the past decade, n=18 of these were excluded as they did not involve odontometric analysis of all teeth to assess sexual dimorphism.

All the studies are based on cast measurements, as it is the oldest, inexpensive, easy to perform, simple and reliable method. Studies are predominantly performed on young adults to reduce the effect of age changes like attrition, that affect the measurements of crown[5].

Linear and diagonal measurements exhibit varying degrees of sexual dimorphism in different population groups. In the Indian population, predominantly the size of tooth in males is greater than in females. This can be explained by specific facts that during histogenesis X- chromosomes promote enamel formation and Y - chromosome helps in both enamel and dentin formation. The size of the tooth is predominantly influenced by Y- Y chromosomes. It predominantly influences the mitotic potential of tooth germ triggering more dentinogenesis and males show longer bell stage during dentin deposition before amelogenesis.[27,29] Jaw size is larger in males. So, proportionately tooth size is also greater in males compared to females.[26] In most of the studies one or few teeth exhibit reverse sexual dimorphism i.e. linear and diagonal measurements are larger in females compared to males. This can be due to an interplay between genetic and environmental factors leading to changes in human evolution.[28] According to Sonali et al, there is a significant correlation between mesiodistal and buccolingual widths of premolars between siblings, suggesting the genetic control of sexual dimorphism.[22] Percentage of accuracy rate varies between teeth in a person and also between different population groups of India. Major factors affecting accuracy percentage are genetic and environmental factors. Along with these factors type of tooth, method of analysis,[26] sample size may also play a role in accuracy percentage. Canines are the teeth that show significant sexual dimorphism in different population groups of India except in the population of central India where DBML (Disto-buccal, Mesio-lingual) measurements of mandibular canine and lateral incisor show non -significant values.[28] The other teeth that have shown significant sexual dimorphism are maxillary first molars and maxillary central incisors.

Most of the studies included in the present systematic review involved a small sample size. For accurate extrapolation of the data to the general population, further studies with larger sample sizes are warranted. In most of the studies, the subjects were selected randomly. Generation pedigree is not mentioned to confirm the geographic location/ ethnicity of the subjects.

Conclusion

All the teeth exhibited varying degrees of sexual dimorphism in the Indian population. More population-specific studies are to be conducted with a larger sample size to further validate the accuracy and reliability of odontometric methods for sex determination in Forensic Odontology. Maintenance of population-specific databases would aid in personal and anthropological identification in the field of Forensics and Palaeontology.

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