Original Study

Odontometric Study of Premolars - A Convenient Method for Gender Determination

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Abstract

Introduction: Determining the sex of an individual is indeed a crucial step in forensic medicine, as it provides valuable information for various investigative and identification purposes. Teeth are decent source for gender determination. Odontometrics offers a benefit of being simple, speedy, and low cost.

Aim: To verify the premolar Odontometric differences in sex determination.

Methodology: Mesiodistal and buccolingual measurements of premolar crown were calibrated for males and females on 50 pairs of plaster models (25 pairs from both sex) from age group 20-30 years. First and second premolars of Upper and lower jaws of both left and right sides were examined with regard to their mesiodistal (MD) and buccolingual (BL)measurements and the intra-arch premolars linear distance measured from lingual-lingual cusp (3- cusp premolars were excluded from study) tips using divider and digital vernier calliper.

Result: The Statistical study incorporated the use of SPSS version 23. Significant difference was noted in the odontometrics of premolars and lingual-lingual cusp distance. This difference was significant in males. Sexual dimorphism was noted in Mandibular left 1st premolar and maxillary left 2nd premolar with Mesiodistal measurement. The Buccolingual measurements of all the 2nd premolars demonstrated a significant male predominance.

Conclusion: It was observed in this study that the use of 2nd premolar buccolingual measurements and linear distance between lingual-lingual cusps of intra arch premolars of opposite side may be used in odontometrics as an aid to determine the sex, males showed a significantly higher odontometrics.

Keywords: Odontometric, Premolars, Sexual-dimorphism.

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Introduction

In the realm of specialized fields, forensic dentistry holds significance in identifying both the living and the deceased, the utilization of skeletal remains and dentition holds paramount importance. Gender determination holds crucial significance, significantly narrowing down the pool of potential matches by half.[1] The assessment of morphological characteristics of the pelvis and skull forms the foundation for the most frequently employed techniques. In forensic studies, it is not uncommon to recover the skull and pelvic bones in a fragmented state. Therefore, teeth can serve as an additional tool for sex determination, given their high resistance to destruction and fragmentation when compared to other tissues. The metric and non-metric analyses of dentition have been instrumental in human research, serving as a central focus in the field of dental anthropology.[2]

"Sexual dimorphism" denotes variations in size, build, and appearance between males and females. This concept extends to dental identification, as it is often asserted that no two mouths are alike.[3]

Teeth, as distinctive organs, are encased in the hardest structure found in the human body—enamel. Teeth are resistant to physical, thermal, mechanical and chemical destruction. Especially in scenarios of skeletal deterioration, teeth play a critical role in identification, serving as resilient elements that retain essential information crucial for forensic investigations.[4]

Tooth size variations, shaped by both genetic and environmental influences, are documented in literature, portraying differences between and within racial groups. The most comprehensive model to explain these variations aligns with a polygenic mode of inheritance. Lundstrom's investigation, involving 97 pairs of like-sex monozygotic and dizygotic twins, showcased a heightened correlation in mesiodistal tooth size within monozygotic twins. The study's findings supported the conclusion that genetic factors play a significant role in determining tooth size. Furthermore, tooth size variations have been noted among various ethnic groups, encompassing North American Caucasians, Negroes, Mongoloids, Dominicans, Egyptians, Mexicans, Nigerians, British, and more.[5]

In the modern world, The increased incidence of mass disasters (plane crashes, fires, earthquakes etc.) bodies are frequently found in decomposed, carbonized or fragmented conditions. It is common to find dental arches as the only preserved structures, thereby making it possible to identify the corpses, because teeth are the most resistant, hard and stable structures of the human body and also because individuals do not have identical dental features.[6] While the DNA technique stands as the most accurate method, its applicability is limited and cannot be universally employed in all cases. The simplicity, speed, and cost-effectiveness of odontometric methods make them paramount in the efficient determination of gender.

The width of the arch is majorly determined in the canine and premolar region. Many studies highlight the importance of odontometrics in forensic identification, limited research has focused on premolars—particularly the intra-arch distance between lingual cusps and their potential for sex determination. While molars and canines are often studied for sexual dimorphism, premolars remain underexplored, especially in terms of their buccolingual, mesiodistal, and cusp tip measurements.

This study aims to fill this gap by using a simple, low-cost method to examine premolar measurements and identify patterns that help determine gender. These dental differences are especially useful in forensic cases where teeth may be the only well-preserved remains.

Materials and Method

This observational, cross-sectional study was conducted using maxillary and mandibular dental models. A total of 50 dental models (25 males and 25 females), aged between 20 and 30 years, were randomly selected from the working models available in the Department of Orthodontics and Dento-facial Orthopaedics at Narsinhbhai Patel Dental College and Hospital, Gujarat, India. The age and gender of the patients were obtained from departmental records, and informed consent was taken from all participants. Inclusion criteria specified that participants included in the study had a full set of natural teeth with no hard tissue abnormalities. Those with developmental

anomalies, regressive changes, or dental restorations were excluded.

First, the models were categorized and information of respective individuals was tabulated into Excel sheet. With the aid of a digital Vernier calliper (Stainless - 150mm/6) measured the mesiodistal (MD) distance (utmost distance between the proximal surfaces of premolars) (Figure 1) and buccolingual (BL) measurement (distance between the extreme points of the buccal and lingual surfaces of the premolar crowns) (Figure 2). In addition, the intra-arch premolars linear distance measured from lingual-lingual cusp (3 cups premolars were excluded from study) tips distance between the lingual cusps of corresponding (homologous) premolars in each quadrant (Figure 3) was measured. The collected data were entered into a database and analysed using SPSS version 23. Descriptive statistics, Friedmans test was done for intra-gender comparison and independent t-test was done for inter-Gender comparison.

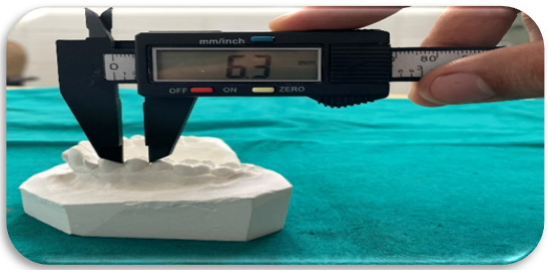


Figure-1. Mesio-Distal distance

Figure-2. Bucco-Lingual distance

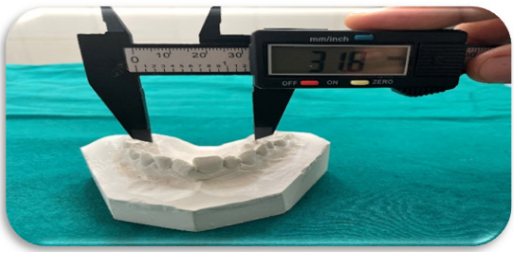


Figure-3. Lingual-Lingual Premolars cusp distance

Results

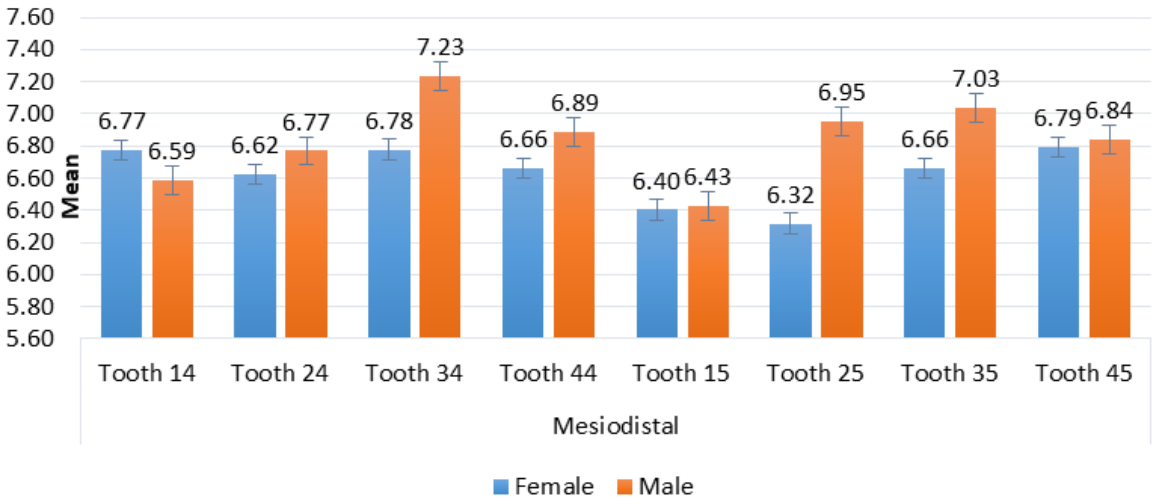
Sexual dimorphism was assessed through odontometric measurements using mesiodistal and buccolingual measurement of all premolars, and lingual-lingual cusp distance (arch width) of bilateral premolars. The measurements were charted and data was analysed using SPSS version 23. Descriptive statistics, Friedmans test for intragender comparison and independent t- test was used for inter gender comparison. Table-1 presents the comparative data between male and female subjects.

- Mesiodistal Measurements:
  - Significant differences were observed in the lower left 1st premolar (tooth 34), upper left 2nd premolar (25), and lower left 2nd premolar (35), with p-values of 0.005, 0.003, and 0.029 respectively.
  - The overall p-values for all teeth measured in this category were significant for both males ($p = 0.022$) and females ($p = 0.010$), indicating a notable level of sexual dimorphism.
- Buccolingual Measurements:
  - Statistically significant differences were noted in the lower right 1st premolar (44; $p = 0.008$), upper right 2nd premolar (15; $p < 0.001$), upper left 2nd premolar (25; $p = 0.036$), lower left 2nd premolar (35; $p < 0.001$), and lower right 2nd premolar (45; $p = 0.005$).
  - Overall, the differences in buccolingual dimensions between sexes were highly significant ($p < 0.001$) for both jaws.
- Lingual-Lingual Cusp Distance:
  - All cusp-to-cusp distances between the premolars of opposing quadrants (14–24, 15–25, 34–44, and 35–45) showed highly significant differences between males and females, with p-values < 0.001, except for 34–44 which had $p = 0.001$.

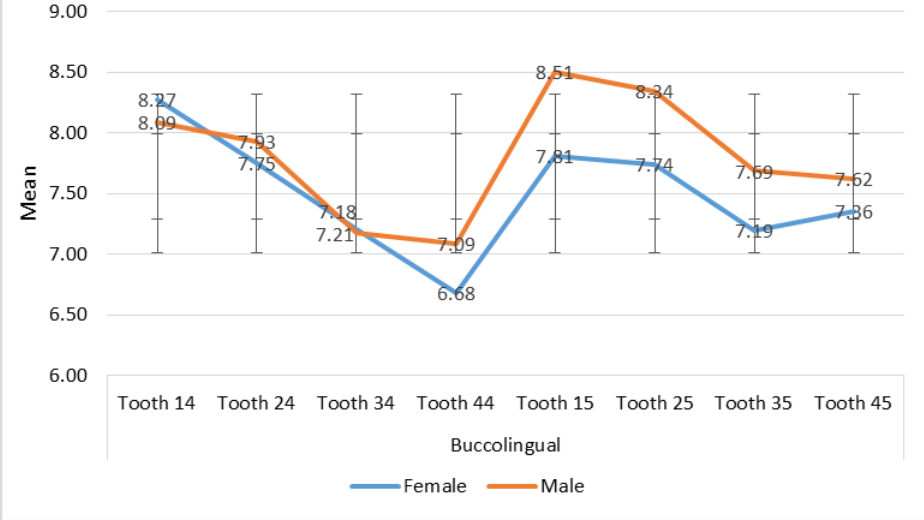
Table 1: Comparison of various parameters

Measurement	Tooth	Female		Male		P-value
		Mean	Std. Dev.	Mean	Std. Dev.	
Mesiodistal	14	6.77	0.48	6.59	0.48	0.246 NS
	24	6.62	0.47	6.77	0.29	0.287 NS
	34	6.78	0.44	7.23	0.63	0.005*
	44	6.66	0.57	6.89	0.51	0.143 NS
	P value	**0.395 NS**		**0.153 NS**		
	15	6.40	0.67	6.43	0.73	0.906 NS
	25	6.32	0.61	6.95	0.80	0.003*
	35	6.66	0.37	7.03	0.57	0.029*
	45	6.79	0.60	6.84	0.57	0.795 NS
	P value	**0.010***		**0.022***		
Buccolingual	14	8.27	0.76	8.09	0.50	0.317 NS
	24	7.75	0.59	7.93	0.80	0.384 NS
	34	7.21	0.67	7.18	0.53	0.864 NS
	44	6.68	0.40	7.09	0.62	0.008*
	P value	**<0.001****		**<0.001****		
	15	7.81	0.60	8.51	0.52	<0.001**
	25	7.74	1.37	8.34	0.32	0.036*
	35	7.19	0.37	7.69	0.38	<0.001**
	45	7.36	0.37	7.62	0.25	0.005*
	P value	**<0.001****		**<0.001****		
L-L Cusp distance	14-24	29.17	1.91	31.91	1.01	<0.001**
	15-25	33.06	2.17	35.21	0.98	<0.001**
	34-44	28.81	2.01	30.95	2.26	0.001*
	35-45	31.82	2.16	34.42	1.89	<0.001**
	P value	<0.001**		<0.001**		

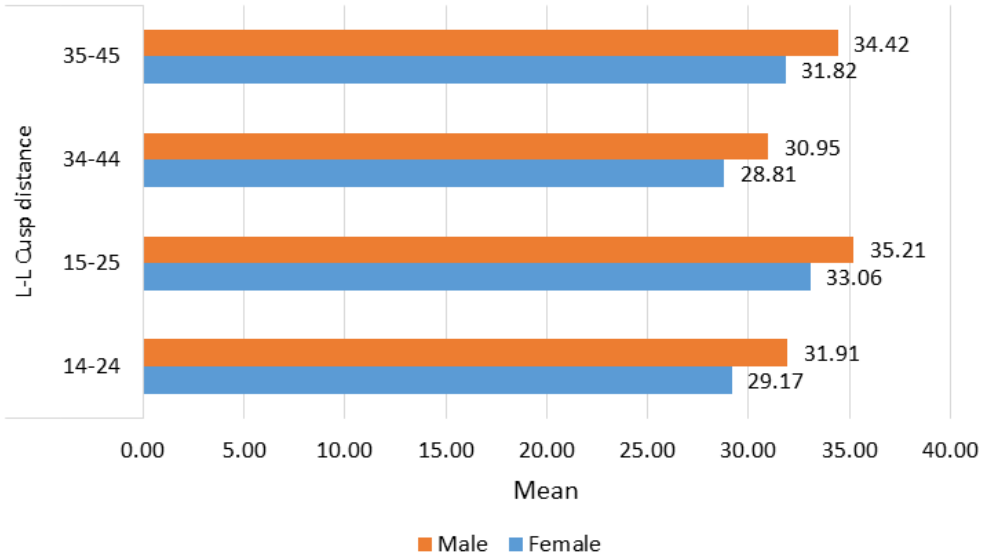
**Highly significant (p<0.001), *-Significant (p<0.05), NS – Not significant (p>0.05)



Graph 1: Mesio-distal measurement premolars



Graph 2: Bucco-lingual measurement of premolars



Graph 3: Lingual – lingual cusp distance

Discussion

Sex determination is a significant aspect in the identification of an individual. Numerous methodologies for identification are presently employed. Withstanding environmental challenges, dentition proves to be an enduring and valuable asset in the field of identification. Amidst the array of gender determination methods like DNA analysis and bone ossification examination, odontometry holds a crucial role. Its applicability as an adjunct method is highlighted by its simplicity, reliability, ease of measurement, and cost-effectiveness, making it especially useful in studies involving large populations.

The present study analyzed buccolingual, mesio-distal measurements of maxillary and mandibular premolars and arch width in premolar region (Table 1) for its application in sex determination. In line with study by Saeed Hossain khan et al; the evaluation of mandibular canines and second premolars, mesio-distal measurements revealed a significant male predominance, with larger dimensions compared to females in both arches (Graph 1). The Buccolingual measurements of all the 2nd premolars was significantly higher in males as compared to females (Graph 2).

Another study by Eleni Zorba et al; The findings revealed a notable sexual dimorphism in all measured dimensions of both upper and lower canines, as well as upper and lower first premolars. According to Garn et al. Notably, the teeth neighbouring the canines, such as the first premolar, exhibit a higher degree of sexual dimorphism compared to other dental structures.[7] In a study conducted by Ashwini Shena, Nithyathe outcomes revealed a consistent pattern where mesiodistal and buccolingual dimensions of maxillary canines, premolars, and molars in males surpassed those observed in females.[8]

The lingual-lingual distance (arch width), between the lingual cusps of premolars in different quadrants showed significant sexual dimorphism in both upper and lower jaw (Graph 3). Study conducted by Rastogi et al; measured the distance between the lower premolars by drawing a straight line between the occlusal grooves of the teeth and results revealed a sex-related difference.[3] Another study done by G. Agnihotri; Results demonstrated a substantial gender difference, revealing that males exhibit greater arch width in both premolars and molars when compared to females.[9] According to, Medha Rajiv Ranjan, Yuvaraj Babu. K, their investigation demonstrated that odontometric measurements, specifically the second maxillary inter-premolar distance, emerged as a reliable parameter for gender determination.[10]

Conclusion

Odontometric measurements, particularly the buccolingual dimensions of the second premolars and the linear distance between lingual-lingual cusps of intra-arch premolars, show significant sexual dimorphism and can serve as reliable indicator in sex determination. Males consistently exhibited higher values in these parameters, reinforcing their forensic relevance.

The limitation of the study is in its potential application in diverse population, age-related and orthodontic influences on tooth dimensions. This opens gate for further exploration into varied ethnic and regional groups with higher sample size for universal application of these parameters to be used as a reliable and economical method for sex determination of incapacitated jaw bones.

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Conflict of interest: The authors reported no conflict of interest during the study.

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