International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Determination of Sexual Dimorphism of Kashmiri Population using Odontometric Dimensions

Dr. Altaf Hussain Chalkoo[1], Dr. Bashir Ahmad Wani[2], Dr. Shazia Maqbool[3]

[1]Professor and Head, Department of Oral Medicine and Radiology Government Dental College Srinagar, India
[2, 3]Post Graduate Students, Department of Oral Medicine and Radiology Government Dental College Srinagar, India

Abstract: ***Introduction: Sex determination is an essential step for medico-legal purposes and identification of victims in mass disaster. Teeth are an excellent material for forensic investigations, as they are known to resist a variety of ante-mortem and post-mortem insults. Using teeth for determination of sex plays a pivotal role in young individuals where the skeletal secondary sexual characters have not yet developed. Sex determination using dental features is primarily based upon the comparison of tooth dimensions in males and females. Hence, this study was undertaken to evaluate the existence of sexual dimorphism in kashmiri population. Aim: To evaluate and estimate the degree of odontometric sexual dimorphism in all permanent teeth except third molars and the variations in odontometric dimensions between teeth of the maxillary and mandibular dental arches in male and female groups. Materials and Methods: The sample comprised of 108 individuals of kashmiri population (56 females, 52 males), young adults in the age-group of 16-26 years. Both Maxillary and Mandibular study models were collected from the Department of Orthodontics from patients who report for orthodontic treatment there. The Mesiodistal (MD) and BuccoLingual (BL) measurements of 28 teeth were estimated using digital Verniers' Caliper. The data obtained were analysed using SPSS version 16.5 and the Students' t-test for two independent samples. Results: The Mesio-distal (MD) and Bucco-lingual (BL) parameters of all permanent teeth in the study group showed sexual dimorphism. The mandibular canines showed the greatest sexual dimorphism followed by central incisors. Out of 56 variables measured, male teeth exceeded females significantly in 09 ($p < 0.05$), of these 06 belongs to the mandible. 16 out of 56 variables were larger in females although the differences were statistically insignificant. Conclusion: This study showed a varied percentage of sexual dimorphism and variation in the mean values of MD and BL dimensions in males and females***

Keywords: Bucco-lingual, Mesio-distal, Forensic odonto-metry, Sexual dimorphism

1. Introduction

All the people in this world are born with an identity and deserve the right to die with an identity. During mass disaster, the first step in the identification of victims is the separation of sexes.[1] An accuracy in sex determination in the range of 96 to 100% is achieved by postmortem radiographs and specimens of pelvic, cranial and long bones. However, when there is severe devastation, body fragmentation or decomposition, sex determination can be achieved by using dental identification.[2]

Sexual dimorphism is defined as the differences in size, shape, stature and appearance between males and females. As no two mouths are alike, there are differences seen between males and females. Studies have confirmed that there exists a sexual dimorphism in specific populations and also within same populations.[3] Variation in tooth size is influenced by genetic as well as environmental factors.[4] Apart from racial differences, the other factors associated with tooth size variability are gender , environment, hereditary factors, bilateral differences and secular changes.[3] Such differences could have implication in the application of diagnostic criteria derived from specific populations, as in prediction equations used to estimate mesiodistal crown dimensions of unerupted permanent teeth. Without information about the size of individual teeth and groups of teeth, it is difficult for a clinician to make a diagnosis and plan treatment and to carry out a plan of therapy.[6] Teeth are hardest and chemically most stable tissues in the body and exhibit least turnover of natural structure. They are well preserved after death. Further, they show significant sexual dimorphism and are readily accessible for examination. Thus, they provide excellent materials for forensic studies involving identification of sex.[5]

Teeth may be used for differentiating sex by measuring their mesiodistal and buccolingual dimensions. Using teeth for determination of sex plays a pivotal role in young individuals where the skeletal secondary sexual characters have not yet developed.[5] 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 shoveling of the upper central incisors. [7]

Therefore, this study was taken to evaluate the existence of variations in odontometric dimensions to signify sexual dimorphism between the left and right side of the dental arches in Kashmiri population.

2. Materials and Methods

The sample comprised of 108 individuals of kashmiri population (56 females, 52 males), young adults in the age-group of 16-26 years. Both Maxillary and Mandibular study models were collected from the Department of Orthodontics from patients who report for orthodontic treatment there. This age group was selected as there is minimum attrition and abrasion. Inclusion criteria included teeth that are healthy, without periodontal disease and caries, and presence of teeth upto the permanent second molars. Measurements were done using digital Verniers' Caliper. Mesiodistal as well as buccolingual measurements of all the teeth were done by two dental surgeons independently and average of

the values was taken. The Mean, standard deviation, and p values were obtained.

The students t-test was used to compare the dimensions measured for males and females (Male v/s Female). A $p < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS 16.5, statistical software programme (SPSS Inc., Chicago, Illinois, USA).

MD dimension: The greatest mesiodistal dimension between the contact points of teeth (fig.2).

BL dimension: The greatest dimension between buccal and lingual surfaces of crown, taken at right angles to the plane in which mesiodistal diameter is taken(fig.1).

Percentage dimorphism defined as "the percent to which the tooth size of males exceeded that of females" in order to express the magnitude of sex dimorphism is calculated as "(Xm/Xf-1) x 100", where 'Xm' is the mean male tooth dimension and 'Xf' is the mean female tooth dimension. Percentage dimorphism with positive value indicates male tooth dimension larger than female tooth dimensions whereas a negative value indicates vice versa

3. Results

The mean values, standard deviation and p-value of MD & BL dimensions of both maxillary and mandibular teeth in male and female groups are shown in [Table 1 and 2].

MD dimension showing significant values for maxillary right second molars(17), right canine(13), left canine(23) , left second premolar (25) and mandibular right and left second premolars(35,45),right and left canine(33 and 43) and right and left central incisors(31,41).BL dimensions does not show significant values between males and females except for left mandibular lateral incisor (32) and right first premolar (44) [table 1and 2].

The mandibular canines showed the greatest sexual dimorphism followed by central incisors. Out of 56 variables measured, male teeth exceeded females significantly in 09 ($p < 0.05$), of these 06 belongs to the mandible. 16 out of 56 variables namely, MD dimensions of teeth 15, 11, 24, 25 and 27, as well as BL dimensions of 17, 13, 12, 24, 25, 27, 35, 32, 31, 42, and 47, were larger in females although the differences were statistically insignificant ($p > 0.05$). The values of sexual dimorphism for both MD & BL dimension of maxillary and mandibular teeth are given in [Table-3].

Table 1: Showing mean values and standard deviation of MD and BL dimension of maxially teeth in male and female groups

Tooth No.	Gender	Mesiodistal			Buccolingual		
		Mean	SD	P-value	Mean	SD	P-value
17	Male	9.71	0.835	0.005*	11.44	0.599	0.616
	Female	9.28	0.447		11.54	1.120	
16	Male	10.26	0.740	0.068	11.60	0.706	0.612
	Female	10.00	0.515		11.51	0.739	
15	Male	6.53	0.514	0.523	9.48	0.522	0.864
	Female	6.61	0.536		9.46	0.476	
14	Male	6.85	0.660	0.562	9.29	0.672	0.874
	Female	6.78	0.370		9.27	0.706	
13	Male	7.62	0.458	0.002*	8.03	0.767	0.961
	Female	7.22	0.658		8.04	1.009	
12	Male	6.80	0.921	0.982	6.60	0.904	0.329
	Female	6.80	0.564		6.76	0.560	
11	Male	8.60	0.736	0.948	7.58	0.644	0.201
	Female	8.61	0.408		7.39	0.664	
21	Male	8.56	0.943	0.707	7.44	0.690	0.961
	Female	8.48	1.013		7.43	0.507	
22	Male	6.92	0.800	0.209	6.91	1.077	0.605
	Female	6.72	0.580		6.81	0.637	
23	Male	7.61	0.501	<0.001*	8.30	0.844	0.059
	Female	7.14	0.606		7.98	0.655	
24	Male	6.84	0.482	0.759	9.38	0.710	0.958
	Female	6.87	0.474		9.39	0.533	
25	Male	6.47	0.442	0.015*	9.38	0.506	0.350
	Female	6.88	0.910		9.48	0.401	
26	Male	10.08	0.710	0.249	11.43	0.672	0.275
	Female	9.90	0.699		11.27	0.615	
27	Male	9.49	0.887	0.808	11.23	0.573	0.794
	Female	9.53	0.500		11.27	0.814	

Table 2: Showing mean values and standard deviation of MD and BL dimension of mandibular teeth in male and female groups

Tooth No.	Gender	Mesiodistal			Buccolingual		
		Mean	SD	P-value	Mean	SD	P-value
37	Male	10.37	1.020	0.078	10.66	0.796	0.596
	Female	10.03	0.656		10.57	0.675	
36	Male	10.99	0.914	0.919	11.41	1.792	0.178
	Female	10.97	0.588		11.01	0.562	
35	Male	7.39	0.787	0.013*	8.54	0.748	0.265
	Female	7.04	0.385		8.69	0.359	
34	Male	7.33	0.773	0.124	8.03	0.711	0.330
	Female	7.12	0.413		7.89	0.577	
33	Male	6.95	0.598	<0.001*	7.65	0.946	0.429
	Female	6.49	0.522		7.52	0.456	
32	Male	6.05	0.449	0.095	6.23	0.535	0.013*
	Female	5.91	0.304		6.59	0.709	
31	Male	5.71	0.461	<0.001*	6.18	0.481	0.537
	Female	5.36	0.348		6.25	0.536	
41	Male	5.67	0.353	0.036*	6.28	0.470	0.831
	Female	5.50	0.343		6.25	0.591	
42	Male	6.13	0.461	0.123	6.32	0.469	0.312
	Female	6.00	0.230		6.46	0.695	
43	Male	6.82	0.560	0.019*	7.64	0.860	0.483
	Female	6.56	0.406		7.52	0.654	
44	Male	7.30	0.686	0.101	8.30	0.487	0.003*
	Female	7.11	0.285		8.02	0.366	
45	Male	7.32	0.892	0.005*	8.76	0.911	0.301
	Female	6.87	0.439		8.60	0.374	
46	Male	11.06	1.024	0.442	10.99	0.811	0.198
	Female	10.91	0.617		10.76	0.787	
47	Male	10.23	1.010	0.273	10.33	0.907	0.083
	Female	10.02	0.771		10.64	0.663	

Table 3: Sexual dimorphism and reference point in maxiallry and mandibular teeth

Tooth No.	Sexual Dimorphism		Reference Point	
	MD	BL	MD	BL
17	4.58	-0.88	9.30	11.75
16	2.61	0.71	10.02	11.57
15	-1.14	0.20	6.58	9.44
14	1.01	0.26	6.67	9.30
13	5.51	-0.12	7.52	8.16
12	0.06	-2.41	6.62	6.51

11	-0.10	2.54	8.44	7.50
21	0.97	0.09	8.55	7.35
22	2.91	1.49	6.71	6.64
23	6.59	4.01	7.43	8.05
24	-0.48	-0.08	6.85	9.29
25	-5.84	-1.00	6.91	9.38
26	1.83	1.39	9.99	11.32
27	-0.40	-0.37	9.32	11.37
37	3.37	0.82	10.02	10.56
36	0.16	3.59	10.82	10.60
35	4.94	-1.67	7.02	8.42
34	2.98	1.78	7.04	7.89
33	7.19	1.73	6.68	7.34
32	2.42	-5.44	5.91	6.50
31	6.64	-1.13	5.48	6.24
41	3.00	0.41	5.58	6.33
42	2.08	-2.09	5.95	6.50
43	3.94	1.58	6.62	7.48
44	2.69	3.59	7.00	8.10
45	6.54	1.85	6.87	8.41
46	1.32	2.14	10.78	10.87
47	2.19	-2.90	10.01	10.36

4. Discussion

Sexual dimorphism represents as the differences in size, shape, stature and appearance between males and females. As no two mouths are alike, there are differences seen between males and females. Studies have confirmed that there exists a sexual dimorphism in specific populations and also within same populations.[3] Forensic odontologists have utilized DNA analysis, tooth dimensions and craniofacial morphology as investigative measure in gender differentiation. [8] Although DNA analysis is time consuming and technique sensitive, it gives irrefutable evidence for the determination of sex in the skeletal remains [9].

Odontometric analysis has been utilized as a method of sex determination since long, as it can be used in poorly fragmented skeletal remains as well as living individuals accurately [10]. Mesio-distal and bucco-lingual are the two most commonly used tooth dimensions for sex assessment in forensic investigations of the permanent tooth crown, because they are simple, easy to measure and reliable. [11] In young individuals who don't have fully developed characters, tooth dimensions can aids in gender determination.[12] As permanent tooth crowns are formed early in the life with their dimensions remaining stable except for functional, pathological or nutritional disorders affecting the morphology or structure of the teeth. Permanent dentition of young individuals are the best sample for tooth dimensions as compared to older individuals, because they are least attritied and mutilated. [13] Therefore subjects in the age group of 16-26 years were only included in the study sample.

In this study, we analyzed the degree of sexual dimorphism in all teeth except third molars by measuring the mesiodistal and buccolingual dimensions of study casts. The mandibular canines showed the greatest sexual dimorphism followed by central incisors. MD dimensions showing significant values for maxillary right second molars(17), right canine(13), left canine(23), left second premolar (25) and mandibular right and left second premolars(35,45),right and left canine(33 and 43) and right and left central incisors(31,41).BL dimensions does not show significant values between males and females except for left mandibular lateral incisor (32) and right first premolar (44) [table 1and 2]. 16 out of 56 variables namely, MD dimensions of teeth 15, 11, 24, 25 and 27, as well as BL dimensions of 17, 13, 12, 24, 25, 27, 35, 32, 31, 42, and 47, were larger in females although the differences were statistically insignificant ($p > 0.05$).

Percentage dimorphism is defined as "the percent to which the tooth size of males exceeded that of females" in order to express the magnitude of sex dimorphism and is calculated as "(Xm/Xf-1) x 100", where 'Xm' is the mean male tooth dimension and 'Xf' is the mean female tooth dimension. Percentage dimorphism with positive value indicates male tooth dimension larger than female tooth dimensions whereas a negative value indicates vice versa shown in table-3. Out of 56 variables measured, male teeth exceeded females significantly in 09 ($p < 0.05$), of these,06 belonged to the mandible. 16 out of 56 variables namely, MD dimensions of teeth 15, 11, 24, 25 and 27, as well as BL dimensions of 17, 13, 12, 24, 25, 27, 35, 32, 31, 42, and 47, were larger in females although the differences were statistically insignificant ($p > 0.05$). Traditionally canines have shown the greatest degree of sexual dimorphism across population. However, first molar dimension have also been reported as the most sexually dimorphic variable by some authors [14]. Reverse dimorphism has also been reported in Iraqi (Ghose et al.) and Ticuna Indians (Harris et al.) populations.[15] Garn et al. concluded that amongst all the teeth, mandibular canine had exhibited the greatest sexual dimorphism.[16] Nair et al. in their study on South Indian subjects reported that the left mandibular canine exhibits a sexual dimorphism of 7.7% and the right mandibular canine of 6.2%.[17]

5. Conclusion

Sex determination by using dimensions of teeth provide an easy and inexpensive method of gender identification. This study reveals that mandibular canines showed the greatest sexual dimorphism followed by central incisors. Out of 56 variables measured, male teeth exceeded females significantly in 09 ($p < 0.05$), of these, 06 belonged to the mandible. 16 out of 56 variables namely, MD dimensions of teeth 15, 11, 24, 25 and 27, as well as BL dimensions of 17, 13, 12, 24, 25, 27, 35, 32, 31, 42, and 47, were larger in females although the differences were statistically insignificant ($p > 0.05$). Studies conducted by different researchers on various populations have shown a varied percentage of dimorphism, indicating that sexual dimorphism is population specific.

References

[1] Sreedevi Dharman, Gnanasundaram N, Maragathavalli Gopal, Arvind Muthukrishnan Phenotypic differences in teeth dimensions among Chennai population: An aid in sex determination Journal of Indian Academy of Oral Medicine and Radiology 2018, IP: 169.149.20.168
[2] Grover M,Bai RG,Ram T,Puri PM, Ghodke KR. An odontologist's key to sex determination: Study analysis

of mandibular canine teeth in south Indian population. J Orofac Res 2013;3:157-60.
[3] Sharlene Sara Babu, Sunil Sukumaran Nair,Devi Gopakumar,Nisha Kurian, Arjun Parameswar, Linear Odontometric Analysis of Permanent Dentition as A Forensic Aid: A Retrospective Study;Journal of Clinical and Diagnostic Research. 2016 May, Vol-10(5): ZC24-ZC28
[4] Vishwakarma N, Guha R. A study of sexual dimorphism in permanent mandibularcani nes and its implications in forensic investigations. *Nepal Med Coll J*. 2011; 13:96-99.
[5] Prabhu S, Acharya AB. Odontometric sex assessment in Indians. *Forensic Sci Int*. 2009; 192:129e1-5.
[6] Saeed Hossain Khan, Gazi Shamim Hassan, Tanzila Rafique, Md. Nazmul Hasan, Md.Sharif Hossain Russell; Mesiodistal Crown Dimensions of Permanent Teeth in Bangladeshi Population: BSMMU J 2011; 4(2): 81-87
[7] Teschler-Nicola M, Prossinger H. Sex determination using tooth dimensions. In: Alt KFW, Rösing F, Teschler-Nicola M, editors. Dental Anthropology, Fundamentals, Limits and Prospects. Wien: Springer-Verlag. 1998; 479-501.
[8] Y. Bilge, P.S. Kedici, Y.D. Alakoc, K.U. Ulkuer, Y. Yilkyaz. The identification of a dismembered human body: a multidisciplinary approach. *Forensic Sci Int*. 2003; 137:141-46.
[9] Luo YC. Sex determination from the pubis by discriminant function analysis. *Forensic Sci Int.* 1995; 74:89-98.
[10] Messina AD. The use of odontometric traits improves the chances of sex identification in a contemporary Silician human population. *Austin J Forensic Sci Criminol*. 2015; 2:1-7.
[11] Teschler-Nicola M, Prossinger H. Sex determination using tooth dimensions. In: Alt KFW,Rosing F,Teschler-Nicola M,editors. Dental Anthropology, Fundamentals, Limits and Prospects.Wien: Springer-Verlag.1998:479-501.
[12] Hemanth M, Vidya M, Shetty N, Karkera BV. Sex determination using dental tissue. Medico-legal Update. 2008; 8:7-12.
[13] Doris JM, Bernard BW, Kuftinec MM, Stom D. A biometric study of tooth size and dental crowding. Am J Orthod. 1981; 79:326-36..
[14] Iscan MY, Kedici PS. Sexual variation in bucco-lingual dimensions in Turkish dentition. Forensic Sci Int .2003; 137:160-64.
[15] Ghose LJ, Bhagdady VS. Analysis of Iraqi dentition: mesiodistal crown diameters of permanent teeth. J Dent Res.1979;58:1047–54.
[16] Garn SM, Lewis AB, Kerewsky RS. Buccolingual size asymmetry and its developmental meaning. Angle Orthod 1967;37:186-93.
[17] Nair P, Rao BB, Annigeri RG. A study of tooth size, symmetry and sexual dimorphism. J Forensic Med Toxicol 1999;16:10-3.

Figure 1: Showing buccolingual dimension

Figure 2: Showing mesiodistal dimension