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ORIGINAL ARTICLE

Comparative Measurement of Mesiodistal Width of Six Anterior Maxillary and Mandibular Teeth in Rajasthan Population

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Abstract The purpose of the study was to determine the mesiodistal width of six anterior teeth for better esthetics and good tooth arrangement in a cross section of Rajasthan population. The mesiodistal dimension of central, lateral incisor and canine on right and left sides was measured in 250 males and 250 females, these readings were used to determine the mean, minimum and maximum maxillary/mandibular teeth 'anterior ratio', difference in mesiodistal width, combined mean mesiodistal width, the number and percent of similar teeth of maxilla and mandible. It was observed from the present study that there is variation in mesiodistal width in right and left sides signifying that the anterior teeth are not mirror images of one another. Male subjects have greater mesiodistal width than female subjects and right side dominates in most of the readings indicating that mesiodistal width is greater on right side than on left side. Percentage variability and sexual dimorphism are also important findings of this study. This study can prove helpful in replacement of artificial teeth of prosthesis in this cross section of population.

Keywords Mesiodistal width · Maxillary · Mandibular teeth · Percentage variability

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Introduction

It was once written that we greet the world with our faces it also helps to determine our social appearance. It is a matter of great concern, when planning treatment to replace artificial anterior teeth in the region of maxilla and mandible since they are the most exposed teeth while speaking, smiling and biting affecting the esthetic personality of an individual.

The introduction of Dentogenics concept by Fisher and Frush has made the selection of teeth more appropriate; with respect to sex, personality and age of the patient. Since it is difficult to establish firm, scientific rule or laws of esthetics, there must be blending of the art and science of Prosthodontics. The artificial teeth available are not dimensionally suitable for the edentulous area available so it is important to determine the adequate teeth size. Most studies done in this area do not include the population of Asia and India, one of its largest countries. The aim of this study is to measure mesiodistal width of six anterior natural teeth in maxilla and mandible in a sample of Rajasthan population to select proper anterior teeth close to natural tooth.

Materials and Methods

This study was conducted on students of Darshan Dental College Udaipur, Rajasthan and patients reporting in the outpatient department. A total size of 250 males and 250 females in the age group 18–25 years without crowding, rotation, spacing and having normal occlusion were selected. Those excluded were subjects with anterior teeth fractures, congenital or acquired maxillofacial defects, attrition, microdontia and macrodontia. Impressions of maxillary and mandibular arches were made using standard protocols and according to manufacturers recommendations using Alginate

(Zelgan® 2002, Dentsply). It was poured with dental stone type III (Kalstone cl III, Kalabhai, Mumbai) within 15 mins. After one hour casts were recovered, damaged casts were discarded and impressions remade. Measurements were done using Digital Vernier caliper (Aerospace) (Fig. 1) on the casts by drawing a line perpendicular to long axis of the tooth in the maximum tooth contours of the teeth between a line parallel to occlusal and labial surfaces (Figs. 2, 3). Mesiodistal widths were measured by three observers. The casts were numbered in serial order i.e., 1, 2, 3.

Results

The results were presented under the headings of various parameters considered for this study as shown in Tables from 1 to 5. The mean, minimum and maximum maxillary/mandibular teeth 'anterior ratio' for male and female subjects is as shown in Table 1.

The mean mesiodistal width in males and females for maxillary teeth, the mean difference in right and left sides, the combined width with their difference and total mean mesiodistal width in maxilla and mandible is as shown in Tables 2 and 3 respectively. The difference of mean mesiodistal width in male and female subjects is 0.86 mm. The difference of combined mean mesiodistal width of male and female subjects on right, left side maxilla and mandible is 0.42 mm, 0.44 mm and 0.45 mm, 0.41 mm respectively as shown in Table 4. These readings signify that the mean mesiodistal widths are larger for male subjects than female subjects and that mean mesiodistal width on right side is greater than left side except the mean mesiodistal width for right and left mandibular canine with a difference of −0.02 mm.

The percent of similar combined mean mesiodistal width of maxillary anterior teeth right and left side in male and female subjects is 7.17 and 9.56% and in mandible is 9.56 and 11.95%, respectively, as shown in Table 5 (Fig. 4). The maximum number of similar right and left teeth in male subjects is maxillary canine which amounts to

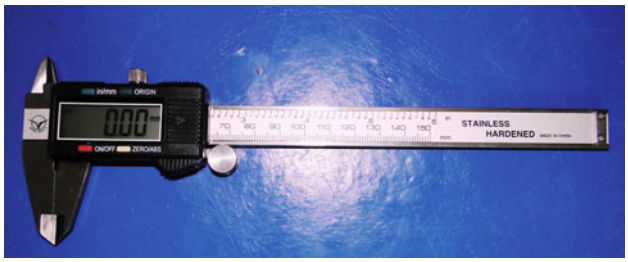

Fig. 1 Vernier caliper

Fig. 2 Measurement of maxillary teeth using Vernier caliper

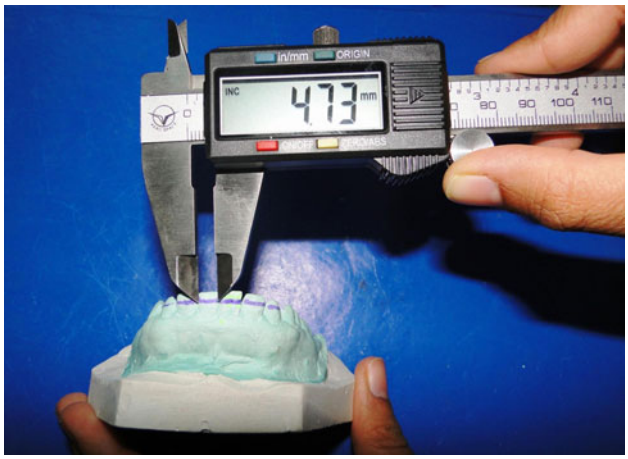

Fig. 3 Measurement of mandibular teeth using Vernier caliper

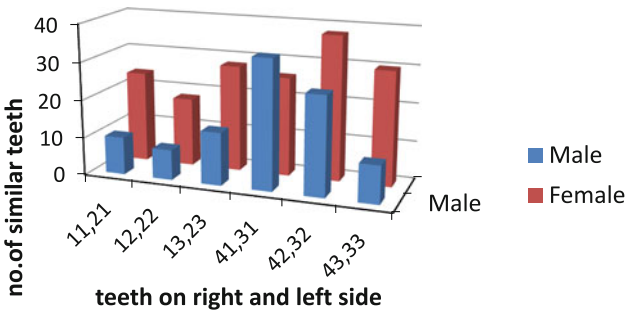

Fig. 4 *Bar diagram* showing the number of similar maxillary and mandibular teeth in male and female subjects

Table 1 'Anterior ratio' (mm) in 250 male and 250 female subjects

	250 Males	250 Females
Mean	1.27	1.28
Minimum	1.12	1.02
Maximum	1.42	1.50

Table 2 Mean mesiodistal dimensions of 11, 12, 13 and 21, 22, 23 the total and difference of each tooth on both sides and combined mesiodistal widths in maxilla

	Mdw 11	Mdw 21	Diff in Mdw 11 & 21	Mdw 12	Mdw 22	Diff in Mdw 12 & 22	Mdw 13	Mdw 23	Diff in Mdw 13 & 23	Total Mdw 11, 12, 13	Total Mdw 21, 22, 23	Diff in 11, 12, 13 & 21, 22, 23	Total
Male	8.80	8.76	0.04	7.04	6.94	0.1	8.03	7.99	0.04	23.87	23.69	0.18	47.56
Female	8.67	8.59	0.08	6.91	6.85	0.06	7.87	7.81	0.06	23.45	23.25	0.20	46.70

Mdw Mesiodistal width; *11* maxillary right central incisor; *21* maxillary left central incisor; *12* maxillary right lateral incisor *22* maxillary left lateral incisor; *13* maxillary right canine; *23* maxillary left canine

Table 3 Mean mesiodistal dimensions (mm) of 31, 32, 33 and 41, 42, 43 the total and difference of each tooth on both sides and combined mesiodistal widths in mandible

	Mdw 41	Mdw 31	Diff in Mdw 41 & 31	Mdw 42	Mdw 32	Diff in Mdw 42 & 32	Mdw 43	Mdw 33	Diff in Mdw 43 & 33	Total Mdw 41, 42, 43	Total Mdw 31, 32, 33	Diff in Mdw 41, 42, 43 & 31, 32, 33	Total Mdw
Male	5.57	5.52	0.05	6.12	6.07	0.05	7.02	7.02	0.00	18.71	18.61	0.10	37.32
Female	5.52	5.48	0.04	6.02	5.98	0.04	6.72	6.74	−0.02	18.26	18.20	0.06	36.46

Mdw Mesiodistal width; *41* mandibullar right central incisor; *31* mandibular left central incisor; *42* mandibular right lateral incisor; *32* mandibular left lateral incisor; *43* mandibular right canine; *33* mandibular left canine

Table 4 Difference in Mean Mesiodistal Width (mm), Combined Mean Mesiodistal Width on right and left side in maxilla and mandible

	Mean Mdw males	Mean Mdw females	Diff	Mean Mdw right side males	Mean Mdw right side females	Diff	Mean Mdw left side males	Mean Mdw left side females	Diff
Mean maxillary	47.56	46.70	0.86	23.87	23.45	0.42	23.69	23.25	0.44
Mean mandibular	37.32	36.46	0.86	18.71	18.26	0.45	18.61	18.20	0.41

Table 5 The no. and % of similar central incisor, lateral incisor, canine and Combined Mean Mdw. and left sides in maxilla and mandible of male and female subjects

	11, 21	%	12, 22	%	13, 23	%	41, 31	%	42, 32	%	43, 33	%	Comb no. of mean Mdw	%	Comb no. of mean Mdw	%
Male	10	4	8	3.2	14	5.6	34	13.6	26	10.4	10	4	18	7.17	24	9.56
Female	24	9.6	18	7.2	28	11.2	26	10.4	38	15.2	30	12	24	9.56	30	11.95

13.6% whereas in female subjects it is mandibular lateral incisor amounting to 15.2% The least number of similar right and left teeth in male subjects is maxillary lateral incisor which amounts to 3.2% and in female subjects it is maxillary lateral incisor amounting to 7.2%.

Discussion

The dentist is the only person who can accumulate, correlate, evaluate the biomechanical information and assess the selection of anterior artificial teeth so that it will meet the individual esthetic and functional needs [1]. Variations in every individual lead to characteristic appearance as mentioned by Young [2]. The tooth size standards based on odontometric investigations can be used in age and sex determination. Most studies done in this area do not include Asia and India even though they form largest population as compared to other ethnic groups, no measurements of tooth sizes have been made on the Rajasthan population. So a study was planned to measure the mesiodistal width of six anterior natural teeth. It also investigates variations in the size of left and right maxillary and mandibular anterior teeth and differences between men and women.

Krajicek [4] in 1969 stated that out of the two proportions width and length, width has been considered the most

important. Tooth selection is usually based on the premise that teeth are identical on each side of the dental arch, which is not the case in the natural dentition [5]. In the matter of size of teeth, the common place thing to do is to accept sets of comparative sizes decided on by the manufacturer [6]. Efforts to identify anatomic landmarks that correlate highly with the width of maxillary anterior teeth have met with limited success so, it is important to determine adequate teeth size.

The mesiodistal diameter of maxillary central incisor according to standard textbooks is 8.5 mm [7] and 8.6 mm [8] and it has been observed from past literature that varies from 8.36 to 9.33 mm [9–13] in different ethnic groups of Caucasian, Ohio, American, American Negroes, Saudi, Mongoloid and North Indian population. In the present study the mean mesiodistal width is 8.78 mm which is equal to the width recorded by Garn et al. [15]. Not much has been mentioned about right and left side, literature states that there is definitive difference between both the sides. In the present study right Central incisor is bigger than left with a difference of 0.04 mm. Garn et al. had stated that the mean values of teeth on either side of midline are within ±0.3 mm. Teeth on the left side exceed the teeth on right side, confirming that bilateral symmetry is not consistent on individual or group basis, the crown size is free from systematic sidedness, when asymmetry is found in most hard—tissue structures. Wazzna [16] stated that a difference of up to 1 mm between right and left maxillary central incisor is considered normal in appearance. Marvroskoufis and Ritchie [5] stated that population differences in mesiodistal crown size of far less than 0.1 mm may be statistically significant even though they fall well within the limits of caliper read out error, measuring error and undetectable enamel loss in apparently unworn young dentitions. The readings in his study are closely similar to present study. Women provided a greater index for identical incisors and a decrease in dissimilar teeth [15].The mean mesiodistal width of maxillary central incisor of maxilla in female subjects varies in the range of 8.21 mm to 9.21 mm [9–13, 17] varying for different racial groups. In the present study the mesiodistal width is 8.63 mm, this is closest to 8.62 mm mentioned by Singh and Goyal [13]. Right side Central incisor is bigger than left side with a difference of 0.08 mm in the present study.

The mesiodistal diameter of lateral incisor according to standard textbooks is 6.5 mm and 6.6 mm [7, 8]. Studies done by various authors [9–11, 13, 15] vary between 6.32 and 7.61 mm in male subjects. The mesiodistal width of maxillary right lateral incisor in male subjects is 7.04 mm in the present study this is close to 7.07 mm as mentioned by Singh and Goyal [13]. It varies between 6.51 and 6.73 mm [9, 14] for different racial groups. The mesiodistal width in the present study is 6.94 mm and as mentioned by different investigators [9, 11, 15, 16] vary between 6.53 mm and 6.71 ± 0.64 mm. The difference in right and left side is 0.1 mm in the present study in contrast of literatures varying in the range −0.02 to 0.02 mm. Various authors have mentioned the range in female subjects varying between 6.45 and 6.95 mm and the mesiodistal width of maxillary right lateral incisor varying between 6.61 and 6.32 ± 0.60 mm [7, 9, 11, 14]. The reading in the present study is 6.91 mm. The mesiodistal width of left lateral incisor varies between 6.57 and 6.28 ± 0.56 mm [12, 14]. The mean mesiodistal width of 6.95 mm recorded by Singh and Goyal [13] is closest to 6.85 mm, the mesiodistal width in present study. In female subjects the mean difference in right and left side is 0.062 mm in the present study and from various literatures is 0.04 mm approximately.

The mesiodistal width of maxillary canine according to standard textbooks is 7.5 and 7.6 mm [7, 8]. The mesiodistal width of right and left maxillary canine of male subjects in present study is 8.03 and 7.99 mm, respectively. The mesiodistal width of maxillary right canine is closer to 8.04 mm mentioned by Lennart and Nils [11] and on the left side is closer to 7.96 mm mentioned by Garn et al. [15]. In various literature varies in the range 7.70 ± 0.66 to 8.05 mm on right side and 7.70 ± 0.61 to 8.03 mm on left side [11, 15, 16] in males. In previous studies varies in the range of 7.53–8.32 mm. The difference in right and left side in the present study is 0.04 mm and in the range of 0.0–0.02 mm in previous studies. Whereas in female subjects the mesiodistal width of right and left maxillary canine in present study is 7.87 and 7.81 mm, respectively. In female subjects from various literatures varies in the range 7.50 ± 0.53 and 7.67 mm on right side and 7.44 ± 0.55 and 7.64 mm on left side. It varies in the range 7.00 and 8.21 mm in previous studies. The difference in right and left side in the present study is 0.068 mm and from previous studies as 0.06–0.03 mm approximately [11, 15, 16].

The mesiodistal diameter of mandibular central incisor according to standard textbooks is 5.0 and 5.3 mm [7, 8] studies done by various authors [9, 11] vary between 5.39 and 5.83 mm in male subjects. The mesiodistal width of right mandibular central incisor in male subjects is 5.57 mm in the present study this is close to 5.58 mm as mentioned by Lavelle [9] in his study. Other investigators [9, 14] have mentioned between 5.22 and 5.7 mm for different racial groups. The mesiodistal width of mandibular left central incisor in male subjects in the present study is 5.52 mm and as mentioned by different investigators [11, 15] vary between 5.20 and 5.50 mm. This width in present study is equal to the width mentioned by Lavelle [9] and Lennart and Nils [11]. In the present study the difference in right and left side is 0.05 mm in contrast of literatures where it varies in the range 0.02–0.3 mm. Various authors

have mentioned mean mesiodistal width of mandibular central incisor in female subjects varying in range of 5.32–6.07 mm. The mesiodistal width of mandibular right and left central incisor varies between 5.37 and 5.38 mm [11, 15] and 5.38 and 5.39 mm [11, 15], respectively. The mesiodistal width of left mandibular central incisor in present study on right and left side is 5.52 and 5.48 mm, respectively. This is closer to the readings mentioned by Lavelle [9]. In female subjects the mean difference in right and left side is 0.04 mm in the present study. However, the difference in right and left side varies in the range −0.01 to −0.01 mm approximately indicating that range is greater on left side.

The mesiodistal diameter of mandibular lateral incisor according to standard textbooks is 5.5 and 5.7 mm [7, 8]. The mesiodistal width of mandibular right and left lateral incisor in male subjects is 6.12 and 6.07 mm, respectively, in the present study. The mesiodistal width of right mandibular lateral incisor varies in range of 5.78 mm–6.05 mm [7, 8] as mentioned by different investigators. The mesiodistal width of the present study is closer to the mean width recorded by Richardson and Malhotra [10] and the left mesiodistal width is equal to mean width recorded by Lennart and Nils [11]. The mesiodistal width of left mandibular lateral incisor varies in range of 5.81–6.08 mm according to previous studies [9, 11, 15]. The mean mesiodistal width as mentioned by various authors varies in the range of 6.0–6.59 mm. The difference in right and left side in present study is 0.05 mm whereas in previous studies varies in range of −0.2 mm to −0.3 mm indicating the range is greater on left side. The mesiodistal width of mandibular right and left lateral incisor of female subjects in the present study is 6.02 and 5.98 mm, respectively. The mesiodistal width of left lateral incisor is equal to the mean width recorded by Singh and Goyal [13]. In male subjects as studied by various investigators on right side is 5.91 mm and on left side are 5.93 and 5.94 mm [11, 15]. The mean mesiodistal width according to various authors varies in between 5.86 and 6.49 mm. The difference in right and left side in present study is 0.04 mm whereas as according to literature varies between −0.02 and −0.03 mm indicating left side variation is greater.

The mesiodistal width of mandibular canine is 7.0 and 6.8 mm according to standard textbooks [7, 8]. The mesiodistal width of right and left mandibular canine of male subjects in present study is 7.02 and 7.02 mm respectively, this is equal to readings recorded by Lennart and Nils [11] and Garn et al. [15]. The mesiodistal width of mandibular right canine in male subjects according to literature varies in between 6.75 and 7.2 mm whereas on right side varies in range of 6.75–7.2 mm and on left side varies between 6.77 and 7.33 mm. The difference in right and left side is 0.00 mm in the present study and in literature varies in range from −0.02 to −0.128 mm indicating that left side is greater than right side. The mesiodistal width of mandibular right and left canine of female subjects in present study is 6.72 and 6.74 mm, respectively. The mesiodistal width of mandibular right canine in female subjects as described in literature varies from 6.58 to 7.41 mm whereas on right side varies in range of 6.59–6.70 mm and on left side between 6.63 and 6.69 mm. The difference in right and left side is −0.02 mm in the present study and in literature varies in range from −0.04 to 0.1 mm. According to Kausal et al. [18] a statistically significant sexual dimorphism exists in mandibular canine and it is greater on left side as compared to right side.

In our study the mean, minimum and maximum maxillary/mandibular teeth ‘anterior ratio’ for male subjects is 1.27, 1.12 and 1.42 mm, respectively, whereas in female subjects it is 1.28, 1.02 and 1.50 mm, respectively. The ‘anterior ratio’ of the present study is not close to the anterior ratio as mentioned by McArthur [12]. He also suggested for a ratio of 1.30 in his study denture teeth were to be set with approximately 1 mm of horizontal over jet and 1 mm of vertical overlap, therefore a slightly larger mold was chosen. This variation in readings is one of the reason we face problems in selection of teeth for removable partial dentures. The standard textbooks also do not mention difference in size between male and female and between right and left side.

Male subjects have greater mesiodistal width than female subjects this depends largely on genetic predisposition. In the present study male subjects show greater variability. Lennart and Nils [11] stated that boys exhibit greater mesiodistal diameter and greater tooth size variability in 20 out of 28 permanent teeth in contrast to findings of Garn et al. [15]. who stated that tooth crown size is mediated partly by X or Y chromosome or both, remains obscure; females show greater variability as crown size is mediated by X chromosome in diploid females as compared to haploid male. From the present study it was seen that male subjects have larger values than female subjects and that right side is greater than left side. Garn et al. [15] further added that these new crown-size values are for a total of 658 Ohio White subjects which include 243 subjects previously reported by them and that it is of interest that sample size affects the values, overall the new and old means agree within ±0.1 mm, except in lateral incisor and canine. They also mentioned that the mandibular teeth adjacent to canine, lateral and premolar exhibit greater percentage of sexual dimorphism in crown size than the teeth of the same morphological classes more remote from mandibular canine. In our study greater percentage of sexual dimorphism is seen in canine. Lennart and Nils [11] reported that highest degree of variation with regard to mesiodistal width is permanent upper lateral incisor (8.5%)

after comparing with different investigators, which has consequences not only for incisor relationship but also for interdigitation of the buccal teeth. Present study also supports these findings with highest degree of variation in lateral incisors. Greater variability of mean mesiodistal width is found in maxilla as percentage mean value is more in mandible than maxilla.

Garn et al. [15] found from his study that sex difference in tooth size for Ohio white children from a single geographical area was 4%. The sex difference in tooth size proved to be greatest for the canines 6% and least for the incisor group 3%. The sex difference in tooth size may be taken as an estimate of the magnitude of the chromosomally-determined and Y influenced size difference where steroid mediation is not involved. Dental irregularity and malocclusion are more prevalent in the industrialized communities of Europe and North America than in more primitive communities. The present day Caucasoid populations represents intermingling of people from diverse and physically dissimilar stocks with interbreeding leading to dental and skeletal disharmonies, it is possible that Negroid and Mongoloid populations are more homogenous skeletally and dentally. This accounts for the fact that maxillary and mandibular tooth size is highly correlated in Negroids than in Caucasoid. Furthermore the average mesiodistal diameter appeared greater in Negroid population than in Caucasoid population, with that for Mongoloid population being intermediate [9].

Conclusion

The present study was undertaken in a sample of Rajasthan population to determine the mesiodistal width of six anterior natural teeth in maxilla and mandible. It was observed that there is variation in mesiodistal width in right and left side signifying that the anterior teeth are not mirror images of one another. The artificial teeth in market also do not differ in size for right and left sides and there is no variation for male and female subjects. This is one of the major factors leading to artificial look in prosthesis.

The finding of the present study indicates that male subjects have greater mesiodistal width than female subjects. Right side dominates in most of the readings indicating that mesiodistal width is greater on right side than on left side. Overall least variability was seen in mandibular lateral incisor in female subjects with a percentage similarity of 15.2%. Maximum variability of 3.2% between right and left side was found in maxillary lateral incisor. Greater percentage of sexual dimorphism was seen in mandibular canine and more variability in maxillary teeth as compared to mandibular tooth. This study can prove helpful in replacement of artificial teeth of prosthesis in Rajasthan population in a better way.

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