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Analyzing Mesiodistal Widths of the Permanent Teeth

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Abstract

Background: Prediction of the mesio-distal width of the unerupted premolars and canine is an important point to the practitioner.

Objectives: The main goal of this study was to find the relationship of the teeth size to be used when needed in treatments planning.

Materials and Methods: 200 plaster casts including 5600 teeth were measured and studies. A caliper with accuracy of 0.1 mm was used for measuring teeth and most teeth were measured twice and the average value was considered as the teeth size. In all cases, the vernier calipers jaws were moved along the teeth longitudinal axis and the biggest width was measured in the contact point area.

Results: Tables of mesiodistal widths of the permanent teeth and some equations were prepared. The measurement difference varied from 0 to 0.04 mm. the average value of difference was 0.016 mm with SD of 0.02 mm. All teeth in male are bigger than those in female and this different is most evident in canine teeth, especially the lower jaw canine teeth.

Conclusions: At the end of this study an equation was found which was used to measure the total value of mesiodistal width of canine and premolar teeth of upper and lower jaws in a simple and exact way.

Keywords: Mesiodistal Widths, Tooth Size Discrepancy, Malocclusion, Bolton Analysis

1. Background

Orthodontics is a branch of dentistry which deals with analyzing and studying the growth of the craniofacial complex, occlusion development and treating dentofacial abnormalities (1). When there are crown size anomalies, aligning teeth and achieving a posterior normal cuspid relation is difficult and sometimes impossible (2). Generally, form of anything in the world has a direct relation with the mission and goal of its creation; teeth are not exception to this general rule and they have been compatible with their missions, which are chewing, developing beauty and facilitating speech, during million years of evolution. To meet three mentioned missions, teeth need a certain form and alignment in order to protect their both soft and hard tissues against potential harms. The fact is that even an imperfect form of a tooth or its displacement in the mandibular arch can destroy the whole jaw system. Dentists, who do not pay attention to form, contour and alignment of teeth may damage this system and exacerbate patients' oral diseases instead of treating them. When there are tooth size anomalies, developing a class I molar relationship is not unusual; however reaching a class I canine relationship is impossible (3, 4). Tooth size is an etiologic factor for malocclusions in different occlusal categories and different racial groups (5). Disproportionate tooth size not only makes the treatment process difficult, it prevents formation of a precise occlusion. Large teeth do not always develop malocclusion, because the available space may be large enough to embed them; on the other hand small teeth also do not develop serious problems; unless cause spacing in the arches. Comparing the teeth size and the available space, determining the effects of teeth size on overbite and overjet and diagnosing dental imbalances in the arches are clinically important (6).

2. Objectives

It is obvious that it is impossible to use analyses and predictive tables of teeth sizes of a society to achieve a proper and successful treatment of orthodontic patients in another society. Accordingly, mesiodistal widths of the permanent teeth in five medical centers in Shiraz were analyzed.

3. Materials and Methods

In general, in this study 200 plaster casts (including 5600 teeth) of people who needed orthodontic treatment and had referred to orthodontists were examined. A caliper with accuracy of 0.1 mm was used for measuring teeth. In this study the biggest mesiodistal width of all permanent teeth (except wisdom tooth) were measured. The samples were collected from five medical centers in

Shiraz. Out of 200 samples prepared in this study, some samples were excluded because the gender of teeth owner was unknown; hence only 162 casts, male (n = 39; 24.07%) and female (n = 123; 75.92%) were considered. The more number of female patients who had been referred to an orthodontist would be due to the fact that beauty is very important for this group. In this study, the following casts were considered:

1. Air-Bubble-free casts
2. Casts without any kind of transformation and extra plaster which may change the dental contour
3. The permanent teeth (except the wisdom teeth) must be erupted
4. Casts without severe crowding (severe crowding that might disturb the measurements were excluded)
5. Without observable anomaly in tooth size: e.g. peg shape, macrodontia, microdontia, mesiodens
6. Without decay that has disturbed the dental contour, especially proximal decay
7. Should not be with crown and bridge
8. stone casts and casts without breakages and abrasion
9: Free from rotations and inclinations that disturb measurements.

3.1. Measurement Method

A caliper with accuracy of 0.1 mm was used for measuring teeth and most teeth were measured twice and the average value was considered as the tooth size. In all cases, the vernier calipers' jaws were moved along with the teeth longitudinal axis and the biggest width was measured in the contact point area. For measuring the error, after the measurement was completed some teeth were chosen randomly through different parts of the mouth and were re-measured. The measurement difference varied from 0 to 0.04 mm. The average value of difference was 0.016 mm with SD of 0.02 mm, which statistically this amount of error with such SD is acceptable. Sample number, average size and SD were calculated for each tooth.

4. Results

Table of difference between measurements done on the plaster cast and those done on the patient's mouth, tables of mesiodistal widths of the permanent teeth in males and females and some equations are presented in the following chapters.

Table 1. The Difference Between Measurements Done on the Plaster Cast and Those Done on the Patient's Mouth[a]

$(X2^b - X1^a)$ mm	Number	(X2 – X1) × Number	$(X2 - X1)^2$ × Number
0	28	0	0
0.1	23	0.23	0.023
0.02	23	0.46	0.92
0.03	13	0.39	0.117
0.04	13	0.52	0.208
Total	100	1.6	0.44

[a]Mean: 0.016, SD: 0.02.
[b]X2, measurement gained from the plaster cast; X1, measurement gained from patient's mouth.

Table 2. The Mesiodistal Width of Permanent Tooth in Upper Jaw of Female Sex

Tooth	Universal Number	Number	Mean	SD
I1 right	8	123	8.85	0.488
I1 Left	9	123	8.81	0.497
I2 Right	7	121	7.08	0.503
I2 Left	10	122	6.94	0.439
C Right	6	120	7.79	0.541
C Left	11	121	7.73	0.448
P1 Right	5	117	7.015	0.412
P1 Left	12	121	6.805	0.419
P2 Right	4	118	6.70	0.408
P2 Left	13	120	10.19	0.502
M1 Right	3	121	10.14	0.448
M1 Left	14	119	10.14	1.025
M2 Right	2	88	9.75	0.490
M2 Left	15	95	9.68	0.595

Table 3. The Mesiodistal Width of Permanent Tooth in Lower Jaw of Females

Tooth	Universal Number	Number	Mean	SD
I1 Right	25	122	5.51	0.354
I1 Left	24	122	5.54	0.360
I2 Right	26	122	6.08	0.367
I2 Left	23	122	6.11	0.0367
C Right	27	123	6.80	0.400
C Left	22	123	6.79	0.419
P1 Right	28	120	7.17	0.415
P1 Left	21	115	7.15	0.416
P2 right	29	109	7.10	0.427
P2 Left	20	111	7.18	1.142
M1 Right	30	121	10.97	0.631
M1 Left	19	116	11.11	0.550
M2 Right	31	88	10.19	0.625
M2 Left	18	84	10.17	0.673

Table 4. The Mesiodistal Width of Permanent Tooth in Upper Jaw of Males

Tooth	Universal Number	Number	Mean	SD
I1 Right	8	39	9.01	0.570
I1 Left	9	39	8.97	0.584
I2 Right	7	37	7.16	0.578
I2 Left	10	38	7.13	0.542
C Right	6	38	8.11	0.485
C Left	11	38	8.03	0.492
P1 Right	5	37	7.21	0.422
P1 Left	12	36	7.26	0.478
P2 Right	4	38	6.84	0.499
P2 Left	13	38	6.80	0.502
M1 Right	3	39	10.28	0.554
M1 Left	14	39	10.17	0.588
M2 Right	2	32	9.85	0.488
M2 Left	15	33	9.85	0.665

Table 5. The Mesiodistal Width of Permanent Tooth in Lower Jaw of Males

Tooth	Universal Number	Number	Mean	SD
I1 Right	25	39	5.69	0.348
I2 Right	26	38	6.22	0.366
I2 Left	23	39	6.24	0.413
C Right	27	38	7.15	0.439
C Left	22	38	7.11	0.464
P1 Right	28	38	7.37	0.438
P1 Left	21	38	7.53	0.785
P2 Right	29	37	7.20	0.488
P2 Left	20	37	7.27	0.483
M1 Right	30	39	11.13	0.457
M1 Left	19	36	11.34	0.550
M2 Right	31	29	10.23	0.625
M2 Left	18	26	10.36	0.673

Table 6. Bolton's analysis about Both Anterior and All Tooth

Average	Variation Range	No.	Ratios
78.43	90.24 - 71.08	192	Anterior Ratio
92.23	102.63 - 70.10	191	Overall Ratio

5. Discussion

The difference between teeth sizes in women and men shows that all teeth in males are bigger than those in females and this difference is most evident in canine teeth, especially the lower jaw's canine teeth. Many studies have confirmed the fact that men's teeth are bigger than women (5, 7). Gran et al. have found the canine tooth with greatest difference in men and women, like our study (8). The minimum difference in terms of teeth size between women and men was found in the first upper molar teeth; whereas Gran et al. believe that incisors have the lowest difference in men and women (8). Sanin and Savara believe that the mesiodistal size of crown in boys in all teeth, except for the central incisors, are bigger than those in girls (2), while this study showed that all permanent teeth in men are bigger than those in women. We also found the relationship of four incisors of the lower jaw with canines and premolars of upper and lower jaws separately, a linear significant relationship was found in both relationships.

X = the total mesiodistal width of four lower jaw's incisors

Y1 = the total mesiodistal width of upper jaw's canine and premolars

Y2 = the total mesiodistal width of lower jaw's canine and premolars

$Y1 = 10.3925 + 0.480512X$

$Y2 = 7.913 + 0.572598X$

Ballard and Wylie found X = 9.41 + 0.52 equation for relationship between the width of four incisors of the lower jaw and all canine and premolars of the lower jaw (9). We also measured the ratio of six anterior teeth of the upper jaw to total six teeth of the lower jaw. It was 1.28. Neff also found the ratio of all six anterior teeth of the upper jaw to all six anterior teeth of the lower jaw and called it anterior coefficient; he found the ideal anterior coefficient 1.20 - 1.22, which shows a normal occlusion with 20% overbite (10). For finding the difference between the measurements done on the plaster cast and mouth of patients, a total of 100 patients were re-measured randomly; and because of convenience these measurements were done on the anterior teeth. As you can see in Table 1, the measured sizes gained from the plaster casts were equal or larger than those that gained from the patients' teeth; as the average difference was ± 0.016 mm with a SD of 0.02 mm which is acceptable statistically. For measuring calculation error, when the process was completed 102 teeth were re-measured randomly. The average difference was 0.02 mm, that with the SD of 0.025 mm are ignorable statistically. The average size and the differential percentage based on every 0.5 mm difference and SD and variation range of each tooth, in men and women, were summarized separately in Tables 2 - 5. After calculating sizes of the teeth, we decided to use two analyses, which are very common in orthodontics and are highly depended on teeth size, in our population. They were Bolton and Moyers analyses.

5.1. Bolton's Analysis

As Table 6 shows 192 patients were analyzed regardless of their gender, the average amount of the anterior ratio was measured 78.43%. About 8.3% of the population almost was compatible with the Bolton's ratio; whereas 31.25% of the population was less than that and 60.45% of the population was more than Bolton's ratio. The overall ratio measured for all teeth was equal to 92.23%, which was not close to Bolton's ratio (91.3); as in 14.65% of cases it was almost equal to Bolton's ratio and was less than that in 24.08% of cases and was more than that in 16.27% of cases (12).

5.2. Moyers Analysis

Moyers' table considers the total size of four incisors in the lower jaw maximally 25.5 mm; whereas according to our analysis this amount in some people was more than 25.5 mm, hence they cannot be embedded in the Moyers' table and category. On the other hand, there were samples though their total size of four incisors of the lower jaw was compatible with Moyers' table, but sizes of canine and premolar teeth of both lower and upper jaws were not compatible with the mentioned percentages; for instance the total size of four incisors of the lower jaw in a woman was 24.3 mm and her total size of canine and premolar teeth in the upper jaw was 23.1 mm but there is not a percentage for it. In analyzing samples, we specified the percent of canines and premolars in both jaws in Moyers' table; the amounts varied from 15% to 95%. Considering 194 subjects the average percentages for the upper and lower jaws were 65% (1,13). Finally using Tanaka and Johnstone method (14), we calculated the half of mesiodistal width of 4 incisors in the lower jaw of all samples and added it to 10.5 mm and then compared it with the mesiodistal width of canine and premolar teeth of the lower jaw, which had been measure already. Likewise, again we added the half of mesdiodistal width of 4 incisors in the lower jaw with 11 and compared with the mesiodistal width

of canines and premolars in the upper jaw of subjects. According to this analysis, only about 9.3% of such sizes were compatible.

5.3. Conclusions

Men's teeth are bigger than those in women. For us, the most precise and simple method for predicting the total size of mesiodistal width of canine and premolar teeth of upper and lower jaws is the following equation:

Y1= 10.39 + 0.48 X

Y2 = 7.91 + 0.57 X

X= total width of 4 incisors in the lower jaw

Y1: Total width of canine and premolars of upper jaw

Y2= Total width of canine and premolars of lower jaw

The relation between total 6 upper anterior teeth width to 6 lower anterior teeth is:

The anterior ratio and overall ratio of Bolton gained in this study (78.43% and 92.23% respectively) is more than the Bolton analysis.

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