ORIGINAL ARTICLE

Intermaxillary tooth size discrepancy and mesiodistal crown dimensions for a Turkish population

Tancan Uysal[a] and Zafer Sari[b]
Kayseri and Konya, Turkey

Introduction: The aims of this study were to determine the size of individual permanent teeth, tooth-size ratios for the maxillary and mandibular dentitions, and sex differences for those variables in a Turkish population, and to compare the figures obtained with those of the Bolton analysis. **Methods:** The data were derived from dental casts of 150 Turkish subjects (72 men, mean age 22.09 ± 3.11 years; 78 women, mean age, 21.11 ± 2.08 years) with normal occlusions. The mean, standard deviation, and minimum and maximum values were calculated for individual tooth size, and overall and anterior ratios, separately for men and women. To determine whether there are sex differences in intermaxillary tooth size discrepancies, an independent samples *t* test was performed. **Results:** The mesiodistal dimensions of the maxillary teeth showed greater variability than the mandibular teeth, with the first molar dimensions having the greatest variability. The overall and anterior ratios were found to be 89.88 ± 2.29 and 78.26 ± 2.61, respectively. A statistically significant sex difference was found only in overall ratio ($P < .001$). According to Bolton's mean values, a discrepancy in the overall ratio was found in 18% of Turkish normal occlusion subjects, and anterior ratios outside 2 standard deviations from the Bolton mean were found in 21.3% of our sample. **Conclusions:** These findings indicate that population-specific standards are necessary for clinical assessments. Bolton's original data do not represent Turkish people, and therefore it is appropriate to use Turkish norms in daily orthodontic practice for Turkish patients. (Am J Orthod Dentofacial Orthop 2005;128:226-30)

Specific dimensional relationships must exist between the maxillary and mandibular teeth to ensure proper interdigitation, overbite, and overjet. Because patients with interarch tooth-size discrepancies require either removal (eg, interdental stripping) or addition (eg, composite build-ups/porcelain veneers) of tooth structure to open or close spaces in the opposite arch, it is important to determine the amount and location of tooth-size discrepancies before starting treatment.[1]

Many studies have shown a correlation between the mesiodistal tooth width of the maxillary and mandibuler teeth.[2-5] Bolton[6] analyzed the relationship between the mesiodistal tooth width of the maxillary and mandibular teeth by studying 55 white subjects with excellent occlusions. Using the mesiodistal width of 12 teeth, he obtained an overall ratio of 91.3% ± 1.91%; using the 6 anterior teeth, he obtained an anterior ratio of 77.2% ± 1.65%. Stifer[7] replicated Bolton's study in Class I dentitions and reported similar results. Subsequently, other authors obtained the normal values of Bolton analysis of different races, eg, that of Chinese,[8-10] black, Hispanic, and white[1] populations. Most investigators concluded that there are significant differences among ethnic and racial groups, and, as a result, many standards have been developed. Most studies indicated that normal measurements for 1 group should not be considered normal for other race and ethnic groups. Different racial groups must be treated according to their own characteristics.

Smith et al[1] derived data from systematically collected preorthodontic casts of 180 patients, including 30 men and 30 women from each of black, Hispanic, and white groups. They concluded that Bolton ratios apply to white women only; the ratios should not be indiscriminately applied to white men, blacks, or Hispanics.

Lew and Keng,[8] studying a group of Singaporian Chinese, reported an anterior ratio comparable with the Bolton standard, even though Singaporean Chinese had smaller maxillary central incisors and larger maxillary lateral incisors. Mesiodistal tooth sizes in southern

[a]Assistant professor, Department of Orthodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey.
[b]Assistant professor, Department of Orthodontics, Faculty of Dentistry, Selcuk University, Konya, Turkey.
Reprint requests to: Dr Tancan Uysal, Erciyes Üniversitesi, Diş Hekimliği Fakültesi Ortodonti A.D. Kayseri, 38039, Turkey; e-mail, tancanuysal@yahoo.com.
Submitted, November 2003; revised and accepted, April 2004.
0889-5406/$30.00

doi:10.1016/j.ajodo.2004.04.029

Chinese people were found to be generally larger than those of other Chinese subraces[9] or whites.[10] Such variation in mesiodistal dimensions could affect the anterior and overall ratios between the maxillary and mandibular teeth.[11]

Arya et al[12] showed that there were differences in tooth size between sexes, as reported by other authors. Lavelle[13] showed that there was sexual dimorphism in tooth dimensions and in the ratio of maxillary to mandibular arch tooth size.

No published data establish Bolton values for diagnosis and treatment planning of Turkish patients. With these points in mind and using the analysis of Bolton, we attempted to determine sizes of individual permanent teeth, tooth-size ratios for the maxillary and mandibular dentitions, and sex difference for those variables, and to compare these figures with those of the Bolton analysis for the Turkish population.

MATERIAL AND METHODS

Orthodontic dental casts were taken from 150 Turkish subjects (72 men, mean age 22.00 ± 3.11 years and 78 women, mean age, 21.11 ± 2.08 years) with normal occlusions and well-balanced faces.

The following selection criteria were used: (1) Turkish with Turkish parents, 20 to 35 years of age; (2) Class I occlusion with minor or no crowding; (3) well-aligned dental arches; and (4) good-quality study models.

The following rejection criteria were used: (1) gross restorations, buildups, crowns, onlays, Class II amalgams, or composite restorations that affect a tooth's mesiodistal diameter; (2) congenital defects or deformed teeth; and (3) obvious interproximal or occlusal wear of teeth.

A digital caliper was used to measure the casts to the nearest 0.01 mm. The mesiodistal crown diameters of all teeth were measured according to the method described by Moorrees et al.[14] The width of each tooth was measured from its mesial contact point to its distal contact point at its greatest interproximal distance. Bolton anterior (canine to the canine) and overall (first molar to first molar) ratios were calculated with the following formulas:

$$\frac{\text{Sum mandibular ``12''}}{\text{Sum maxillary ``12''}} \times 100 = \text{overall ratio (\%)}$$

$$\frac{\text{Sum mandibular ``6''}}{\text{Sum maxillary ``6''}} \times 100 = \text{anterior ratio (\%)}$$

Bolton's normal-range values were used in the comparisons of Turkish values. According to the Bolton analysis, a significant discrepancy was defined as one whose value was outside 2 SD from Bolton's mean[15] because approximately 95% of Bolton's subjects were within this range. For the overall "12" ratio, a significant discrepancy is therefore defined as a ratio below 87.5 or above 95.1, with ratios in between falling within 2 SD of Bolton's mean. Likewise, any ratio below 73.9 or above 80.5 was considered to be a significant discrepancy for the anterior "6" ratio.

To determine the errors associated with measurements, 25 dental casts were selected randomly. Their measurements were repeated 8 weeks after the first measurements. A paired *t* test was applied to the first and second measurements.

All statistical analyses were performed with a software package (Statistical Package for Social Sciences, Windows 98, version 10.0, SPSS, Chicago, Ill). For each variable, mean, standard deviation, minimum, and maximum values were calculated and also separately for men and women. To determine whether there were sex differences in intermaxillary tooth-size discrepancies, an independent samples *t* test was performed.

RESULTS

The skewness and kurtosis statistics showed that the variables were normally distributed.

It was found that the difference was insignificant between the first and second measurements of the 25 dental casts to determine the errors associated with the measurements. The molars had the largest errors; the premolars and the canines had the smallest errors.

Table I shows the mean, range, and standard deviation of the width of the maxillary and mandibular teeth in the male and female subgroups.

The mean overall "12" ratio for the Turkish population was found to be 89.8 (Table II), with a standard deviation of 2.29. The values ranged from 84.9 to 98.6, and the median was 90.0. The mean anterior "6" ratio for the Turkish population was found to be 78.2, with a standard deviation of 2.61. The values ranged from 72.4 to 88.4, and the median was 78.0.

The following results were obtained through the independent samples *t* test applied to compare the measurement differences of men and women. The mean anterior and overall ratios for Turkish men and women are shown in Table II. A statistically significant sex difference was found in the overall ratio ($P < .001$). The overall ratios were 89.8 for men and 91.7 for the women. In our sample, both men's and women's anterior ratio measurements followed similar distribution patterns, with the men having slightly larger dimensions. The anterior ratios were 78.1 for men and 78.3 for women.

The frequency of tooth-size discrepancy outside 2