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Tooth size discrepancy among different malocclusion groups in Sudanese sample

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ABSTRACT

Background: Many difficulties encountered during the finishing-phase of orthodontic treatment arise due to lack of intermaxillary tooth-size matching. Bolton ratio is one of the most useful calculations for precise orthodontic diagnosis as it shows whether a correct ratio between dental proportions exists or not.
Objectives: To determine the mesiodistal tooth width in anterior and overall Bolton ratios in normal occlusion and different malocclusion groups in a Sudanese sample and compare to Bolton's standard.
Materials and methods: The sample consisted of 196 (86 male and 110 female) study models with normal occlusion, Class I, II and III malocclusions, and the age of subject 17–20 years old. Tooth size measurements were performed by electronic digital calipers. Tooth size ratios were analyzed as described by Bolton. The incidence of mesiodistal tooth size discrepancies in the malocclusion groups was analyzed and compared between male and female. The anterior and overall ratios were compared with the ratios Bolton's study.
Results: No significant difference in the anterior and overall ratios of normal occlusion sample when compared to Bolton's standard. No significant differences were found among gender. ANOVA indicated that no significant difference was determined in the anterior and overall ratios in different malocclusion groups.
Conclusion: Bolton's values can be used for Sudanese population until a large representative sample is studied.

1. Introduction

Correct tooth size relationship between maxillary and mandibular teeth is an important factor to achieve a proper occlusal interdigitation during the final stages of orthodontic treatment [1].

An excellent orthodontic treatment result with optimal occlusion and ideal intercuspation, overjet and overbite is often jeopardized by tooth size discrepancies or problematical tooth anatomy [2]. Differences in tooth size have been associated with different ethnic background and malocclusion [3].

Tooth size discrepancies have conventionally been described as a relative excess of tooth structure in one arch

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in relation to the other arch [4], and as a disproportion among the size of individual teeth [5]. Specific dimensional relationships must exist between the maxillary and mandibular teeth to ensure proper interdigitation, overbite and overjet and it is important to determine the amount and location of a tooth size discrepancy before starting treatment [6].

Tooth sizes and their inter-arch relationships are fundamental to orthodontic treatment. In the early 1900s Angle [7] included eight variables in occlusion: position, interincisal relation, size of teeth, pattern of teeth, length of teeth, length of cusps, width of arch, arch form, and curve of Spee.

Bolton [1] developed two analyses where by the ratio of mandibular to maxillary tooth material was determined. Fifty-five sets of dental casts were carefully selected and judged to have excellent occlusions. In the overall ratio, the mesiodistal widths of the mandibular 12 teeth were summed and divided it by the sum of the maxillary 12 teeth. For the anterior ratio, summed the mesiodistal widths of the mandibular anterior six teeth (two canine, two central incisors and two lateral incisors) and divided it by the sum of the maxillary anterior six teeth. The obtained results were a means of 91.3% (SD = 1.91) for the overall ratio and 77.2% (SD = 1.65) for the anterior ratio.

The importance of harmony between the maxillary and mandibular teeth brought the attention of many investigators over the years, Crosby and Alexander [3] and Freeman et al. [8] reported that there are 22.9% and 30.6% of orthodontic patients who have anterior tooth size discrepancy. In recent years, much more attention has been paid to tooth size discrepancy, because this may be an obstacle to achieving an ideal result in many cases. Therefore Mclaughlin et al. [9] recommended a seven-key of occlusion 'correct tooth size'. Dental literature has many studies comparing tooth size discrepancy and different types of malocclusion in different parts of the world and among different ethnic group. However, tooth size discrepancy for Sudanese population remains uncertain. Therefore, the present study aims were (1) to compare tooth-size ratios of the normal occlusion to Bolton's original sample, (2) to compare Bolton anterior and overall ratios among different occlusion groups and (3) to identify possible sex differences in anterior and overall tooth size ratios.

2. Materials and methods

A descriptive cross-sectional community based study carried out at the Department of Orthodontic University of Khartoum. A total of 196 orthodontic study models (the age of the subject 17–20 years old) were studied. The normal occlusion sample consists of 55 a homogeneous Sudanese dental students (25 male, 30 female). Whereas, the malocclusion models consist of 49 study models Angle's Class I (23 male, 26 female), 49 Angle's Class II (22 male, 27 female) and 43 Angle's Class III (16 male, 27 female).

The inclusion criteria for normal and malocclusion models were:

1. All permanent teeth (first permanent molar right to first permanent molar left) are present.
2. No mesiodistal or occlusal tooth abrasion.
3. No tooth deformity, gemination or peg shape lateral incisor.
4. No proximal restoration or reduction.
5. No residual crown or bridge restoration.

The normal occlusion criteria were:

- Class I molar and cuspid relation with good intercuspation.
- 2–3 mm overjet and overbite.
- No previous orthodontic or prosthetic treatment.
- No extensive caries or tooth fillings (Class II and IV restorations).
- No apparent congenital anamoli.

The mesiodistal tooth size for the 12 maxillary and mandibular teeth from the right first permanent molars to the left first permanent molars were measured in the study models by the investigator. The readings were obtained by measuring the greatest width between the contact points of each crown by digital calipers accurate to 0.01 mm which held parallel to the incisal edges or occlusal surfaces. The caliper beaks were inserted from the buccal (labial), and held occlusal parallel to the long axis of the tooth. The beaks were closed until gentle contact with the contact points of the tooth was felt. The reading was recorded at the 0.1 mm level (Fig. 1).

Tooth size ratio between upper and lower teeth was calculated as described by Bolton [1]

$$\text{Overall ratio (OR)} = \frac{\text{Sum of mesiodistal width of mandibular 12 teeth} \times 100\%}{\text{Sum of mesiodistal width of maxillary 12 teeth}} \quad (1)$$

$$\text{Anterior ratio (AR)} = \frac{\text{Sum of mesiodistal width of mandibular six teeth (3–3)} \times 100\%}{\text{Sum of mesiodistal width of maxillar six teeth (3–3)}} \quad (2)$$

2.1. Statistical analysis

Frequency tables and descriptive statistic (mean, range and standard deviation) were done for each tooth in normal and malocclusion groups, the anterior and overall ratio and for each group of malocclusion. *T* test was used to compare normal occlusion and Bolton's sample and measure the difference between genders. Analysis of variance (ANOVA) was used to compare between Bolton ratios in different malocclusion groups and to compare Bolton ratio between normal occlusion and different malocclusion groups.

Error of the method was calculated by selecting 15 casts randomly by main investigator and re-measured twice within 10 days interval period using Dahlberg's formula.

3. Results

The result from Dahlberg's method showed the mean of the measurement error of the mesiodistal tooth size for the individual teeth with of 0.28 mm ± 0.136 mm. The highest value was 0.86 mm and the lowest value was 0.01 mm.

No significant difference between the two sets of measurement was found ($p < 0.05$).