

Applicability of Bolton's tooth size ratio for Nepalese population

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Abstract

Objectives: To test the applicability of Bolton's method for use in Nepalese population and to compare the reliability of present values against those of most commonly used values.

Materials and methods: The sample consisted of 60 Nepalese males and 60 females (total 120 subjects) aged between 17 to 23 years. Subjects without any previous orthodontic treatment, fully erupted permanent teeth, and with no dental anomalies were included in this study. The measurements of mesio-distal widths of teeth were made on dental cast using digital caliper. Sample *t* test was used whenever necessary and the mean, range, and standard deviation were calculated for the anterior ratio and overall ratio. The measured values were compared with Bolton's original values.

Results: The mean anterior "6" ratio for Nepalese subjects was found to be 79.46 with a standard deviation of 2.60. The values ranged from 68.75 to 89.17. The mean overall "12" ratio for Nepalese subjects was found to be 92.42 with a standard deviation of 1.80. The values ranged from 85.93 to 98.68.

Conclusion: Mean anterior tooth width ratios between Nepalese male and female samples were statistically significant but mean overall tooth width ratios between Nepalese male and female were not statistically significant. These findings suggest that a large number of Nepalese subjects presenting for orthodontic treatment possess a Bolton's tooth size discrepancy that may influence treatment goals and results.

Key words: Tooth size ratio, Bolton's analysis; Digital caliper

Introduction

Prediction of accurate space has prime role in diagnosis and treatment planning in Orthodontics. According to Proffit and Fields¹, space analysis should be done accurately before any Orthodontic treatment. Tooth size discrepancy is defined as a disproportion among the sizes of individual teeth¹. In order to achieve optimal occlusion, ideal intercuspation, normal overjet and overbite, maxillary to mandibular tooth width ratios must be proportional in size. Bolton² in 1958 evaluated 55 cases with excellent occlusions and developed Bolton's tooth size ratio for six anterior teeth and the overall ratio for twelve teeth.

Similarly many authors have evaluated factors associated with differences in the tooth width ratios. The relationship between malocclusion type and tooth size proportions has been reported³⁻⁸.

Since differences in tooth size have been reported with ethnic groups⁹⁻¹², most of the practitioners now disagree to apply the methods developed from the different ethnic groups.

The Bolton's tooth size ratio develops from white population (Caucasians), so its reliability is still questionable when applied to different ethnic groups^{13,14}.

So, it's necessary to test the applicability of Bolton's tooth size ratio for Nepalese population to make accurate diagnosis and treatment planning.

The objectives of the present study were to:

1. Determine the Bolton's ratios for Nepalese subjects.
2. Determine the sexual differences in tooth size between Nepalese males and females.

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- Compare the ethnic difference in tooth size between Nepalese and Caucasians.

Materials and methods

The samples for this study were collected from the CODS, Universal College of Medical Sciences, Bhairahwa, Nepal. A random sampling technique was used. The subjects were informed appropriately and informed consent was obtained. The samples included dental impressions obtained from the students of the dental and medical sciences. Total 120 subjects were selected (60 males and 60 females). In spite of the ethnic diversity in the Nepalese population, we considered there was low error in sample selection, because the students selected for medical studies came from different parts of Nepal.

Inclusion criteria were, native Nepalese with Nepalese phenotypical characteristics such as brown skin color, black hair and eye color ranging from brown to black, age ranging from 17-23 years and all permanent teeth erupted (except third molar). Exclusion criteria were subjects with proximal or occlusal wear, interproximal caries or restorations, crowding, spacing or diastema, any cross bite, any over retained deciduous tooth, missing permanent tooth, deep carious tooth, any hypoplasia or dental anomalies and any past history of orthodontic treatment^{15,16}.

The alginate impressions were made by the well trained dentists of CODS, Universal College of Medical Sciences, Bhairahwa, Nepal. The impressions were poured using dental plaster. Starrett digital caliper (0-150mm, 799A-6/150, Starrett tools (Suzhou) Co. Ltd., China) providing measurements to ± 0.01 mm was used to measure the mesio-distal dimension of all teeth. The teeth measured included the mandibular and maxillary permanent incisors, mandibular and maxillary permanent canines, mandibular and maxillary first and second premolars, mandibular and maxillary permanent first molars. All measurements were made by single investigator.

Maximum 10 pairs of casts were measured per day to avoid errors by eye fatigue. All measurements were done directly from unsoaped plaster models. Maximum mesio-distal width of each tooth was measured and recorded to 0.1mm. All measurements were taken perpendicular to the long axis of the tooth with the caliper beak entering the interproximal area from the buccal or occlusal side¹⁵. Repeated measurements were performed to minimize the possible errors. Intra-examiner reliability was predetermined at 0.2mm as mentioned by Bishara et al¹¹. Bishara^{11,17} recommended that measurements that varied by 0.2mm or less to be averaged and re-measurement was done for measurements that varied more than 0.2 mm and the three measurements were averaged.

The mean, range, standard deviations were calculated for the size of teeth. The Bolton anterior ratio and the Bolton overall ratio were calculated and tabulated.

Results

The results are summarized in Table 1 to 3. Table 1 reports the mean, range, and standard deviation of the anterior and overall ratio in the Nepalese male and female subjects.

Table 1 suggests there was significant difference between sexes for the anterior ratio ($P=0.0089$), but there was no significant difference for overall ratio ($P=0.88$)

The combined male and female anterior ratio and overall ratio were calculated and tabulated in Table 2.

The mean anterior "6" ratio for Nepalese subjects was found to be 79.46 with a standard deviation of 2.60. The values ranged from 68.75 to 89.17. The mean overall "12" ratio for Nepalese subjects was found to be 92.42 with a standard deviation of 1.80. The values ranged from 85.93 to 98.68 (Table 3).

Table 1: Tooth size ratio of male and female in the Nepalese population

Ratio	Male				Female			P	
	Range	Mean	SD	Range	Mean	SD			
Anterior Ratio	73.70	89.17	80.44	3.52	68.75	87.05	78.48	4.47	0.0089*
Overall Ratio	85.93	98.68	92.46	2.72	86.60	97.54	92.38	2.89	0.8808

SD, Standard deviation; *significant P value ($P < 0.05$)

Table 2: Tooth size ratio male and female combined for Nepalese population

Ratio	Range	Mean	SD	
Anterior Ratio	68.75	89.17	79.46	2.60
Overall Ratio	85.93	98.68	92.42	1.80

Table 3: Parameters obtained in the present study compared to the Bolton parameters

Ratio	Range				Mean		SD	
	Nepalese		Caucasian		Nepalese	Caucasian	Nepalese	Caucasian
Anterior Ratio	68.75	89.17	74.5	80.4	79.46	77.2	2.60	1.65
Overall Ratio	85.93	98.68	87.5	94.8	92.42	91.3	1.80	1.91

Discussion

The Bolton sample was obtained from 55 subjects with excellent occlusion; 44 were orthodontically treated². In present sample, all subjects were untreated and some had mild malocclusions. Therefore, a direct statistical comparison between groups is disputable.

Although in some studies the reported differences with Bolton's ratios were statistically significant, the clinical relevance is questionable. Originally, Bolton² suggested that a ratio greater than 1 SD from his reported mean values indicated a need for diagnostic consideration. More recently, a clinically significant tooth width ratio discrepancy has generally been defined as 2 SD outside Bolton's published mean ratio^{3,4,12}.

By using the above definition, an anterior ratio below 73.9 or above 80.5 and overall ratio below 87.5 or above 95.1 would be considered as clinically significant. High prevalence rate of an anterior tooth size discrepancy more than 2 SD above Bolton's mean was found for Nepalese subjects (Table 3). Although the mean values of Nepalese subjects in this study and those of the Bolton study are nearly same, the ranges and standard deviations of the Nepalese subjects significantly larger. Similar findings were found by Crosby and Alexander³.

If cases with ratios greater than 2 SD away from Bolton's values truly represent a significant discrepancy, then a large number of Nepalese subjects present with relative tooth sizes that could potentially cause problems in attaining an optimal occlusal relationship.

Conclusions

Mean anterior tooth width ratios between male and female samples were statistically significant but mean overall tooth width ratios between male and female were not statistically significant. These findings suggest that a large number of Nepalese subjects presenting for orthodontic treatment possess a Bolton's tooth size discrepancy that may influence treatment goals and results. In both the overall ratios and the anterior ratio, the range and standard deviation were varied in the present study than in Bolton's study.

Thus it is probably necessary to do precise space analysis based on our own data to make an accurate diagnosis and treatment plan for orthodontics in

Nepalese population. Although such an analysis may appear to be time consuming, the benefits would seem to outweigh this minor inconvenience by allowing more efficient diagnosis of problems, more specific treatment planning, and good success rate in achieving optimal occlusions.

Limitations

Further studies based on larger sample size, are required to confirm the applicability of the results of the present study.

Further study is required to test the applicability of Bolton values on Nepalese population having different types of Angle's malocclusion.

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