Prevalence of Bolton's Discrepancy in Patients

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Abstract

Introduction: To evaluate the prevalence of Bolton's discrepancy in patients reporting to Saveetha dental college
Materials and methods: The sample comprised of 100 pre-treatment study casts which were randomly selected from the records of orthodontic patients aged between 16-36 years. Mesio distal diameters of the teeth were measured at contact points using digital caliper. The overall Bolton's ratio and anterior Bolton's ratio were calculated for subjects and the obtained results were compared with the values reported by Bolton using student's t-test.
Results: There were no statistically significant differences in Bolton's anterior and overall ratios among the different occlusal categories.There is no statistically significant difference between the two genders for both the anterior and overall ratios From the results of our study, it is found that the mean mesiodistal width of lateral incisors for males is 5.7-7.5 and for females it is 5.6-7.3 which is out of the normal range which is 7.07-7.38 mm. But, the mean mesiodistal widths of central incisors and canines are within the normal values.
Conclusion: From this study it was concluded that, there were no significant differences between overall and anterior Bolton's discrepancy is Angle's class I and II malocclusions when compared with Bolton's standards.There was no sexual dimorphism in Bolton's anterior and overall ratios for the combined three classes of malocclusion. The highest tooth size discrepancy was found in lateral incisors when compared with other maxillary anterior teeth.
Keywords: Bolton's analysis, malocclusion, mesio-distal, discrepancy, overall ratio

INTRODUCTION

Arch size and shape affect the stability of the dentition and play an important role in diagnosis and treatment planning.In the last few years great development has taken place as the dental casts are now digitized and can be stored indefinitely. Further, they are used to determine interarch tooth-size discrepancy for various groups of malocclusion and are helpful in planning treatment accordingly.Every orthodontist's goal is to successfully treat patients of malocclusion ensuring that treatment plan and orthodontic techniques are properly carried out. Orthodontic diagnosis and treatment planning requires the patients thorough history, extra and intra oral examination, analysis of diagnostic records comprising of orthodontic photographs, necessary radiographs and properly trimmed study casts.An excellent orthodontic treatment result with optimal occlusion and ideal intercuspation, overjet and overbite is often jeopardized by tooth size discrepancies (TSDs) or problematic tooth anatomy. A TSD conventionally has been described as a relative excess of tooth structure in one arch in relation to the other arch. It can also be defined as a disproportion among the sizes of individual teeth.(1)The term tooth size particularly refers to the mesiodistal width of the tooth. Every single tooth size discrepancy can be troublesome and their accumulation along the arch can produce difficulties in achieving perfect occlusion. Although , the natural teeth match very well in most individuals , approximately 5% of the population has some degree of disproportion among the sizes of individual teeth. It is very common to achieve a perfect class 1 molar relationship and yet not be able to achieve a similar cuspid relationship because of tooth size discrepancies. The presence of a tooth size discrepancy prevents the achievement of an ideal occlusion. A high percentage of

finishing phase difficulties arises because of tooth size imbalance that could have been detected and considered during initial diagnosis and treatment planning. In some situations, tooth size discrepancy is not observed at the initial examination and could result in poor contacts, spacing, crowding, and an abnormal overjet and overbite.(2)The etiology of malocclusion can be broadly categorized under either hereditary, environmental, or a combination of both factors. Exploring the etiology of malocclusion is imperative for selecting the most appropriate treatment approach as well as the most appropriate retention device.(3)Malocclusion is a common problem that is encountered in day to day life. This may be caused by many different factors. One such contributing factor maybe tooth size.(4)Crowding and spacing are considered the most common manifestations of malocclusion and can occur as a result of either a shortage of the space required for tooth alignment or an excess of available space. The tooth size measurements of Wheeler also are frequently used.(5) As significant tooth size discrepancies prevent an ideal occlusion being produced at the end of orthodontic treatment, the absence of a TSD is the seventh ''key'' for an ideal occlusion.(6) 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 buildups or porcelain veneers) of tooth structure to open or close spaces in the opposite arch, it is important to determine the amount and location of a tooth size discrepancy before starting treatment.Discrepancies in tooth size should be known early during the initial diagnosis and treatment planning stages if perfect results in orthodontic finishing are to be

achieved. Many investigators give interest to the harmony between the upper and lower dental arches.Neff developed a proportion for the width dimension of the teeth called the "anterior coefficient". He found that an optimal overbite was represented when maxillary mesiodistal sum divided by the mandibular mesiodistal sum resulted in a ratio of 1.20 to 1.22. Lundstrom studied the relationship between the mandibular and the maxillary anterior sum and named it the "anterior index". For an ideal overbite, the optimal ratio was found to be from 73% to 85%, with a mean of 79%.(7)

In the last few years great development has taken place as the dental casts are now digitized and can be stored indefinitely. Further, they are used to determine interarch tooth-size discrepancy for various groups of malocclusion and are helpful in planning treatment accordingly.(8)Bolton realized the importance of the harmonious relationship between the teeth in the same arch and between arches.(7)Bolton developed a method of analyzing the mesiodistal tooth size ratio between maxillary and mandibular teeth.(9) The Bolton analysis has been designed based on a constant proportion between the sum of size of the mesiodistal dimension of maxillary to mandibular teeth, and is widely used as the most recognised method for diagnosing tooth size discrepancies.(10)Later on other researchers 5-7 proposed new methods to study tooth size discrepancies. Bolton's method is still the most widely used till now for the diagnosis of tooth size discrepancies.(7)Bolton's anterior and overall tooth size ratios have been accepted as essential diagnostic criteria in orthodontics since Bolton published his tooth size studies. Bolton established ideal anterior and overall ratios with mean values of 77.2% and 91.3%, respectively, for proper harmony of maxillary and mandibular teeth.(1) Bolton's ratios aid the orthodontists to gain some knowledge about the final post-treatment result without the need for diagnostic setups. Clinically, Bolton analysis has been used for determining the need for tooth size reduction through interproximal stripping or the addition of tooth size by composite resin restorations.Also, Bolton analysis can help orthodontists in treatment of patients with severe tooth size discrepancies. Nonetheless, it has some limitations and its precision and dependence to other factors are still matters of discussion. For instance, Bolton's studied population and their ethnicity were not exactly specified; whereas, there is evidence regarding the presence of differences between various ethnicities in terms of tooth size discrepancies. In other words, differences in tooth size are not similar in all population. Blacks have larger canines, pre-molars and first molars compared to whites, while there is no difference in size of maxillary central and lateral incisors between blacks and whites. Also, difference in tooth size of men and women is not similar for all teeth. Since ethnic and population-based differences in size of maxillary teeth do not always match those of mandibular teeth, different interarch relationships can be expected. Although several studies investigated the difference in the incidence of the Bolton discrepancy between genders, there are still conflicting results in the literature(10).Many studies reported that the incidence of tooth size discrepancy is high, but relatively little studies in the literature correlated malocclusion with the tooth size discrepancy. Differences in tooth size have been associated with different ethnic backgrounds and malocclusions. Smith et al, who examined the validity of Bolton ratios for different ethnic groups, recently concluded that Bolton's ratios apply only to white women and should not be applied indiscriminately to white men, blacks, or Hispanics.(6)Variation in tooth size is influenced by genetic and environmental factors. Some of the factors that contribute to the variability of permanent tooth size are race, sex, heredity, environment, secular changes and bilateral asymmertry.(11) For this reason, the application of Bolton analysis and the proposed values for a harmonious dentition might not be valid for other populations.(7)Another relevant question is the relationship between the Bolton ratio and the various types of malocclusion.(12) Again, although there is evidence on the prevalence of the Bolton discrepancy in diverse populations, there is no consensus about its relationship with the different types of malocclusions classified by Angle.(13) Given the importance of these topics, this study aimed to evaluate the presence of the Bolton anterior and total discrepancy in individuals with natural Class I and Class II malocclusions.

Materials and methods
The sample comprised of 100 pre-treatment study casts which were randomly selected from the records of orthodontic patients aged between 16-36 years.

The following selected criteria were used.
Inclusion Criteria:
i)   Permanent first molar of both the sides in upper and lower arch.
ii)   Good quality study models.
iii)   Angles Class I molar and Class I canine relationship.
iv)   Angles class II molar and class 2 canine relationship.

Exclusion criteria:
i)   Endodontic and prosthetic restorations.
ii)   Develpomental deformities.
iii)   Deformed teeth.
iv)   Attrition.
v)   Orthodontic corrections.

Mesio distal diameters of the teeth were measured at contact points using digital caliper.

Bolton's analysis was carried out using the formula,
Overall ratio
= Sum of mandibular 12/ Sum of maxillary 12 x 100

Anterior ratio
= Sum of mandibular 6/ Sum of maxillary 6 x 100

Data was statistically analysed by using SPSS. A t-test was carried out to test for statistical difference between means.

RESULTS

Table 1: Comparison of Bolton's overall and anterior ratios in Class 1 malocclusion group with Bolton's standards

Ratio	Class I	Bolton's value	t-value	p-value
	Mean +/-SD	Mean+/-SD		
Anterior ratio	77.91+/-0.66	77.20+/-2.74	1.991	0.50
Overall ratio	91.63+/-0.92	91.30+/-1.71	1.223	0.22

Table 2: Comparison of Bolton's overall and anterior ratio in Class 2 malocclusion groups with Bolton's standards.

Ratio	Class II	Bolton's value	t-value	p-value
	Mean+/-SD	Mean+/-SD		
Anterior ratio	76.75+/-0.40	77.20+/-2.74	1.288	0.20
Overall ratio	91.09+/-0.39	91.30+/-1.71	0.836	0.40

Table 3: Comparison of Bolton's overall and anterior ratio between two genders

Ratio	Males	Females	t-value	p-value
	Mean+/-SD	Mean+/-SD		
Anterior ratio	76.45+/-3.84	77.03+/-4.02	0.728	0.47
Overall ratio	90.85+/-0.07	91.25+/-1.91	1.494	0.14

Table 4: Mean, range, standard deviation of the mesiodistal dimension of the permanent maxillary anterior teeth for males and females.

Tooth	Males			Females		
	Mean	Range	SD	Mean	Range	SD
Central incisor	8.949	8.3-9.8	0.246	8.869	8-9.5	0.322
Lateral incisor	6.423	5.7-7.5	0.514	6.31	5.6-7.3	0.435
Canine	7.97	6.9-9.1	0.515	7.47	6.8-9	0.607
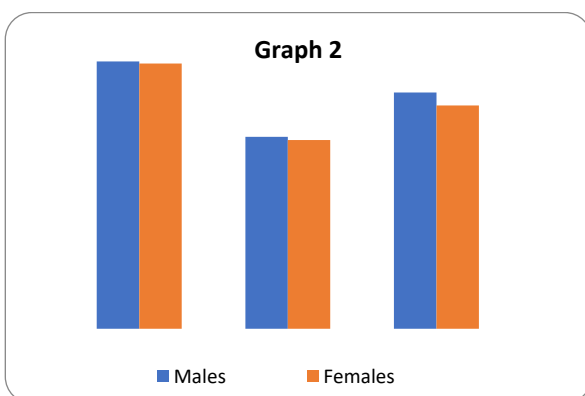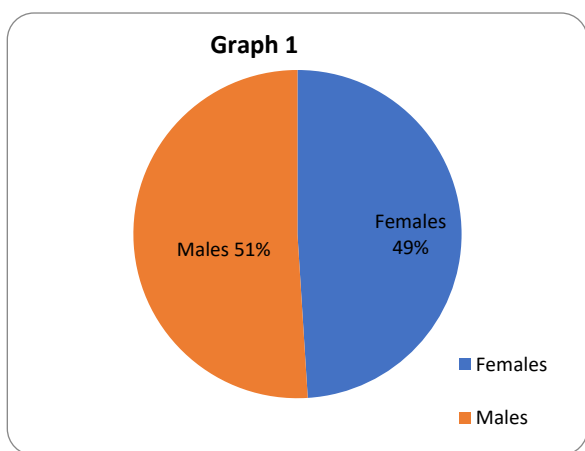
Graph 1

Graph 2

There were no statistically significant differences in Bolton's anterior and overall ratios among the different occlusal categories. Table 1 and Table 2 summarizes the means, standard deviations and statistical comparisons of Bolton's anterior and overall ratios observed in each group. It shows that there is no statistically significant difference between Boltons standard values and the Bolton's discrepancy calculated for Class 1 and Class 2 malocclusion groups.

Since there were no significant differences between the groups of malocclusion, all the casts were combined and then separated into males and females. Again, there was no statistically significant differences in both ratios between males and females. Table 3 summarizes the means, standard deviations and statistical comparison of Bolton's anterior and overall ratios observed in each sex. It shows that there is no statistically significant difference between the two genders for both the anterior and overall ratios. Table 4 shows the mean, standard deviation and range of the mesiodistal widths of the permanent maxillary anterior teeth in males and females. Graph 2 representing the comparison of mean mesiodistal widths of maxillary anterior teeth between males and females.

DISCUSSION

Tooth size discrepancies in orthodontic diagnosis has been widely reported in the literature and accepted in the orthodontic field as the relationship between the upper and lower anterior and posterior dentitions is related to proper orthodontic finishing.(14) In this study Bolton anterior and

overall ratios in Angle's class I and class 2 malocclusions in a South Indian population were studied.

In this study, the statistical analysis of Bolton anterior and overall ratios calculated in the two classes of malocclusion studied showed no significant differences. This finding was in agreement with earlier studies done by other researchers. Crosby and Alexander(15) found that there was no significant difference among Class I; Class II, division 1; Class II, division 2; and Class II surgery groups. Also Qiong and Jiuxiang (16) compared five different malocclusion groups and reported that there were no statistically significant differences between these groups.Also in a study by Fahah F.H et al(17), carried out in Saudi Arabia, there was no significant difference in Boltons overall and anterior ratios between the three malocclusion groups.

This study demonstrated that there were no sex differences in both anterior and overall· Bolton ratios, a finding which is in agreement with other investigators. Nie and Lin(18) found no statistically significant sex differences in his Chinese sample. Nourallah et aI.,(19) also obtained the same results concerning the gender difference when he applied the Bolton standards upon the Syrian population. Crosby and Alexander(15) did not differentiate be- tween sexes for any gender differences.

In a study done by O'Mahonya in Irish population and by Araujoto determine tooth size discrepancies among different malocclusion groups, the mean anterior tooth size ratios exhibited no statistically significant differences between genders and no statistically significant differences among the malocclusion groups which is similar to our study.(14,19)

This study demonstrated a moderate level of Bolton discrepancy among the two malocclusion groups studied when compared with the established ratios of Bolton.(10,21) The cause of this could be attributed to the fact that Bolton sample was all of ideal occlusion meanwhile our sample here are all having malocclusion. From this it could be suggested that Bolton discrepancies may be a cause of or a predisposing factor to malocclusion. If these discrepancies are diagnosed early, the orthodontist will be able to plan proper solutions like composite buildups or mesiodistal stripping when required and finishing orthodontics can be better predicted.

Table 4 shows the mean, standard deviation and range of the mesiodistal widths of the permanent maxillary anterior teeth in males and females.From the results of our study, it is found that the mean mesiodistal width of lateral incisors for males is 5.7-7.5 and for females it is 5.6-7.3 which is out of the normal range which is 7.07-7.38 mm. But, the mean mesiodistal widths of central incisors and canines are within the normal values. This concludes that lateral incisors have the highest discrepancy among any of the maxillary anterior teeth.

Therefore, it is clear that the Bolton's tooth-size ratios are not applicable across all the populations. Hence, separate standards for different populations are needed to deal with tooth-size discrepancy and to establish and evaluate proper inter-arch relationship of the sum mesio-distal width of the maxillary teeth to the mandibular teeth which would favor an optimal post treatment occlusion.(22,23)

CONCLUSION

From this study it was concluded that,

1) There were no significant differences between overall and anterior Bolton's discrepancy is Angle's class I and II malocclusions when compared with Bolton's standards.

2) There was no sexual dimorphism in Bolton's anterior and overall ratios for the combined three classes of malocclusion.

3) The highest tooth size discrepancy was found in lateral incisors when compared with other maxillary anterior teeth.

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