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ASSOCIATION BETWEEN BOLTON'S RATIO AND OVER JET DEVIATION IN CLASS II MALOCCLUSION AMONG SOUTH INDIAN POPULATION- A RANDOMIZED CONTROLLED TRIAL

Orthodontics

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ABSTRACT

Introduction: The aim of this study is to analyze the difference in the incidence of tooth size discrepancies using boltons ratio in class II malocclusion with varying overjet. **Materials And Methods:** The study groups consists of Group I: normal occlusion with ideal overjet and overbite (control), Group II: Class II div.1 with less than 5mm overjet Group III: Class II div.1 with more than 5mm overjet. The anterior and overall tooth size ratio was calculated for each sample as described by Bolton and included in statistical analysis. **Results:** The mean anterior and overall Bolton ratio of the normal occlusion group (78.8 and 91.88) is slightly greater than the original value. Class II malocclusion with overjet greater than 5mm showing a lowest anterior ratio, the overall ratio for the class II malocclusion group is almost same. **Conclusion:** Inter proximal slicing may be recommended in the anterior segment to eliminate the interarch discrepancy especially in increased overjet.

KEYWORDS

overjet, Bolton's ratio, Class II malocclusion, anterior ratio, overall ratio

INTRODUCTION

Establishing ideal overjet, overbite and posterior occlusal equilibrium was the main goal of orthodontic treatment. A proper proportion of total mesiodistal maxillary tooth width to mandibular tooth width must be present when all of the teeth are well aligned. Most often, orthodontic patients do not possess the correct proportion of maxillary tooth size to mandibular tooth size which is required to attain an ideal occlusion. According to Bolton, in an ideal occlusion, the sum of the mesiodistal widths of the mandibular incisors and canines should be 77.2±1.65% of the sum of the mesiodistal widths of the maxillary incisors and canines. The sum of the mesiodistal widths of 12 mandibular teeth should be 91.3±1.91% of the sum of the mesiodistal widths of 12 maxillary teeth.[1] Deviation from this proportion is considered to be a tooth size discrepancy. Proffit[2] stated this type of discrepancy exists in approximately 5% of the general population. Others have claimed that between 22% and 30.6% of orthodontic patients possess a significant tooth size discrepancy.[3] Total inter arch relationship was more important for many treatment considerations like esthetic bonding, prosthetic rehabilitation, stripping of enamel. Ballard[4]reported 90% of orthodontic patients have a mesiodistal tooth discrepancy of at least 0.25 mm on at least one pair of contralateral teeth within an arch, while 80% showed at least one discrepancy of 0.5 mm or more.

It is known that anterior Bolton ratios were smaller in Class II and larger in Class III patients compared to those with Class I molar relationship.[5] However, Alkofide and Hashim[6] did not find a significant difference in anterior ratios among the different malocclusion groups. In addition, it has been shown that tooth size discrepancies are population and gender specific.[7] But there are only a few studies which have explored the relationship between Bolton ratio and overjet or overbite.[8]

Previous studies concerning sagittal deviations and tooth size discrepancies have mostly studied associations between Angle classifications of malocclusion and Bolton ratio. Studies found significant differences in Bolton overall ratios between groups with normal, increased and decreased overjet and concluded that decreased overjet was associated with significantly larger overall ratios.[9] However, in individuals with an acceptable sagittal molar relationship, increased or decreased overjet can occur due tooth size discrepancy. Therefore, there is a need to understand the relationships between tooth size discrepancies and overjet and also find out their correlation in class II malocclusion in particular. Hence the aim of this study is to analyze the difference in the incidence of tooth size discrepancies using boltons ratio in class II malocclusion with varying overjet.

MATERIALS AND METHODS

This retrospective cross sectional study protocol was reviewed and approved by Institutional Review Board (IHEC-I/0126/21). The study group consists of pre treatment study models selected randomly from the outpatient department of a dental college. The sample size was determined by a previous study by Shastri D. et al., 2015 [13] was calculated to be N = 180, with 80% power at 5% α- error.

The Inclusion criteria includes Indian population of age 20-40, patients without systemic disorders, good quality study models and complete permanent dentition from 6-6 in upper and lower arch.

The Exclusion criteria are: subjects with presence of mesiodistal and occlusal abrasions or carries or Class II fillings; Presence of dental prosthesis; Presence of partially erupted teeth; Presence of tooth anomalies such as form, structure, and development; Fusion of teeth and gemination were excluded because it was not possible to analyze the specific size of teeth; Congenital defects or deformed teeth; Obvious interproximal or occlusal wear of teeth; Presence of missing teeth from right to left premolar;

The study groups were divided into 3 groups
Group I: normal occlusion, ideal overjet and overbite (control); n=60, male=45, female=15
Group II: Class II div.1, overjet less than 5mm n=60, male=40, female=20
Group III: Class II div.1, overjet more than 5mm n=60, male=15, female=45

Overjet were measured using standard ruler of 0.01metres from the tip of right central incisors to incisal edge of mandibular central incisor. The divider with steel arms of high flexibility was used for measuring the width of each tooth. The width of each tooth is measured from its mesial contact point to distal contact points at its greatest interproximal distance and recorded.

The anterior tooth size ratio was calculated for each study sample as described by Bolton: Sum of mandibular anterior teeth *100/Sum of maxillary anterior teeth. The overall tooth ratio is calculated using the formula: Sum of mandibular 12 teeth *100/Sum of maxillary 12 teeth. The values thus obtained is recorded and included in the statistical analysis.

RESULT:

Data analysed using SPSS (version 22.0; SPSS, Chicago, IL, USA). Descriptive statistics were calculated for both anterior and overall

ratios. Student t test was used to find out the statistical significance for each of the study group. Paired sample t test was used for comparing class II malocclusion-overjet groups and normal occlusion. Paired sample correlation test is done to find out the association between class II malocclusion overjet groups and normal occlusion.

The mean anterior Bolton ratio in normal occlusion was 78.86 with the standard deviation of 2.18 and the mean overall Bolton ratio(control) was 91.88 with the standard deviation of 3.26. The mean anterior Bolton ratio for class II malocclusion-overjet less than 5mm(group II) was 78.90 with standard deviation 2.09 and overall Bolton ratio was 92.81 with SD 2.68. The mean anterior Bolton ratio for class II malocclusion-overjet greater than 5mm(group III) was 76.41 with SD 2.20 and the mean overall Bolton ratio was 92.13 with standard deviation of 3.07(Fig. 1.)

Student t test shows statistically significant mean value for the anterior and overall Bolton ratio of class II malocclusion overjet greater than 5mm group and the normal occlusion grou ($p<0.05$) and there is no statistical significant mean value of the anterior and overall ratio of class II malocclusion group with overjet less than 5mm(table 1)

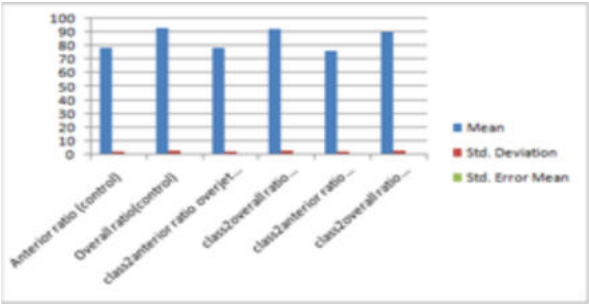

Fig.1: Mean And Standard Deviation Of The Anterior And Overall Ratio

Table 1: Student t test

Group	N	Mean	SD	Std. Error Mean	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Anterior ratio (control)	60	78.8650	2.18731	.54058	3.080	59	.003	1.66500	.5833	2.7467
Overall ratio(control)	60	92.8103	3.26623	.42167	4.222	59	.000	1.78033	.9366	2.6241
class2anterior ratio overjet <5mm	60	78.9033	2.09154	.39912	-.743	59	.460	-.29667	-1.0953	.5020
class2overall ratio overjet<5mm	60	92.133	2.68905	.34716	-1.402	59	.166	-.48667	-1.1813	.2080
class2anterior ratio overjet>5mm	60	76.4100	2.20156	.54242	2.231	59	.030	1.21000	.1246	2.2954
class2overall ratio overjet>5mm	60	90.1350	3.07454	.39692	-2.935	59	.005	-1.16500	-1.9592	-.3708

Table 3: Paired T Test and Correlations

Group	Paired Differences					t	df	Sig. (2-tailed)	Correlation	Sig.
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference						
				Lower	Upper					
class2anterior ratio overjet <5mm & Anterior ratio (control)	-.45500	5.50091	.71016	-1.87604	.96604	-.641	59	.524	.140	.036
class2overall ratio overjet<5mm & Overall ratio (control)	-2.94533	4.49090	.57977	-4.10546	-1.78521	-5.080	59	.000	.019	.888
class2anterior ratio overjet>5mm & Anterior ratio (control)	-1.96167	5.27345	.68080	-3.32394	-.59939	-2.881	59	.006	-.028	.833
class2overall ratio overjet>5mm & Overall ratio (control)	-2.26700	4.19187	.54117	-3.34988	-1.18412	-4.189	59	.000	-.002	.986

Paired sample t test shows statistically significant differences between anterior and overall ratio of class II malocclusion overjet group and normal occlusion except anterior Bolton ratio in the class II malocclusion overjet greater than 5mm and the normal occlusion anterior boltons ratio. Paired correlation test reveals there exist a statistically significant positive correlation between the anterior boltons ratio with overjet less than 5 and the boltons anterior ratio in normal occlusion (table 2). The lowest anterior Bolton ratio and greater overall ratio was found in the class II malocclusion with overjet greater than 5mm group.

DISCUSSION:

This study aims to ascertain the relationship between Bolton ratio and the overjet deviations. Subjects with class II malocclusion with overjet less than 5mm and overjet greater than 5mm but less than 10mm were compared to subjects with normal occlusion.

The primary goal of orthodontic treatment is to obtain a good molar relationship, a perfect interdigitation, and a ideal overjet and overbite. Hence this study is undertaken to understand the intermaxillary tooth size discrepancy in our population groups with varying overjet especially in class II malocclusion groups which is considered to more prevalent.

When comparing the mean anterior and overall Bolton ratio of the normal occlusion group(78.8 and 91.88) to Bolton's ideal ratio(77.2 and 91.3), the anterior Bolton ratio in our study sample was almost equal to slightly greater than the original value. The result of our study is in accordance to Santoro et al.,[10] reported that the overall ratio was found to be equivalent to the Boltons whereas the anterior ratio was 78.1, larger than the 77.1 Bolton ratios. Also the result of other studies by NieQ,et. al., LundstromA.et. al., and Othman S,et al.,[5,11,12] shows greater anterior Bolton ratio which was relatively similar to the result of our study sample. To conclude, almost majority of studies in different population groups have reported larger anterior ratios in subjects with normal occlusion compared to the original anterior ratio presented by Bolton and the overall ratio was similar to original overall ratio given by Bolton.

Only limited amount of research has been conducted to study the relationship between Bolton ratio and over jet. The study by Alam and Iida [13], found increased tooth size ratios in subjects with dental mid-line discrepancy and also in those with decreased overjet or decreased overbite. The result of our study is in accordance to the previous study that class II malocclusion with overjet lesser than 5mm showing a greater overall ratio when compared to class II malocclusion with overjet greater than 5mm and class II malocclusion with overjet greater than 5mm showing a decreased anterior ratio when compared to class II malocclusion with overjet lesser than 5mm and the normal occlusion. Our finding can also be cooroborated with the study by Lopatiene K et al.,[14] a moderate correlation was found between the Bolton overall ratio and overjet ($r=-0.45$, $p<0.001$). According to him, 1-mm increase in overjet resulted in a 0.551% decrease in the Bolton ratio.

The result of our study depicts almost similar overall ratio in both the normal occlusion group as well class II malocclusion overjet less than 5mm group but smaller anterior ratio in class II malocclusion with overjet greater than 5mm. These results reflect that increased overjet may be due to the tooth size discrepancies in the anterior segment in addition to the discrepancies in molar relationship in class II malocclusion cases. The study by Wedrychowska-Szulc B,et al., [15] concerning molar relationships, have found associations between deviations from Bolton ratio and Angle Class II and Class III malocclusions. Also the recent study by Turtinen H et al.,[16] Tooth size discrepancy between upper and lower anterior teeth was related to overjet, especially in subjects with extreme and negative overjet and widths of the maxillary anterior teeth differed between overjet groups which supports the results of our study. Thereby to conclude that smaller Bolton ratios are more common in individuals with increased

overjet/Class II malocclusion and vice versa. Conversely, some researchers have not found any difference in Bolton ratios between malocclusion groups. [17] The results of this study suggest that overjet deviations partly result from variations of teeth width, in particular anterior teeth widths.

It has been suggested that maxillary mesiodistal tooth size may be larger in Angle Class II population especially in increased overjet and partly explains the anterior Bolton tooth size discrepancy. Tooth size discrepancies or abnormal tooth anatomy make it challenging for clinicians to achieve optimal overjet simultaneously with acceptable intercuspation especially in increased overjet.

Although molar relationship generally reflects deviations in overjet, in cases with tooth size discrepancy these are not always related. Hence to conclude inorder to achieve ideal intercuspation including ideal overjet and overbite in cases of class II malocclusion with increased overjet may require proximal stripping in the anterior segment in addition to correction of molar and canine relationship.

CONCLUSION

The mean anterior and overall Bolton ratio of the normal occlusion group is significantly greater than the original Bolton's ratio.

Class II malocclusion with overjet greater than 5mm showing a significantly lowest anterior ratio.

Inter proximal slicing may be recommended in the anterior segment to eliminate the interarch discrepancy especially in increased overjet.

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