Available online at www.jobpcr.com

ISSN-2394:3076
CODEN(USA) : JBPCBK

Journal of Biological Pharmaceutical And Chemical Research , 2017,4(2): 1-6

(http://www.jobpcr.com/arhcive.php)

Effect of Premolar extraction on the Bolton's overall ratio in different malocclusion groups in local Gujarati Population

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ABSTRACT

Andrew's six keys to normal occlusion are essential for a balanced and stable occlusion in orthodontic patients. Bolton further gave the seventh key "Bolton's ratio" which is as important as Andrew's key during orthodontic diagnosis to achieve best possible esthetic and functional outcome for patients undergoing orthodontic treatment. Extraction of premolars during orthodontic treatment have known to cause changes in the Bolton's overall ratios and affect the interarch tooth size discrepancies in these patients. 106 pretreatment study models with different malocclusions as per Angle's classification were subjected to Bolton's analysis and Bolton's overall ratios were calculated for all study subjects and compared with the ratios obtained after hypothetical extraction of premolars of different combination to determine their effect on overall ratios. In all malocclusion groups, it was observed that extraction of 5\5 and 5\4 affected the Bolton's overall ratios more significantly as compared to extraction of 4\4 and 4\5.

Key words: Bolton's Ratio, premolar extraction, Angle's classification of malocclusion

INTRODUCTION

The purpose of orthodontic diagnosis and treatment planning is to determine the best possible functional and esthetic results for the patients at the end of treatment[1]. With almost daily progress in the field of clinical orthodontics with plentiful advances in the diagnostic aids in orthodontic treatment, study models are still a vital diagnostic aid[2].

Bolton[3] stated that a correct maxillary and mandibular mesiodistal tooth size relationship is important for achievement of proper occlusal interdigitation in the finishing stages of orthodontic treatment. Thus Bolton analysis[3-5] based on the ratios between the mesiodistal tooth diameter sums of the mandibular and the maxillary dentitions, remains the most recognized and widely used method for detecting interarch tooth size discrepancies[6-9].There is good evidence that populations differ with respect to interarch tooth size relationships because differences in tooth sizes are not consistent[10-12].

Therefore if one is aware that Bolton's overall ratio and tooth size discrepancy may be affected after extraction of premolars, one is likely to be more cautious in deciding whether to extract or not and if necessary which tooth combination is more preferable over the other to reduce or correct Bolton's

discrepancy[13].

Attempts have been made by various authors to study the validity of Bolton's ratio and effects of premolar extractions in different regional Indian population[14,15]. With this view in mind, this study was undertaken to investigate the effects of premolar extractions on the Bolton's overall ratios in various malocclusion groups in local Gujarati population to achieve the best possible treatment outcome with stable static as well as dynamic occlusion.

AIMS AND OBJECTIVES

- To compare the Bolton's overall ratio given by ***Bolton WA*** in the given study sample.
- To estimate and compare the effects of premolar extractions on the Bolton overall ratios in different malocclusion groups.
- To assess which premolar extraction combination affects the Bolton overall ratio the most

MATERIALS AND METHOD

For this study, 106 pre-treatment subjects with age between 18-25 years having different malocclusions were selected from orthodontic patients who reported for treatment. The inclusion criteria for selection of subjects

- Patient's age ranged from 18-25 years
- 3rd molars may or may not be present. All other permanent teeth should be present.
- No history of previous orthodontic treatment
- Morphologically teeth to be normal in shape

The exclusion criteria for selection of subjects

- Gross restorations, build ups, crowns, Onlays, Class II amalgam or composite restoration that affect the tooth's mesiodistal diameter
- Congenital defects or deformed teeth
- Missing tooth/teeth
- Interproximal or occlusal attrition of the teeth
- Over retained deciduous teeth/ supernumerary teeth if present

Impressions of the selected subjects were made with alginate impressions material and study models were prepared. These study models were divided into 4 groups based on the Angle's classification of malocclusion

Group 1: Angle Class I Malocclusion -30 subjects

Group 2: Angle Class II Division 1 Malocclusion -30 subjects

Group 3: Angle Class I Division 2 Malocclusion -30 subjects

Group 4: Angle Class III Malocclusion -16 subjects

Armamentarium

1. Digital caliper with vernier scale

2. Orthodontic study models

Assessment of Bolton overall ratios and tooth size discrepancy

Digital caliper with vernier scale is used to measure the mesiodistal widths from first molar on one side to the first molar on the other side for both the maxillary and mandibular arches. The tooth material is calculated by measuring the maximum mesiodistal dimensions of the teeth up to the nearest of 0.01 mm on each cast and adding them up separately for the maxillary and the mandibular cast. All measurements were done by one investigator.

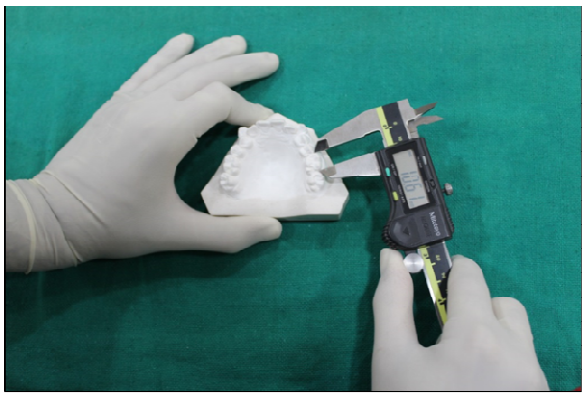


Figure 1 showing measurement of mesiodistal width of tooth using digital caliper with vernier scale

The overall ratios are calculated by using the following method as suggested by Bolton[3].

$$\text{Bolton's overall ratio} = \frac{\text{sum of mesiodistal width of mandibular 12 teeth}}{\text{sum of mesiodistal width of maxillary 12 teeth}} \times 100$$

The study models obtained from 106 pretreament subjects are divided into four malocclusion groups as mentioned earlier and calculations are made based on Bolton analysis to determine the Bolton overall ratios for all the subjects.

After determination of individual overall ratio of all the subjects, hypothetical tooth extractions are performed on each subject in the following 4 combinations:

4\4 - 1) Maxillary and mandibular first premolars

5\5 - 2) Maxillary and mandibular second premolars

4\5 - 3) Maxillary first and mandibular second premolars

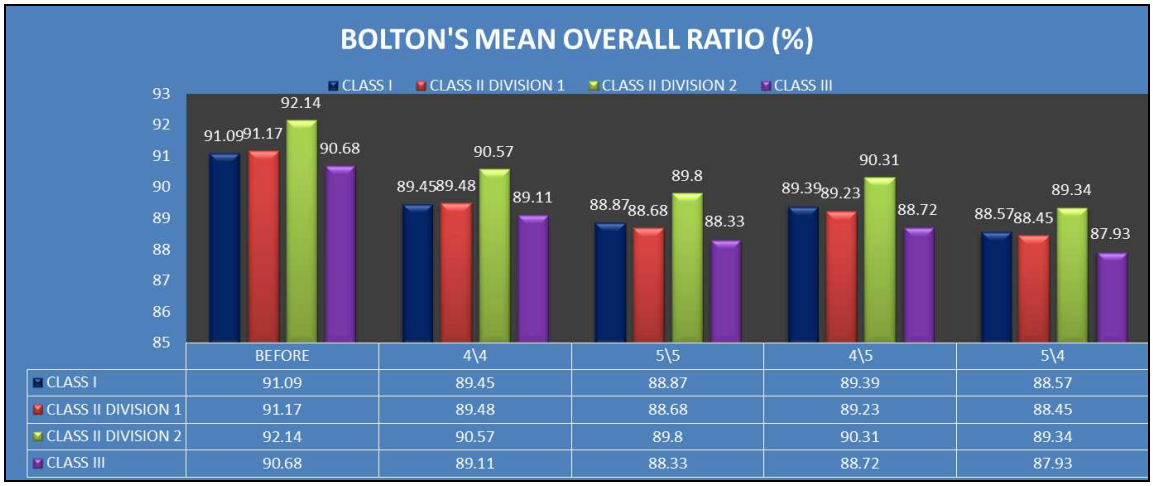
5\4 - 4) Maxillary second and mandibular first premolars

Once the hypothetical extractions are done as per the respective combination, the Bolton's overall ratio is again calculated as suggested by Bolton[5].

$$\text{Bolton's overall ratio} = \frac{\text{sum of mesiodistal width of mandibular 10 teeth}}{\text{sum of mesiodistal width of maxillary 10 teeth}} \times 100$$

The Bolton's overall ratios obtained with different premolar extractions combination is compared with original Bolton's overall ratio in each malocclusion group.

RESULT AND DISCUSSION



Graph 1 - Mean comparisons of Bolton overall ratios before and after extractions in different malocclusion groups.

Table 1 – one way ANOVA with post hoc Tukey test in different malocclusion groups

MALOCCLUSION	One way ANOVA	BOLTON OVERALL MEAN	EXTRACTION	p value	Tukey HSD
CLASS I	HS	OVERALL	4\4	0.033*	S
			5\5	**0.001*** **	HS
			4\5	0.024*	S
			5\4	**0.00*** **	HS
CLASS II DIV 1	HS	OVERALL	4\4	0.043*	S
			5\5	**0.001*** **	HS
			4\5	0.013*	S
			5\4	**0.00*** **	HS
CLASS II DIV 2	HS	OVERALL	4\4	0.096	S
			5\5	**0.001*** **	HS
			4\5	0.033*	S
			5\4	**0.00*** **	HS
CLASS III	S	OVERALL	4\4	0.624	NS
			5\5	**0.04***	S
			4\5	0.407	NS
			5\4	**0.027***	S
NS - p > 0.05 (NON SIGNIFICANT), S - p ≤ 0.05 (SIGNIFICANT)* , HS - p ≤ 0.001 (HIGHLY SIGNIFICANT)***					

DISCUSSION

Graph 1 shows the Mean comparisons of Bolton overall ratios before and after extractions in different malocclusion groups.

The mean Bolton overall ratio for class I malocclusion is 91.09% ± 2.07%,class II Division 1 malocclusion is 91.17% ± 2.24% ,class II Division 2 malocclusion is 92.14% ± 2.22% and class III malocclusion is 90.68%± 2.98%. **The mean Bolton overall ratio for the entire study subjects before extraction is 91.27% ± 2.34%.** This is in accordance with the mean overall ratio given by

Bolton[3]and ***Stifter***[16]of 91.3%± 1.91% and 91.04% ± 1.90% respectively with higher standard deviations. The mean overall 12 ratio observed by ***Freeman et al***[8]was 91.4% ± 2.57%, ***Crosby and Alexander***[6] was 91.4% ± 2.4% and ***Kayalioglu et al***[17] was 90.61% ± 1.08%.

The mean Bolton overall ratio for the entire study subjects obtained after extraction of maxillary and mandibular first premolars (4/4) is 89.65% ± 2.50%, after extraction of maxillary and mandibular second premolars (5/5) is 88.92% ± 2.56%, after extraction of maxillary first and mandibular second premolars (4/5) is 89.41% ± 2.54% and after extraction of maxillary second and mandibular first premolars (5/4) is 88.57% ± 2.43%.

Bolton[5]advocated that after extraction of premolars the mean overall ratio should be 88% ± 1 %. In the present study, the Bolton mean overall ratio observed after any combination of premolar extraction was greater than 88% ± 1% with higher standard deviations. This difference in the mean overall ratio and standard deviations could be attributed to the difference in the selection of study subjects. Bolton selected patients who were treated orthodontically (mostly) with nonextraction for his mean whereas the study subjects included in this study were of different malocclusion types. Study by ***Endo et al***[18] also showed mean overall ratio greater than the mean advocated by ***Bolton***[5] with higher standard deviations in all malocclusion types. Thus, the ***Boltons***[3] mean overall ratio of 91.3% ± 1.91% before extraction is held validated for the given study subjects. But the mean overall ratio of 88% ± 1 % after extraction of premolars does not hold true for the given study subjects.

Two Way ANOVA to test Bolton's overall ratios as a function of extraction and malocclusion types showed statistically significant difference in mean Bolton's overall ratios after any extraction combinations, irrespective of any malocclusion group soOne way ANOVA with post hoc Tukey test is carried out in each malocclusion group to determine which premolar extraction combination affected the mean Bolton's overall ratios more significantly than the others.

Table 1shows **One Way ANOVA** test to compare the Bolton's overall ratios before and after premolar extractions in different malocclusion groups. Statistically highly significant difference is seen between the Bolton's overall ratios before and after premolar extraction in Class I, Class II division 1, Class II division 2 and significant difference in Class III malocclusion. From, **Post hoc Tukey** test it can be concluded that the Mean Bolton's overall ratios decreases more significantly after extraction of maxillary and mandibular second premolars (5\5) and extraction of maxillary second and mandibular first premolars (5\4) when compared to extraction combination of maxillary and mandibular first premolars (4\4) and extraction of maxillary first and mandibular second premolars (4/5). This is in accordance with the study conducted by ***Endo et al***[18] and ***Tong et al***[13]where it was concluded that extraction combination of 5\5 and 5\4 affected the Bolton overall ratio significantly when compared with the extraction combination of 4\4 and 4\5.

CONCLUSION

The Mean Bolton overall ratio observed in given local Gujarati population was in accordance with the mean overall ratio described by Bolton with higher standard deviations.Bolton's overall ratio decreases after any combination of premolar extraction in all malocclusion groups and this difference is more significant after extraction of maxillary and mandibular second premolars [5\5] and extraction of maxillary second and mandibular first premolars [5\4] when compared to extraction of maxillary and mandibular first premolars [4\4] and extraction of maxillary first and mandibular second premolars [4\5].

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