

Effect of Premolar Extraction on Overall Bolton Ratio in Class II Malocclusion in RSGM FKG USU

Ika Pizarina

Orthodontic Resident

Faculty of Dentistry, University of North Sumatera
Medan, Indonesia

Nurhayati Harahap

Orthodontic lecturer

Faculty of Dentistry, University of North Sumatera
Medan, Indonesia

Muslim Yusuf

Orthodontic lecturer

Faculty of Dentistry, University of North Sumatera
Medan, Indonesia

Abstract–Tooth extraction to overcome the functional and aesthetic outcomes has become an issue in orthodontic treatment. Tooth size discrepancy was determined through a Bolton analysis. Overall Bolton ratio has changed after the tooth extraction, and affected by different extraction. The aim is to determine the effect of premolar extraction to overall Bolton ratio in Class II malocclusion. Subject was 40 patients with Class II malocclusion in accordance with the inclusion criteria. Measurements performed directly on 12 maxillary and mandibular teeth using an electronic digital caliper. The initial overall Bolton ratio was calculated on the whole samples and continued with several hypothetical extractions. After that, the calculation of the overall Bolton ratio after hypothetical extractions were done and the results were statistically tested to see the effect of the premolar extraction on overall Bolton ratio in Class II malocclusion. The initial overall Bolton ratio consisted of small overall Bolton ratio (86.27 ± 3.19) the number of 7 subjects (17.5%), normal overall Bolton ratio (91.63 ± 1.19) with the number of 23 subjects (57,5%) and large overall Bolton ratio (95.65 ± 2.47) with the number of 10 subjects (25%). Wilcoxon test showed the effect of premolar tooth extractions on overall Bolton ratio in Class II malocclusion ($p=0.001$). Overall Bolton ratio shifted significantly into the normal Bolton ratio were observed in the combination of maxillary first premolar and mandibular second premolar extractions, while the maxillary first premolar extraction increased the overall Bolton ratio. Premolar tooth extraction affects the overall Bolton ratio in Class II malocclusion.

Keywords–*premolar extraction, hypothetical extraction, overall Bolton ratio, Clas II malocclusion*

I. INTRODUCTION

Tooth size has become a critical parameter in orthodontic's diagnosis and treatment planning. It has been known that the major cause of malocclusion is a tooth size discrepancy, whether in maxilla or mandible. Bolton developed a method of analyzing mesio-distal tooth size ratio between maxillary and mandibular teeth, and two ratios were developed; anterior ratio ($77.2 \pm$

1.65%) which were obtained by measuring the six anterior teeth, and overall ratio ($91.3 \pm 1.91\%$) which were obtained by measuring from first molar to first molar [1].

Class II malocclusion can be divided into extraction and non-extraction cases. Tooth extraction is usually done to correct the tooth/arch length discrepancy, to correct the inclination of anterior teeth, or to obtain the aesthetic of the profile. The most frequent tooth to be extracted is the premolar, due to its position in the middle of the arch [1].

The overall ratio and tooth-size discrepancies are directly influenced by premolar extraction. Kale et al stated that the overall ratios after extraction of all premolar combinations were smaller than those before extraction, and, in some of the patients, normal and large overall ratios changed into small and normal overall ratios, respectively, after extraction of premolars [2]. Han et al investigated tooth-size discrepancies created by premolar extractions using the Bolton index, which is a positive value of either maxillary or mandibular corrections required to give the Bolton mean overall ratio [3].

The purpose of this study was to investigate the effects of premolar extractions on the Bolton overall ratios in Class II malocclusion in RSGM FKG USU.

II. MATERIALS AND METHODS

Study casts of 40 class II malocclusion patients of the RSGM FKG USU were selected for this study. All subjects were between ages of 17 - 35 years old. None of the subjects had undergone orthodontic treatment.

The following inclusion criteria were used in the selection of the study models was Class II malocclusion with $ANB > 4^\circ$, good quality of study models and lateral cephalograms, all permanent teeth were fully erupted and present from right to left first permanent molar, no extraction or interproximal stripping performed and no obvious interproximal or occlusal wear of teeth.

The following were the exclusion criteria was broken study models, gross restorations, build-ups, crowns, onlays, or class II restoration, congenitally missing teeth and impacted teeth and gross carious teeth which involve mesial or distal surfaces.

Digital caliper (Mitutoyo) was used to measure the mesiodistal widths from first molar to first molar to the nearest 0.01 mm on each cast. The mesiodistal width of each tooth was measured at the greatest distance between the contact points on the proximal surfaces. All measurements were done by one operator. The overall ratios were calculated using the Bolton method. Two weeks later all the casts were re-measured by the same operator.

Hypothetical tooth extractions were performed on each subject in the following 5 combinations: (1) all first premolars, (2) maxillary first and mandibular second premolar, (3) maxillary second and mandibular first premolars, (4) all second premolar, and (5) maxillary first premolars. The overall ratios were again calculated after the hypothetical extractions in each malocclusion group.



Figure 1. The measurement of the width of the teeth

Paired t-test was performed to determine the difference between the first and second measurements. Normality and homogeneity of data were analyzed by Levene test. ANOVA was performed to determine whether there were changes in each group, and Post Hoc and Benferroni were performed to determine the difference of each group. Wilcoxon test was performed to determine the rate of each group.

III. RESULTS

Table I shows the overall distribution of overall Bolton ratios prior to premolar extraction on Class II malocclusion subjects, which is 7 subjects with low overall Bolton ratio (86.27 ± 3.19), 23 subjects with normal overall Bolton ratio (91.63 ± 1.19) and 10 subjects with high overall Bolton ratio (95.65 ± 2.47). All data were tested homogeneously using Levene test and it was found that the data came from the same variant.

TABLE I. THE VALUE OF OVERALL BOLTON RATIO PRIOR TO EXTRACTION

Overall Bolton ratio	N	%	X ± SD
Low	7	17,5	86.27±3.19
Normal	23	57,5	91.63±1.19
High	10	25	95.65± 2.47
Total	40	100	91.70± 3.61

Table II shows the result of one-way ANOVA test (significance degree $\alpha = 0.05$) from the data distribution changes of the average overall normal Bolton ratio after the hypothetical premolar extraction.

TABLE II. THE CHANGES OF LOW OVERALL BOLTON RATIO AFTER HYPOTHETICAL PREMOLAR EXTRACTION

Low overall Bolton ratio	N	X ± SD (%)	P
Initial	7	86.27±3.19	0,0001
4P1	7	84.71± 3.19	0,0001
P1 maxilla & P2 mandible	7	84.86± 3.34	0,0001
P2 maxilla & P1 mandible	7	84.45± 3.15	0,0001
4P2	7	84.60± 3.10	0,0001
P1 maxilla	7	101.54± 4.09	0,0001

Table III shows the result of one-way ANOVA test (significance degree $\alpha = 0.05$) from the data distribution changes of the average overall normal Bolton ratio after the hypothetical premolar extraction on Class II malocclusion.

TABLE III. THE CHANGES OF NORMAL OVERALL BOLTON RATIO AFTER HYPOTHETICAL PREMOLAR EXTRACTION

Normal overall Bolton Ratio	N	X ± SD (%)	P
Initial	23	91.63±1.19	0,0001
4P1	23	90.34± 1.69	0,0001
P1 maxilla & P2 mandible	23	90.57± 1.53	0,0001
P2 maxilla & P1 mandible	23	89.22± 1.81	0,0001
4P2	23	89.44± 1.55	0,0001
P1 maxilla	23	108.25± 1.32	0,0001

Table IV shows the result of one-way ANOVA test (significance degree $\alpha = 0.05$) from the data distribution changes of the average high overall Bolton ratio after the hypothetical premolar extraction on Class II malocclusion.

TABLE IV. THE CHANGES OF HIGH OVERALL BOLTON RATIO AFTER HYPOTHETICAL PREMOLAR EXTRACTION

High overall Bolton ratio	N	X ± SD (%)	P
Initial	10	95.65± 2.47	0,0001
4P1	10	94.25± 2.59	0,0001
P1 maxilla & P2 mandible	10	94.25± 3.13	0,0001
P2 maxilla & P1 mandible	10	93.23± 2.34	0,0001
4P2	10	93.38± 2.58	0,0001
P1 maxilla	10	113.06± 2.74	0,0001

Furthermore, the effect of the five hypothetical premolar group removals on the overall Bolton ratio changes can be seen in Figure 2.

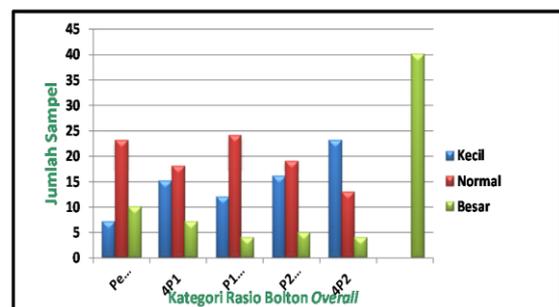


Figure 2. Graphic of changes of hypothetical premolars to overall Bolton ratio.

IV. DISCUSSION

The purpose of this study was to determine the overall Bolton ratio after the hypothetical premolar extraction. This study did not investigate the difference in Bolton ratios between men and women, according to research conducted by Endo, Saatci, and Othman [4].

According to a study conducted by Tong et al in 2004, the overall Bolton ratio changes was seen in all combinations of premolars extraction. After the hypothetical premolar extraction, the authors found that overall Bolton ratio were most elevated in the maxillary removal group and most decreased in the group of first premolar maxillary and second premolar mandible, resulting in the changes of overall Bolton ratio closest to the highest normal value seen in this group [5].

One-way ANOVA test showed a significant difference in overall Bolton ratio before and after the hypothetical premolar extraction, similar study held by Tong et al. Kale et al (2004) concluded that patients with high Bolton ratios would turn into normal overall Bolton ratio and patients who grouped into normal overall Bolton ratio would have low overall Bolton ratio after the premolars were removed [2].

The Wilcoxon test showed that the group closest to normal values was the group of first premolar maxillary and second premolars mandible, followed by the second group of premolar maxillaries and the first premolar mandibular. While the first premolar maxillary removal group showed the elevation of overall Bolton ratio.

Class II malocclusion treatment with extraction may involve two maxillary premolars or two maxillary premolars and two mandibular premolars. The removal of two maxillary premolars is generally indicated when there is no crowding or cephalometric discrepancy in the mandible. Removal of four premolars is particularly indicated for crowding in the mandible or in combination of growing patients [6].

Dental discrepancies may affect the outcomes of care and orthodontic stability. If the average value of overall Bolton ratio after hypothetical premolar extraction is greater than the mean value prior to removal, it indicates that if the mesiodistal width of the maxillary teeth is normal, the mesiodistal width of the mandible is greater than the maxillary teeth size. From a clinical perspective, the finding suggests that mandibular anterior teeth need to be recontoured in order to obtain Class I canine relation. In certain cases, it is necessary to consider interproximal enamel reduction to reduce the mesiodistal width of the mandibular teeth in order to achieve a good interdigitation [7,8].

Maxillary and mandibular correction can be done to evaluate dental discrepancies. If the width of teeth in

one jaw is considered normal, then the teeth in the other jaw are bigger or smaller than the opposite which make the Bolton ratio is unbalanced.

Several previous studies have shown that changes in relation between the size of the teeth and the length of the curve are multifactorial, depending on the overbite, the overjet, the inclination of the anterior teeth, the intercanine width, the intermolar width, the curve width, and the curve of Spee [9].

The conclusion of the study was Class II malocclusions in RSGM FKG USU (40 samples, ANB $5.51^\circ \pm 3.73$ and Class II molar relation) found to have three groups of Bolton ratios, the low overall Bolton ratio (86.27 ± 3.19) is 7 subjects (17.5%), the normal overall Bolton ratio (91.63 ± 1.19) with the total number of 23 subjects (57.5%) and the high overall Bolton ratio (95.65 ± 2.47) with 10 subjects (25%). The hypothetical premolars extraction has a significant effect on the overall Bolton ratio. The proper pattern for correcting Class II malocclusions from the overall Bolton ratio is the first maxillary premolars and the second mandibular premolars extraction. The removal of the first maxillary premolars will increase the Bolton overall ratio. The existed extraction patterns should consider the condition of each case to obtain the best possible treatment result.

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