Post orthodontic treatment stability measurement in dentoskeletal class I malocclusion based on The Objective Grading System Index

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ABSTRACT

The purpose of this study was to examine the stability of orthodontic treatment results in dentoskeletal class I malocclusion treated with and without extraction of four premolars and to compare the stability of treatment result between those groups. Occlusal relationship after treatment and six month post retention were measured on dental cast using The Objective Grading System Index at Orthodontic Specialist Clinic, Faculty of Dentistry Universitas Padjadjaran. The analytic descriptive study was carried out on 30 samples that comprised 14 samples were treated without extraction of four premolars and 16 samples were treated with extraction of four premolars. ABO Measuring Gauge was used to measure seven variables: tooth alignment, height of the marginal ridges, buccolingual inclination, occlusal relationships, occlusal contacts, overjet, and interproximal tooth contacts. The results were statistically analyzed with the Wilcoxon rank test to test the difference of The Objective Grading System Index between posttreatment and postretension. Mann-Whitney U test was applied to determine the difference between the group with extraction of four premolars and the group without extraction of four premolars. The level of significance was set at 0.05. The results of this study showed these following variables: tooth alignment, occlusal contacts and overjet were unstable at the group with extraction of four premolars, while only tooth alignment was found to be unstable at the group without extraction of the four premolars. Mann-Whitney U test did not show statistically significant difference in stability comparison test between the groups.

Key words: Stability, objective grading system index.

ABSTRAK

Tujuan penelitian ini adalah untuk mengukur stabilitas hasil perawatan ortodonti pada maloklusi kelas I dento skeletal yang dirawat baik dengan pencabutan 4 premolar maupun tanpa pencabutan dan membandingkan stabilitas hasil perawatan antara keduanya berdasarkan pengukuran pada hubungan oklusal model studi diakhir perawatan dan setelah retensi menggunakan indeks Objective Grading System di klinik PPDGS ortodonti FKG UNPAD. Penelitian ini bersifat deskriptif analitik yang dilakukan pada 14 sampel tanpa pencabutan dan 16 sampel dengan pencabutan 4 premolar. Model studi di akhir perawatan dan model studi setelah retensi dinilai kualitas hubungan oklusalnya dengan menggunakan ABO Measuring Gauge pada 7 variabel pengukuran yaitu: kesejajaran gigi, tinggi tepi marginal, inklinasi

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buko-lingual, hubungan oklusal, kontak oklusal, overjet, kontak interproksimal gigi. Hasil pengukuran dianilisis secara statistic dengan menggunakan Wilcoxon Rank test untuk uji perbedaan nilai indeks Objective Grading System setelah perawatan dengan nilai indeks Objective Grading System setelah retensi dan Mann-Whitney U test untuk menentukan perbedaan antara kelompok pencabutan 4 premolar dan tanpa pencabutan premolar dengan a = 0.05. Hasil pengujian menunjukkan adanya ketidakstabilan pada variabel kesejajaran, kontak oklusi dan overjet pada perawatan dengan pencabutan 4 premolar, sedangkan pada perawatan tanpa pencabutan ketidakstabilan terdapat hanya pada variabel kesejajaran. Untuk uji perbandingan kestabilan antara perawatan dengan pencabutan 4 premolar dan tanpa pencabutan menggunakan Mann-Whitney U tes tidak memperlihatkan perbedaan yang bermakna secara statistic.

***Kata kunci**: Stabilitas, indeks objective grading system*

INTRODUCTION

Orthodontic treatment aims to obtain a normal occlusion with a stable ideal teeth composition, aesthetics, and functional.[1] A good occlusal relationship functionally affects the stomatognathic system, reduces the potency of relapse after an active orthodontic treatment as well as giving comfort to patients.[2] Stomatognathic system consists teeth in upper and lower jaws together with their supporting tissues, muscles around the oral cavity and head, temporomandibular articulation, tongue, nerve system, vascular system, and other tissue structures that are important parts that must be considered in orthodontic treatment since they have a close relationship with curve shape and teeth function, jaws relation, temporomandibular joint, craniofacial suitability and teeth occlusion.[3]

According to Nett's research, patient with an ideal occlusal relationship after treatment shows a better stability because the occlusion contact with good interdigitation is able to prevent teeth shift after treatment caused by the occlusal power and the masticatory muscles as well as creating functional stability.[1] Teeth occlusion contact is the most important factor in determining teeth stability in the final treatment result. Consequently, teeth must reach the normal occlusion and must be maintained with the precise retention use.[4]

In order to get an ideal result of orthodontic treatment, there are some variables that must be considered, malocclusion type and severity, treatment period, patient's cooperation, growth period, adaptation of hard and soft tissues, type and time of retainer equipment use. If an orthodontic treatment is conducted based on proper treatment analysis and plan, after several years the stability after the retention use period will be very well.[5] Therefore, orthodontists have to achieve an ideal treatment result with proper treatment procedure, diagnosis, and retention.

For all this time, evaluation on orthodontic treatment result and its stability have not been carried out in Orthodontic Specialist Clinic of Universitas Padjadjaran Bandung. It happens because the success of a treatment is not only seen on the final result but also from how long the result can last. Therefore, a research on the stability to get the treatment's result indicator needs to be conducted in the Orthodontic Specialist of UNPAD.

Evaluation of orthodontic treatment result can be measured and evaluated qualitatively and quantitatively.[6] American Board of Orthodontic uses several index for evaluating treatment result by comparing the data before and after treatment, such as the Peer Assessment Rating Index which was developed in 1987 to evaluate malocclusion severity and treatment result, as well as to measure how much the malocclusion deviation from normal occlusion.[7]

In 1988, American Board of Orthodontic developed the Objective Grading System Index to evaluate the occlusal relationship. In order to evaluate the occlusal relationship, a study model after treatment is used by measuring 7 para-meters: teeth alignment, marginal edge height, buccolingual inclination, occlusal relationship, occlusal contact, overjet, interproximal teeth contact, and panoramic radiography images to measure the angulation of teeth root.[7]

According to American Board of Orthodontic, by using the Objective Grading System measurement, the success of a treatment is determined by the occlusal position functionally and it can be seen in a model study with good articulation.[6] Based on the description above, the authors are interested to conduct an evaluation on the quality of occlusal relationship of orthodontic treatment result, compare the score of Objective Grading System Index in patients who have completed the retention use period and see the relationship of orthodontic treatment quality with Edgewise standard fixed tool on the stability of its treatment result which is measured to the patients model study that have been treated by the participants of the Orthodontic Specialist Dentist Education of UNPAD by using the Objective Grading System Index assessment from the American Board of Orthodontic, but the measurement does not include the parallel evaluation of teeth root on panoramic images because the study is only focused in the measurement of dental mold models as well as to avoid patients from the X ray exposure.

METHODS

This research was an analytic descriptive method to measure the occlusal relationship of orthodontic treatment result after retention period in dentoskeletal class I malocclusion patients with 4 premolars extraction and without extraction with the Edgeweise standard fixed tools on upper and lower jaws using the Objective Grading System. Research population are all patients who have been

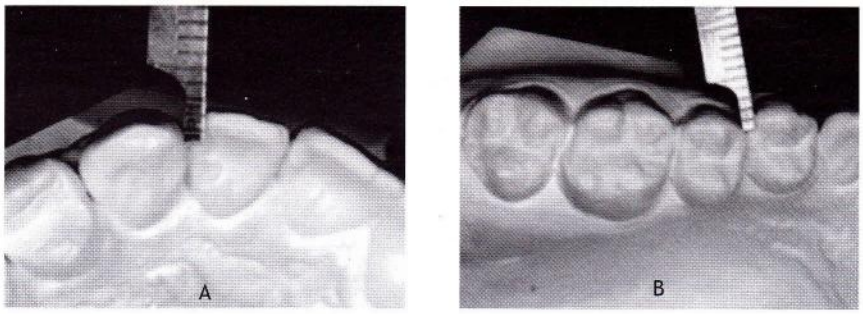

Figure 1. How to measure teeth alignment; (a) in regio anterior; (b) in regio posterior, there is more than 1 mm deviation.[2]

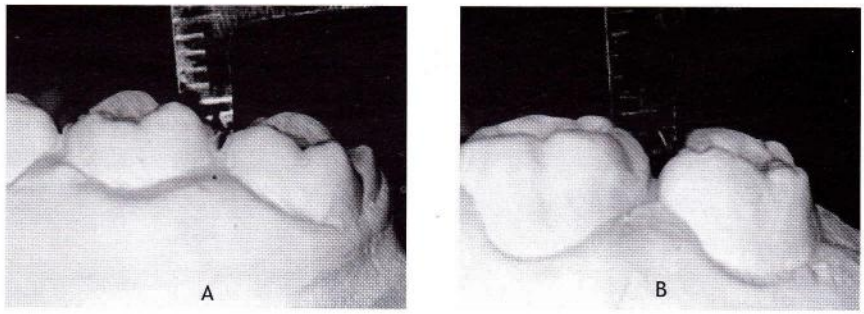

Figure 2. Measurement of marginal edge: less than 1 mm deviation (A); more than 1 mm deviation (B).[2]

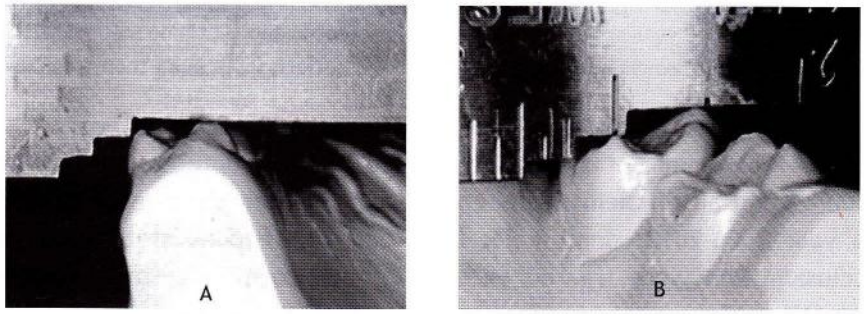

Figure 3. Measurement of Buccolingual Inclination: regio posterior of the lower jaw (A); the upper jaw (B).

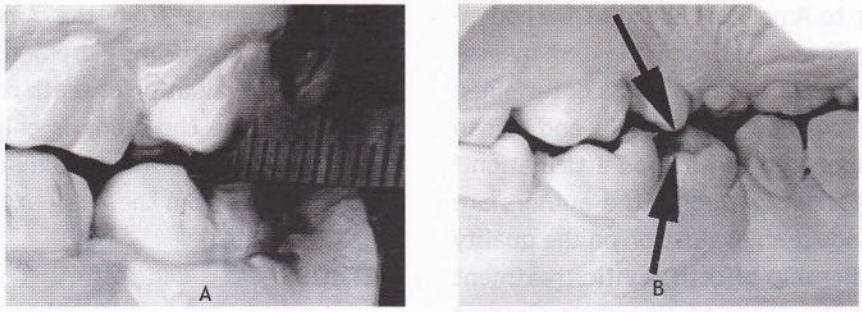

Figure 4. Measurement of occlusal contact: less than 1 mm deviation (A); more than 1 mm deviation (B).[2]

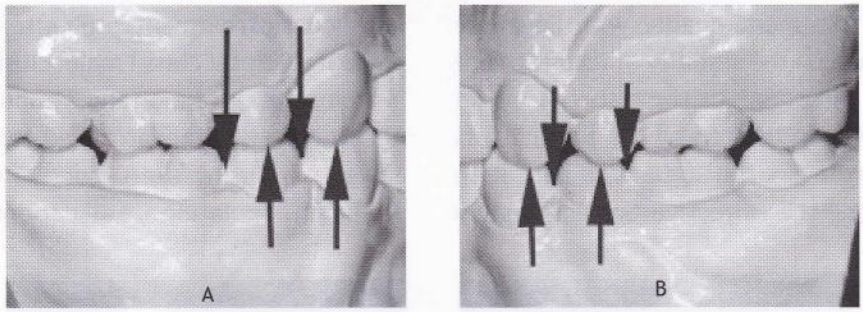

Figure 5. The occlusal relationship measurement; less than 2 mm deviation (A), more than 2 mm deviation (B).[2]

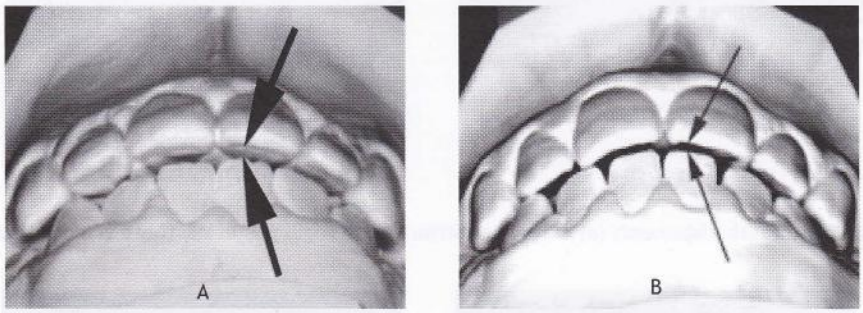

Figure 6. Measurement of anterior overjet: more than 1 mm deviation (A), less than 1 mm deviation (B).[2]

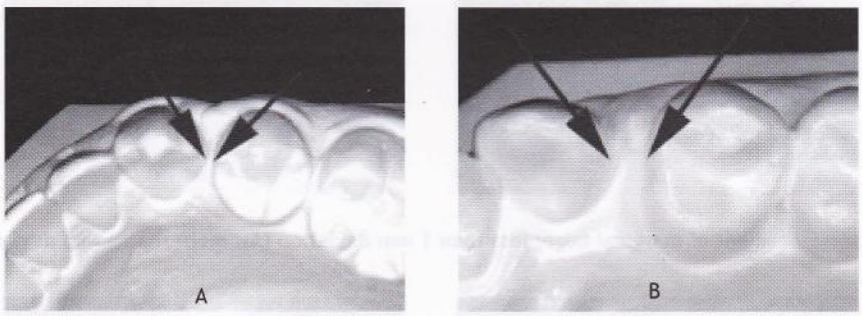

Figure 7. The deviated interproximal contact: less than 1 mm deviation (A), more than 1 mm deviation (B).[2]

treated by the the participants of the Orthodontic Specialist Education Programme of Universitas Padjadjaran Bandung, and all of them had been cured since the year 2006-2010, dentoskeletal 1st class I malocclusion who were treated with 4 premolars extraction and without premolars extraction; patients' age at the time of retainer installation was 15-35 years old; all permanent teeth have erupted to the first molar teeth; have worn Hawley Retainer for 6 months; medical records; the model study after treatment was still in good condition. This research was conducted in the Orthodontic Specialist Clinic *Rumah Sakit Gigi dan Mulut* (Oral and Dental Hospital) Faculty

Table 4.1. Assessment test of value change of the Objective Grading System index at the end of treatment and after retention period on the treatment with 4 premolars extraction and without 4 premolars extraction

Group	Rank					Change score
	End of treatment	Before retention	z count	p value	Characteristic	
Extraction	170,5	357,5	-3.53	0.00021	Significant	increased
Without extraction	166,5	239,5	-1.69	0.05	Non Significant	increased

of Dentistry Universitas Padjadjaran Bandung, Indonesia. Number of samples were 30 dental molds, 16 models of patients with 4 premolars extraction and 14 models of patients without premolars extraction. The model study were measured using the Objective Grading System index comprises.

For teeth alignment measurement, if the alignment was mesial or distal at the contact point deviates 0.50-1 mm from the normal value, then the teeth which were out of line will be reduced 1 value. If the adjacent teeth are not aligned, then each tooth was reduced 1 value. If the discrepancy in teeth alignment at the contact point was greater than 1 mm, then the teeth will be reduced 2 values (Fig. 1).

For the marginal edge of posterior teeth measurement, if the marginal edge of the adjacent teeth deviates 0.50-1 mm (Fig. 2A), then it will be reduced 1 value for interproximal contact. If the discrepancy of marginal edge is more than 1 mm (Fig. 2B), then it will be reduced 2 values for interproximal contact.

For buccolingual inclination measurement; if the knurl of mandible lingual or the knurl of maxillary buccal was more than 1 mm but less than 2 mm from the ruler surface (Fig. 3), then the teeth were reduced 1 value. If the discrepancy was more than 2 mm (Fig. 4), then they were reduced 2 values.

For occlusal contact mesurement; if the knurl was not in contact with the opponent's arch and the distance was 1 mm or less (Fig. 4A), then the teeth are reduced 1 value. If the knurl is not in contact and the distance is more than 1 mm (Fig. 4B), then the teeth are reduced 2 values.

Occlusal relationship; if the knurl of upper jaw buccal deviates between 1 to 2 mm from the position mentioned before (Fig. 5A), the teeth were reduced 1 value. If the knurl premolar buccal or upper jaw molar deviates more than 2 mm from the ideal position (Fig. 5B), each deviated tooth was reduced 2 values.

Overjet measurement; if the knurl of the lower jaw buccal deviates 1 mm or less from the center of its opponent's teeth (Fig. 6A), the teeth were reduced 1 value. If the knurl's position of the lower jaw deviates more than 1 mm from the center of its opponent's teeth (Fig. 6B), the teeth were reduced 2 values.

Interproximal contact measurement; if more than 1 mm gap between two teeth (Fig. 7B), it was reduced 2 gap values in the interproximal up to 1 mm between two adjacent teeth then it was reduced 1 value (Fig. 7A).

Table 2. Assessment test result of the Objective Grading System index at the end of treatment and after retention of each variable on treatment with 4 premolars extraction

Variable	Rank				
	z count	p value	Characteristic	End of treatmenr	After retention
Teeth alignment	-3.28	0011	significant	249	279
Marginal edge height	0.08	9333		266	262
Buccolingual inclination	-0.47	6854		252	276
Occlusion contact	-1.89	0293	significant	216	312
Occlusal relationship	-0.71	2373		249	279
Overjet	-2.82	0048	significant	192	336
Interproximal contact	-0.41	3427		255.5	272.5

Table 3. The assessment test result of the Objective Grading System at the end of treatment and after retention on each variable with treatment without extraction

Variable	Rank				
	z count	p value	Characteristic	End of treatment	After retention
Teeth alignment	-2.93	0034	significant	141.5	264.5
Marginal edge height	0.58	5625		215	191
Buccolingual inclination	-1.01	4496		182	224
Occlusion contact	0.10	4613		205	201
Occlusal relationship	-0.14	4461		200.5	205.5
Overjet	-0.05	9625		202	204
Interproximal contact	0.76	2248		217	189

RESULTS

The measurement result of assessment test data of the Objective Grading System index value comparison at the end of treatment and the Objective Grading System index value after the use of retention on the treatment with 4 premolars extraction and the treatment without premolars extraction are shown in Table 1.

In Table 1, it can be seen, in the treatment with 4 premolars extraction, the rank at the end of treatment period was 170.5 and the rank after the use of retention was 357.5 based on the Wilcoxon - Mann/Whitney evaluation test with the z count -1.69 and the p value 0.05. It can be assumed that the value change of the Objective Grading System index between the end of treatment and after the use of retention was statistically significant. In the treatment without premolars extraction, the rank at the end of treatment was 166.5 and the rank after the use of retention was 239.5 based on the Wilcoxon-Mann/Whitney evaluation test with the z count -1.69 and the p value 0.05, it could be assumed that the value change of the Objective Grading System index was not statistically significant between the end of treatment and after retention period.

The assessment test data result of the Objective Grading System index at the end of treatment and after retention on treatment with extraction of each variable can be seen in Table 2. From Table 2, it could be seen that there were 3 variables with the Objective Grading System index value at the end of treatment and after the period of retention use which change significantly in the alignment variable, occlusion contact and overjet. The rank of the Objective Grading System index value at the end of treatment and in alignment variable was 249 and the rank after the period of retention use was 279. Based on the similarity evaluation test result using the Wilcoxon-Mann/ Whitney assessment test with the z count -3.28 and the p value 0.0011, it can be assumed that the difference between both of them was statistically significant.

In variable of the occlusion contact with the Objective Grading System index value rank at the end of treatment was 216 and after the period of retention use was 312. Based on the similarity assessment test using the Wilcoxon-Mann/Whitney assessment test with the z count -1.89 and the p value 0.0293, it can be assumed that the difference between both of them is statistically significant. In the overjet variable with the Objective Grading System index value rank at the end of treatment was 192 and after retention period was 336. Based on the similarity assessment test result using the Wilcoxon-Mann/Whitney assessment test with the z count -2.82 and the p value 0.0048, it can be assumed that the differences between both of them was statistically significant. The assessment test result of the Objective Grading System index at the end of treatment and after the period of retention use in the treatment without extraction from each variable can be seen in Table 3.

It can be seen that the rank of the Objective Grading System index value in the alignment variable at the end of treatment was 141.,5 and the rank of the Objective Grading System index value after retention period was 264.5. Based on the similarity assessment test result using the Wilcoxon-Mann/Whitney assessment test with the z count -2.93 and the p value 0.0034, it can be assumed that the difference between both of

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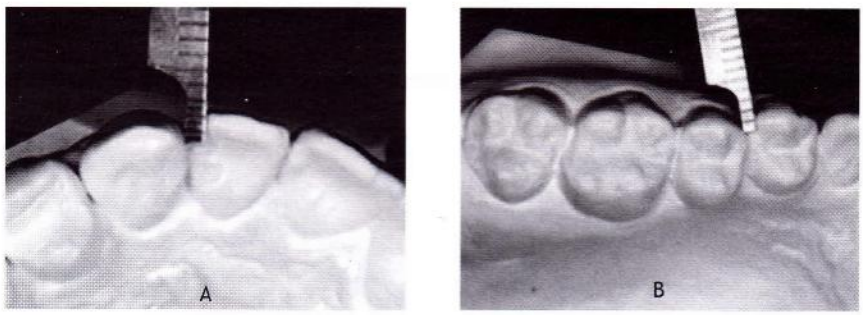

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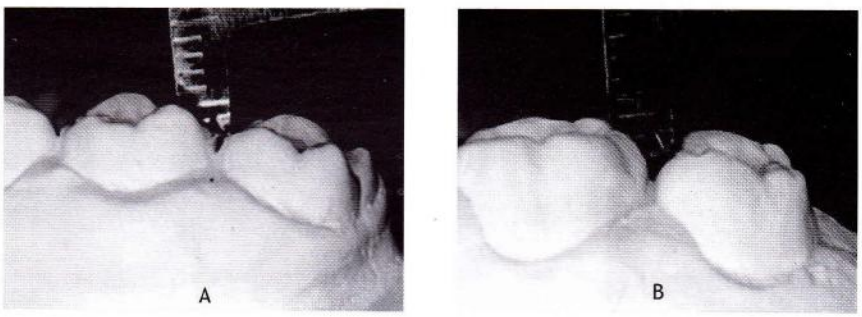
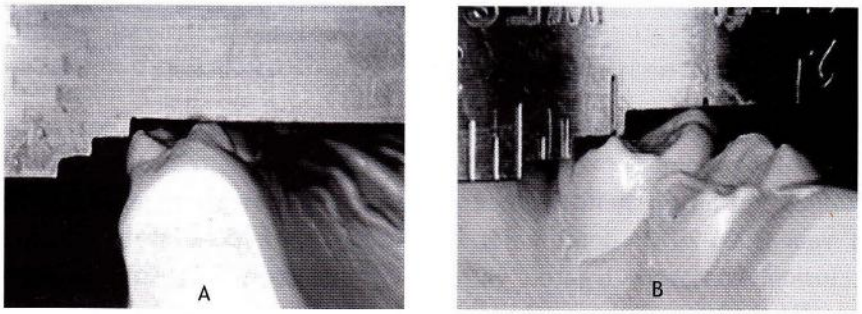


Figure 2. Measurement of marginal edge: less than 1 mm deviation (A); more than 1 mm deviation (B).[2]



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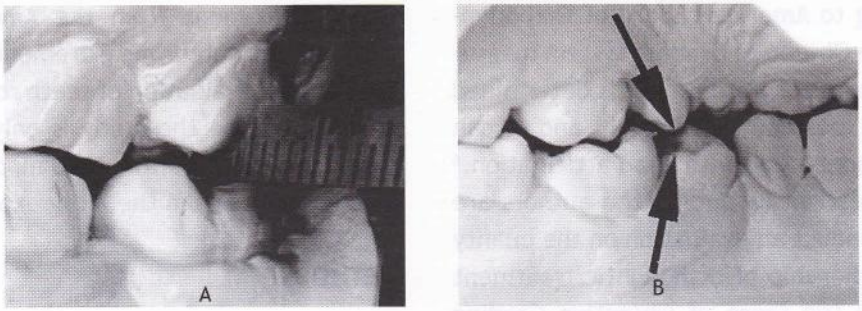
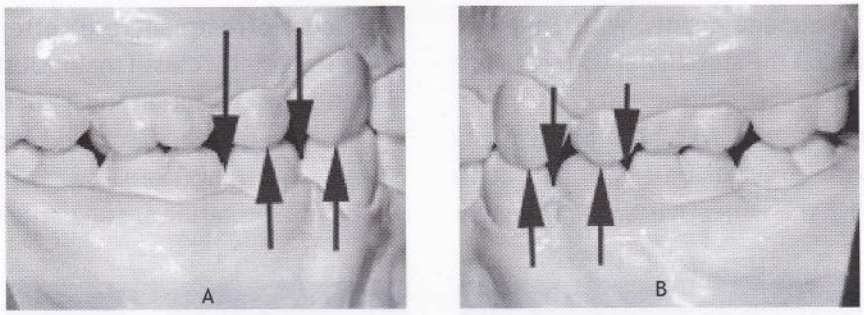


Figure 4. Measurement of occlusal contact: less than 1 mm deviation (A); more than 1 mm deviation (B).[2]



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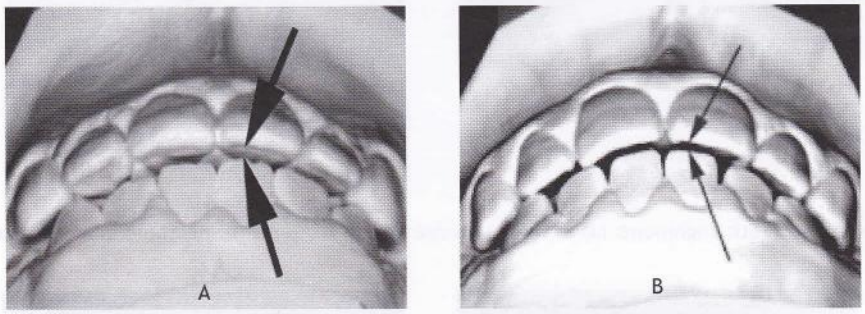

Figure 6. Measurement of anterior overjet: more than 1 mm deviation (A), less than 1 mm deviation (B).[2]

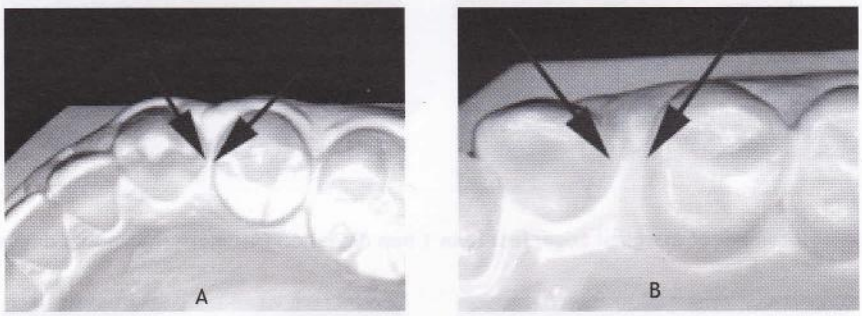

Figure 7. The deviated interproximal contact: less than 1 mm deviation (A), more than 1 mm deviation (B).[2]

treated by the the participants of the Orthodontic Specialist Education Programme of Universitas Padjadjaran Bandung, and all of them had been cured since the year 2006-2010, dentoskeletal 1st class I malocclusion who were treated with 4 premolars extraction and without premolars extraction; patients' age at the time of retainer installation was 15-35 years old; all permanent teeth have erupted to the first molar teeth; have worn Hawley Retainer for 6 months; medical records; the model study after treatment was still in good condition. This research was conducted in the Orthodontic Specialist Clinic *Rumah Sakit Gigi dan Mulut* (Oral and Dental Hospital) Faculty

them was statistically significant. The result data got from the assessment for seeing whether or not there was a significant difference among the Objective Grading System variable score change in treatment with 4 premolars extraction and without premolars extraction.

In treatment of 4 premolars extraction, there are 3 Objective Grading System variables which have significant changes; they are alignment, occlusion contact and overjet. In treatment without extraction, the significant change occurs in alignment variable. Based on the statistic analysis, the change of 3 variables in 4 premolars extraction and 1 variable without extraction with the z count 1.15 and z table 1.96 using the Wilcoxon-Mann/Whitney assessment test, it can be assumed that the change among the 7 variables of the Objective Grading System between the groups with extraction and without extraction was statistically not significant.

DISCUSSION

Through this study, the result shows the comparison of the Objective Grading System index value at the end of treatment and after retention period experience a statistically significant change in treatment with 4 premolars extraction. This is shown by the rank at the end of treatment period which is 170.5 and the rank after retention use period is 357.5 based on the Wilcoxon-Mann/Whitney evaluation test result with the z count -3.53 and the p value 0.00021, the change was statistically significant. The value change of the Objective Grading System index which statistically significant means that in the treatment of dentoskeletal class I malocclusion with 4 premolars extraction conducted at the clinic of Orthodontic Specialist Dentist Education Program of Dentistry Faculty of UNPAD undergoes a stability change or relapse.

Huang, based on their research, conclude that a good occlusal relationship at the end of an orthodontic treatment does not guarantee the post retention stability.[8] Reinforced by the research of Fernandez that finds no correlation between the quality of occlusal relationship at the end of treatment to the post retention stability.[9] The value comparison of the Objective Grading System index at the end of treatment and after retention period in treatment without extraction does not show a statistically significant change. This was proven by the rank at the end of treatment which was 166,5 and the rank after the period of retention use is 239.5 based on the Wilcoxon-Mann/Whitney assessment test result with the z count -1.69 and the p value 0.05, it can be assumed that the value change of the Objective Grading System index was not statistically significant between the end of treatment and after the retention period.

This means that the class I dentoskeletal treatment which was not accompanied by premolar extraction despite of experiencing significant change in a variable, based on the statistic analysis, the treatment result was more stable. In treatment with 4 premolars extraction from 8 measured variables, there were 3 variables which have statistically significant change; they were alignment, occlusion contact and overjet. This means, based on the value comparison of the Objective Grading System index at the end of treatment and after retention period of the three variables were not stable while in treatment without premolars extraction, there was a variable that statistically undergoes a significant value change in the Objective Grading System index that was alignment, meaning in group without extraction, teeth alignment experience a relapse.

Post retention relapse occurs when teeth were placed in an unstable position both in inclination and angle so that the pressure and withdrawal of the soft tissues around the teeth such as periodontal tissue, lips muscle, mentalist muscle, tongue muscle may cause the teeth become not in order.[10] Based on the research conducted by Uhde, overjet and overbite relapse in an orthodontic treatment accompanied by extraction is the impact of the overjet correction which is not optimal and also the post retraction of anterior teeth placement that tends to produce the teeth crown inclination more to palatinal, so that the lips muscle withdrawal as well as the periodontal ligament fiber resulting the teeth back to their original position, therefore torque after the withdrawal of anterior teeth to the posterior relative is required to place teeth in the right inclination.[3]

CONCLUSION

There was no relationship between better Objective Grading System index value after treatment to the stability of treatment result after retention. There was a statistically significant difference on the Objective Grading System index value after treatment and after retention in fixed Edgewise standard orthodontic treatment in class I dentoskeletal malocclusion with 4 premolars extraction and without extraction. There was no treatment result stability difference in class I dentoskeletal malocclusion with premolars extraction and without extraction which are measured based on the value change of the Objective Grading System index after treatment and the Objective Grading System index value after retention.

REFERENCES

1. Liothard N, Hans M, Valiathan M. Shorttherm postorthodontic changes in the absence of retention. Angle Orthod 2010;80:1045-50.
2. Casko J. Objective grading system for dental cast and panoramic radiographs. Am J Orthod Dentofac Orthop 1998;114(5):589-99.
3. Pulfer RM, Drake CT, Maupome G. The association of malocclusion complexity and orthodontic treatment outcomes. Angle of Orthod 2009;79(3):468-72.
4. Grabber TM. Retention and relapse. Philadelphia: W.B. Saunders; 1994. p. 908-11.
5. Freitas KM, Freitas MR, Janson AP, Henriques JFC. Retrospective analysis of orthodontic treatment outcomes and its relation to postretention stability. J Appl Oral Sci 2006; 14(5):324-9.
6. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 4th ed. St. Louis: Mosby Inc.; 2007. p. 617-31.
7. Bowman SJ, Johnston LE. The esthetic impact of extraction and nonextraction treatment on Caucasian patients. Angle Orthod 2000;70(1):3-10.
8. Freitas KM, Freitas DS. PAR evaluation of treated class I extraction patients. Angle Orthod 2008;78(2):270-4.
9. Dincer M, Meral O. The investigation of occlusal contact during the retention periode. Angle Orthod 2003;73:640-6.
10. Miyazaki H, Motegi H. Occlusal stability after extraction orthodontic therapy in adult and adolescent patients. Am J Orthod Dentofac Orthop 1997;114(5):530-7.