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Assessment of the Removable Orthodontic Treatment Outcome Using Peer Assessment Rating Index

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Background and objectives: Removable orthodontic appliances are useful in a variety of situations but present the inherent disadvantage of the treatment being in the control of the patient. Evaluation of orthodontic treatment result, aids to establish aims and reach a measurable finish for completed treatment for patients. In order to study the quality of treatment, it is advisable to assess the results of treatments. To achieve this aim, an accepted index is required to assess the occlusion and the positions of teeth in the arch. Peer Assessment Rating (PAR) is a typical mean to evaluate the result of orthodontic treatments. The aim of the study is to assess the results of orthodontic treatments by removable appliances on the basis of PAR index.

Patients and methods: Treatment of patients has been done by dental students by using removable orthodontic appliances, therefore the dental study casts of 64 consecutively completed removable appliance cases were examined before and after orthodontic treatment using the PAR index.

Results: On the basis of weighted PAR criteria, the difference between scores before and after treatment was significant for anterior maxillary segment (P<0.001), overjet (P<0.001), overbite (P<0.001), midline (P<0.001), buccal occlusion in transverse and anteroposterior direction (P<0.01). On the other hand, a non-significant difference was recorded regarding buccal occlusion in vertical sections (P=0.99).

Conclusion: The average of PAR index reduction was higher in girls than in boys. The proper selection of cases for Phase I orthodontic treatment is critical to the success of the treatment. Removable orthodontic appliances are useful for correction of minor abnormalities, especially in anterior region.

Keywords: PAR index, Outcome assessment, Orthodontic treatment.

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Introduction

Removable appliances are the appliances that can be removed by the patient without any supervision by the orthodontist. Removable orthodontic appliances are useful in a variety of situations but present the inherent disadvantage of the treatment being in the control of the patient.[1]

Evaluation of the orthodontic treatment result aids to establish aims, to set standards and to reach a measurable finish for completed treatment for patients. Also, it is helpful for educational reasons for postgraduate orthodontic programs. Usually, evaluation of orthodontic treatment has been done by using the subjective estimation and knowledge of the clinician.[2]

In order to study the quality of treatment, it is advisable to assess the results of treatments. To achieve this aim, an accepted index is required to assess the occlusion and the positions of teeth in the arch. Peer Assessment Rating (PAR) is a typical mean to evaluate results of orthodontic treatments.[3] The PAR index is increasingly used in studies assessing the effectiveness of orthodontic treatment in private practices and graduate clinics.[4-8] The PAR index is considered specifically for the evaluation of treatment results. The PAR index affords a single summary score for all the occlusal anomalies which may be found in a malocclusion.[9]

It quantifies malocclusion based on five criteria of different weightings: upper and lower anterior segment alignment (x1), left and right buccal occlusion (x1), overjet (x6), overbite (x2), and centerline (x4). The analysis is performed on dental casts and involves a comparison between pre-treatment and post-treatment study models permitting the evaluation of treatment effectiveness in aligning teeth within and between the dental arches,[10]

There are two methods for evaluating improvement of treatment by using the PAR index, either reduction in the weighted PAR score or percentage reduction in the weighted PAR score. It has been recommended that a good standard of orthodontic treatment should result in a mean PAR reduction of 70% or more.[11]

Unfortunately, due to variation in the criteria which is used by different orthodontists, it is difficult to match results of treatment. So it is essential to accurately assess whether a valuable enhancement has been achieved in terms of overall alignment and occlusion for a single patient and a larger proportion of a practitioner's caseload.[11]

The purpose of this study is to assess the results of orthodontic treatments by removable appliances performed by dental students in the department of pedodontics, orthodontics and preventive dentistry at the College of Dentistry - Hawler Medical University, on the basis of PAR index.

Patients and methods

A cross-sectional study carried out at the department of pedodontics, orthodontics and preventive dentistry, College of Dentistry - Hawler Medical University. The pre- and post-treatment records, including orthodontic files and study casts of 64 consecutively finished cases representing different malocclusion categories, were evaluated by authors. The inclusion criteria adopted were: patients who received complete orthodontic treatment at the orthodontic clinic in the College of Dentistry and the availability of pre- and post-treatment records (orthodontic casts and files,). Exclusion criteria were retreatment cases (i: e, treatment after relapse). Both pre- and post-treatment weighted PAR scores were calculated according to British weightings system, by a single author who was calibrated in the use of PAR index. Each upper and lower dental cast was measured as separate and in occlusion according to the criteria of PAR index using PAR index ruler (Figure 1). The data were recorded on a data sheet specially designed for the study.

Figure 1: PAR index ruler was used to make measurements easier.

Descriptive statistics including means, standard deviations and ranges were calculated for pre-treatment PAR score, post-treatment PAR score, and reduction in PAR score. The PAR scores were calculated at the pretreatment stage and at the end of active treatment. Points reduction and percentage reduction in the weighted PAR score was calculated to assess the improvement in malocclusion at the end of treatment. Cases were divided into three categories; "Greatly improved", "improved" and "worse or no different" based on PAR score reduction.[9] Occlusion parts were evaluated before and after treatment on the basis of PAR index. PAR index has 11 parts which include: anterior mandibular segment, right and left posterior mandibular segments, overjet, overbite, midline, right and left buccal occlusion. For each part, a specific scoring has been determined (Figure 2).[11]

PAR SCORING SHEET

Name

CASE NUMBER		**Pre-Treatment**				**Date**						
PAR COMPONENTS	**RIGHT**									**LEFT**	**UN-WEIGHTED TOTAL**	**WEIGHTED TOTAL**
Upper anterior segments	3-2		2-1		1-1		1-2		2-3			X1
Lower anterior segments	3-2		2-1		1-1		1-2		2-3			X1
Buccal occlusion	Antero-posterior		Right			Left						X1
	Transverse		Right			Left						X1
	Vertical		Right			Left						X1
Overjet	Positive			Negative								X6
Overbite	Overbite			Openbite								X2
Centre line												X4
										TOTAL		

CASE NUMBER		**Post-Treatment**				**Date**						
PAR COMPONENTS	**RIGHT**									**LEFT**	**UN-WEIGHTED TOTAL**	**WEIGHTED TOTAL**
Upper anterior segments	3-2		2-1		1-1		1-2		2-3			X1
Lower anterior segments	3-2		2-1		1-1		1-2		2-3			X1
Buccal occlusion	Antero-posterior		Right			Left						X1
	Transverse		Right			Left						X1
	Vertical		Right			Left						X1
Overjet	Positive			Negative								X6
Overbite	Overbite			Openbite								X2
Centre line												X4
										TOTAL		

ASSESSMENT OF OUTCOME

PAR SCORE		**IMPROVEMENT**	
Change in PAR score		Greatly improved	
% change in PAR score		Improved	
		Worse or no different	

Figure 2: PAR scoring sheet used to record 11 parts of study on dental casts.

After measurements and giving a specific score to each part, the scores added to each other and raw data scores were achieved. But since the total scores were not sufficient for the evaluation of occlusion improvement and standard treatment, the other points had been considered as PAR index was measured for each model and weighted according to criteria of Richmond *et al.*[11]

The grades achieved for each segment of occlusion were multiplied by the related coefficient and the final result is found for each segment. These figures were added together and called weighted PAR criteria. After 4 weeks, intra- and inter examiner calculation was re-performed on 15 randomly-selected dental casts by estimating Pearson correlation coefficient. Results showed excellent reliability. At the end, the data analyzed on the basis of our goals in order to evaluate treatment success. Data analysis was done by means of SPSS software. The applied test for analysis was Wilcoxon signed rank test for pair comparisons. *P*-values less than 0.05 were considered to be statistically significant.

Results

On the basis of weighted PAR criteria, the difference between scores before and after treatment was significant for anterior maxillary segment ($P<0.001$), overjet ($P<0.001$), overbite ($P<0.001$) and midline ($P<0.001$), buccal occlusion in transverse and antero-posterior section ($P=0.01$). On the other hand, a non-significant difference was recorded regarding buccal occlusion in vertical sections ($P=0.99$) (Table 1, 2 and 3). The difference between the total scores of PAR index before and after treatment was significant ($P<0.001$). Total average of decreased percentage of PAR index was calculated as 56.6% (Table 4). Also, on the basis of the current study, 9.37% of samples had "with no difference or worse" grades, 71.87% had "improvement" grade and 18.75% had "complete improvement" grade.

Table 1: Evaluation of removable orthodontic treatment according to Peer Assessment Rating indexes.

Orthodontic treatment							
All		Score of PAR			Weighted PAR		*P* value
		degree before	degree after	Scores	degree before	degree after	
		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Anterior maxillary segment		4.578(1.88)	1.75(1.6)	1	4.57(1.88)	1.75(1.6)	< 0.001
Ant-post	**Buccal**	0.75(1.41)	0.4375(1.1)	1	0.75(1.41)	0.4375(1.1)	0.01
Trans		0.5625(1.45)	0.25(1.1)	1	0.56(1.45)	0.25(1.1)	0.01
Vertical		0.03125(0.17)	0	1	0.03(0.17)	0	0.99
Over jet		1(1.13)	0.375(0.6)	6	6 (8.16)	2.22(3.6)	<0.001
Over bite		0.7188(1.14)	0.4688(0.94)	2	1.42(2.28)	.92(1.88)	< 0.001
Center line		0.25(0.50)	0.1667(0.37)	4	1(2)	0.64(1.48)	< 0.001
Total		**7.891(1.55)**	**3.438(0.57)**	**16**	**14.31(2.28)**	**6.21(0.81)**	**< 0.001**

Table 2: Evaluation of removable orthodontic treatment according to Peer Assessment Rating indexes for female patients.

Female		Orthodontic treatment					
		Score of PAR			Weighted PAR		*P* Value
		degree before	degree after	Scores	degree before	degree after	
		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Anterior maxillary segment		4.51(1.43)	1.93(1.32)	1	4.51(1.43)	1.93(1.32)	< 0.001
Ant-post	Buccal	0.67(1.25)	0.4(.85)	1	0.67(1.25)	0.4(.85)	0.01
Trans	Buccal	0.59(.89)	0.29(1.19)	1	0.59(.89)	0.29(1.19)	0.01
Vertical	Buccal	0.034(.27)	0	1	0.034(.27)	0	0.99
Over jet		1.05(.97)	0.32(0.88)	6	6.03(5.82)	1.92(5.28)	<0.001
Over bite		0.59(1.32)	0.38(.67)	2	1.18(2.64)	.76(1.34)	< 0.001
Center line		0.22(.43)	0.18(.45)	4	0.44(.86)	.72(1.8)	< 0.001
Total		**7.7(1.48)**	**3.52(.96)**	**16**	**13.45(2.34)**	**6.02(1.14)**	**< 0.001**

Table 3: Evaluation of removable orthodontic treatment according to Peer Assessment Rating indexes for male patients.

Male		Orthodontic treatment					
		Score of PAR			Weighted PAR		*P* Value
		degree before	degree after	Scores	degree before	degree after	
		Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Anterior maxillary segment		4.63 (1.26)	1.57(1.34)	1	4.63 (1.26)	1.57(1.34)	< 0.001
Ant-post	Buccal	0.83(.94)	0.46(.57)	1	0.83(.94)	0.46(.57)	0.01
Trans	Buccal	0.53(1.24)	0.21(.87)	1	0.53(1.24)	0.21(.87)	0.01
Vertical	Buccal	.026(.14)	0	1	.026(.14)	0	0.99
Over jet		.95(1.04)	0.42(.95)	6	5.7(6.24)	2.52(5.7)	<0.001
Over bite		.83(1.32)	0.54(1.12)	2	1.66(2.64)	1.08(2.24)	< 0.001
Center line		.28(.56)	0.14(.43)	4	1.12(2.24)	.56(1.72)	< 0.001
Total		**8.076(1.34)**	**3.34(.46)**	**16**	**14.49(2.37)**	**6.4(0.78)**	**< 0.001**

Table 4: Amount of decreased percentage of weighted PAR index after removable orthodontic treatment.

Criteria	Amount of decrease percentage mean (SD)
Anterior maxillary segment	61.7 (4.8)
Ant-post	41.66 (14.43)
Trans	55.35 (23.94)
Vertical	0 (0)
Over jet	63(35.43)
Over bite	35.21 (22.71)
Center line	36 (21.26)
Total	56.6 (36.48)

Discussion

Since PAR index offers a specific score to any parameter in occlusion; it can be used to assess different types of malocclusions and treatments. The degree of improvement and success of treatment is settled by comparing PAR index scores before and after orthodontic treatment. In the current study, different occlusion segments of 64 orthodontic patients (32 girls and 32 boys) were examined. The results showed that there was significant a difference in PAR scores of the anterior maxillary segment, overjet and overbite and midline, but PAR scores had no significant difference in the cases of posterior occlusion before and after treatment. The degree of improvement was more in boys than girls with non-significant difference.

In the current study, treatment of patients had been done by dental students by using removable orthodontic appliances; therefore, achieving lower percentage for PAR index decrease was expected. It is interesting to know that only 9.37% of those patients were placed in "with no difference of worse" group. According to a study done by Abtahi (2009), the results showed that there was a significant difference in PAR scores of right buccal occlusion, overjet, and overbite and PAR scores had no significant difference in the cases of left buccal occlusion, anterior maxillary segment, and midline. Total PAR indices showed a significant difference before and after removable orthodontic treatment (P<0.001) and weighted PAR index decrease percentage was 34.07%. Also, 38.6% of samples had "with no difference or worse" grade, 57.1% had "improvement" grade which is less than the current study, and 4.3% had "complete improvement" grade which is less than the current study.[3] This represents an average 50.2% reduction in the PAR score which is less than the current study. The current study showed better results compared to Abtahi's study.

One of the reasons for the better results, may be due to the age of the patients, as our patients were younger, so the chance of faster tooth movement is possible. Another reason for better treatment result for the current study is that most of the cases were class I malocclusion, while Abtahi (2009) used class II cases more. However, both studies showed significant improvement after treatment. In the Abtahi (2009) study, PAR index decreased percentages for girls and boys were 42.39 ± 34.7% and 54.2 ± 19.38% respectively. In Alyami's study, PAR index decreased percentages were 69.4 ± 25.9% for girls and 68.2 ± 26.31% for boys. In the current study, PAR index decreased percentages for girls and

boys were 54.77± % and 58.43± % respectively. This difference can be due to the difference of devices used in these studies.

According to Kerr's study (1993), in which removable appliances were used for treatments, 89% of samples had "improvement" grade and 16% had "with no difference or worse" grade[3] which shows better result than the current study. It seems that in this study, patient selection was done properly. The case with complicated problems had not been treated by removable appliances. Exact diagnosis and case selection is a factor for better results by removable appliances. In the current study, some cases were too difficult to be treated by removable appliances but due to patients' economic stati, it was decided to try to improve the case by removable appliances.

Based on the results of this study, removable appliances are not generally able to completely address Phase I orthodontic treatment needs. Apart from mechanical inefficiency, other possible explanations for this finding are poor patient compliance and appliance failure. These features are more common with removable appliances than with fixed appliances. Fixed appliances are generally more efficient because compliance and failure are more easily managed, which appears to translate into less need for additional episodes of treatment.

Phase I (early or limited treatment) is not necessarily designed to finish the occlusion but to address major concerns of the malocclusion that are noted early, thereby alleviating the need for comprehensive orthodontic treatment, so complete reduction of PAR is not expected in Phase I.

Conclusion

The average of PAR index reduction was higher in girls than in boys. The proper selection of cases for Phase I orthodontic treatment is critical to the success of the treatment. As removable orthodontic appliances are used for tipping and rotation movements and depend on patient compliance, so lower percentage of reduction is expected compared to fixed appliances.

Conflicts of interest

The authors reported no conflicts of interest.

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